Program of the 85th Annual Meeting of the American Association of Physical Anthropologists

April 12 – 16, 2016

To be held at the

Atlanta Marriott Marquis
265 Peachtree Center Avenue
Atlanta, GA 30303

AAPA Scientific Program Committee:
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Message from the Program Chair

Welcome to the 85th Annual Meeting of the American Association of Physical Anthropologists in Atlanta 2016! Our meeting officially begins on Wednesday, April 13 with the **Undergraduate Research symposium**, followed by the **AAPA welcoming reception**. Earlier on Wednesday, the Committee on Diversity has organized a **Women's Mentoring Workshop and an IDEAS Workshop (Increasing Diversity in Evolutionary Anthropology)**. Once again, we are having dedicated time for posters from 4:00 to 6:00 (5:00 – 6:00 on Saturday), so that everyone will have time to participate in the poster sessions. The time of day is ideal for an "enhanced" afternoon break at 4:00. Posters will be up all day, as in the past, but there will be no concurrent podium sessions after 4:00.

As in the past two years, the **AAPA annual business meeting** will be held after the scientific sessions on Friday afternoon, beginning at 5:45. A highlight of this meeting is the presentation of the **Charles R. Darwin Lifetime Achievement Award and the Gabriel W. Lasker Service Award**. Please come to learn more about the AAPA and to celebrate the careers of this years' honorees. The **AAPA Annual Luncheon** is on Saturday and features Dr. Lee Berger, whose luncheon address is titled**: "Almost Human –*Homo naledi* and the implications of new hominin discoveries from southern Africa."** See the Annual Meeting Registration web site for tickets and information.

This year's program includes 1096 scientific presentations over the three full days of the meeting. The 58 sessions include seven invited podium symposia, 16 invited poster symposia, 18 contributed podium sessions and 17 contributed poster sessions. Dedicated time for posters has resulted in shorter afternoon podium sessions, so we added a fifth podium session on Saturday afternoon only, with four concurrent podium sessions on other days.

Our extensive scientific program includes a truly international group of scholars. This year, we are joined by the *Paleoanthropology Society* (PS), the *Paleopathology Association* (PPA), the *Human Biology Association* (HBA) the *American Association of Anthropological Genetics* (AAAG) and the *Dental Anthropology Association* (DAA).

The 2016 Wiley podium symposium, titled **Hybridization in Human Evolution: What can other organisms tell us?** and organized by Rebecca R. Ackermann and Benedikt Hallgrimsson, takes place on Thursday morning. The joint AAPA–HBA session, held on Friday morning, is an invited poster symposium titled: **Biocultural Perspectives on Family Health within and across Generations**, and is organized by Melanie A. Martin and Lisa McAllister. The joint AAPA-AAAG session, held on Thursday afternoon, is an invited podium symposium titled: **Ancient Alleles in Modern Populations: Ancient structure, introgression and variation- maintaining adaptive forces**, organized by Omer Gokcumen and Aaron Sams. This year we also have a joint poster session with the Dental Anthropology Association: **Old Questions, New Approaches and New Solutions: Celebrating the 30th Anniversary of the Dental Anthropology Association** on Thursday afternoon.

The AAPA silent and live auctions take place on Thursday evening. These auctions, started by Mark Teaford and continued by Susan Antón and Josh Snodgrass, have raised thousands of dollars that fund the Pollitzer Student Travel Awards. Please participate through donations (contact Josh Snodgrass) and bidding. Finally, our popular **Closing Reception and Student Awards Ceremony** will be held on Saturday evening.

AAPA President, Susan Antón, will host a **Panel Discussion** on Saturday afternoon titled 'Working Together to Change the Future: A dialog on harassment in biological anthropology."

I am very grateful to all those who have helped to put the 2016 program together. First and foremost, webmaster Ed Hagen, designer and upgrader of our on-line system has worked to integrate the AAPA system with our new membership and registration system hosted by Burk and Associates. Except for a few initial little bumps, the new integration is working very well. I appreciate sage advice from officers and the other members of the Executive Committee. Thanks to all of the members of the Program Committee for their careful work and helpful comments while reviewing symposium proposals and abstracts. My program assistant, Kim Edwards, has been a tremendous help. Special thanks to Frank Williams and John Redmond and their local arrangements committee. Please express your appreciation when you see them in Atlanta.

Anne Katzenberg
AAPA Vice President and Program Chair

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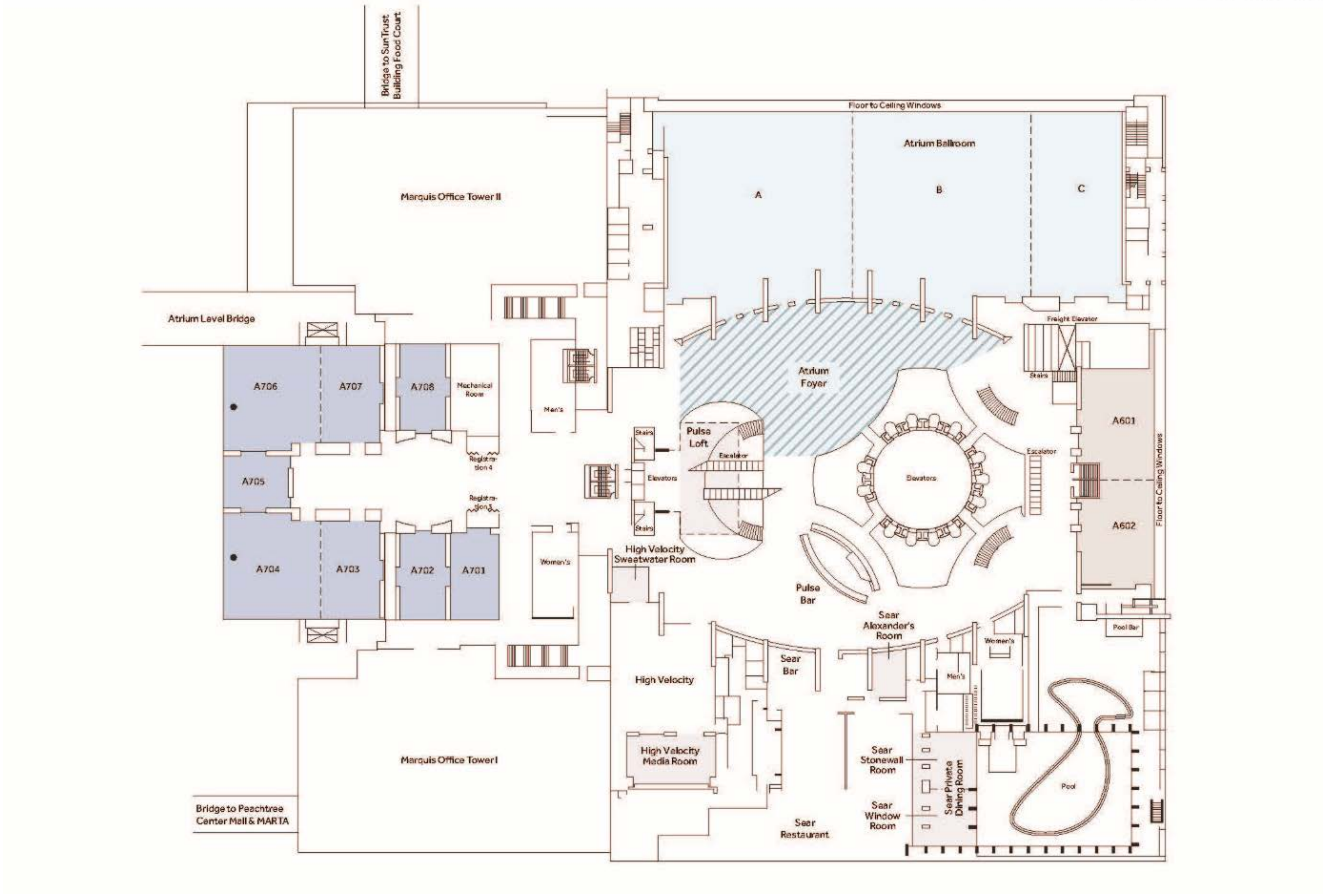
On the cover: Atlanta Skyline

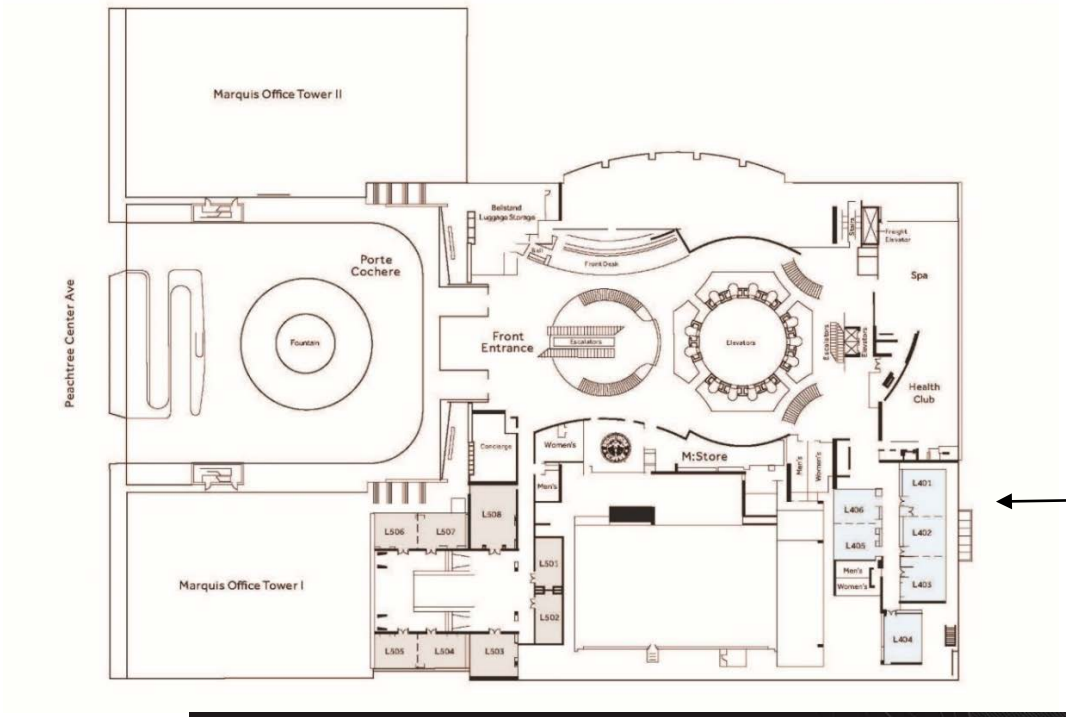
KEY TO ACRONYMS:

AAAG – American Association of Anthropological Genetics
AAPA – American Association of Physical Anthropologists
ADA – American Dermatoglyphics Association
AJHB – *American Journal of Human Biology*
AJPA – *American Journal of Physical Anthropology*
BANDIT Biological Anthropology Developing Investigators Troop
COD – AAPA's Committee on Diversity
DAA – Dental Anthropology Association
HB – *Human Biology*
HBA – Human Biology Association
JHE – *Journal of Human Evolution*
PAWMN AAPA Physical Anthropology Women's Mentoring Network
PPA – Paleopathology Association
PS - Paleoanthropology Society

ATRIUM LEVEL



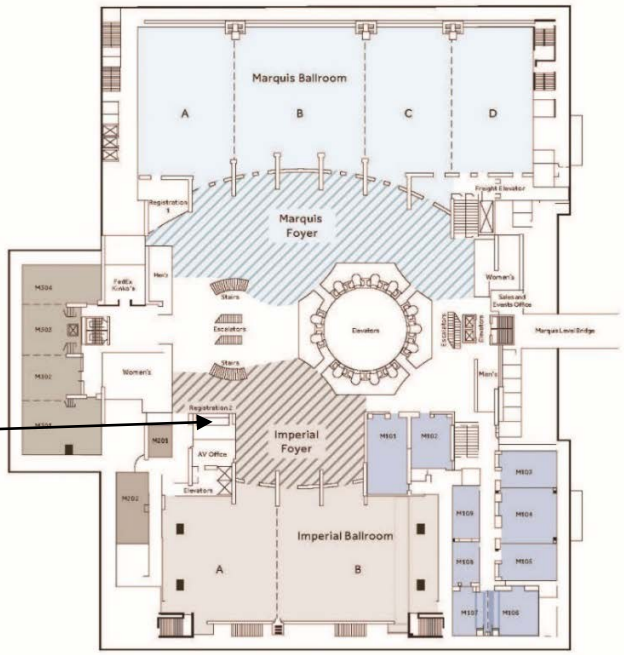
LOBBY LEVEL



Rooms

L 501-505

MARQUIS LEVEL



AAPA Registration

Monday, Evening

PALEOPATHOLOGY ASSOCIATION

Paleopathology Association Registration	Registration 3 - Atrium Level	6 p.m.-9 p.m.

Tuesday, All Day

AAPA

Family Respite Room	L 503	7:30 a.m.-10 p.m.

PALEOANTHROPOLOGY SOCIETY

Paleoanthropology Society Registration	Atrium Foyer	7 a.m.-5 p.m.
Paleoanthropology Society Podium presentations	A 706/707	9 a.m.-12:15 p.m.
Paleoanthropology Society Podium presentations	A 706/707	2 p.m.-4 p.m.
Paleoanthropology Society Posters	Atrium Ballroom A	4 p.m.-6 p.m.

PALEOPATHOLOGY ASSOCIATION

Paleopathology Association Registration	Registration 3 - Atrium Level	8:00 a.m.-5 p.m.
Paleopathology Association Workshop 1	A 601	8 a.m.-noon
Paleopathology Association Workshop 2	A 602	8 a.m.-noon
Paleopathology Podium Presentations	Imperial Ballroom A	1:30 p.m.-5 p.m.
Paleopathology Student Action Meeting	A 708	5 p.m.-6:30 p.m.
Paleopathology Association Banquet and Business Meeting (ticketed event)	Imperial Ballroom B	6:45 p.m.-10 p.m.

Wednesday, Morning

HUMAN BIOLOGY ASSOCIATION

AJHB Editorial Board Breakfast	A 702	7:30 a.m.-9 a.m.
HBA Breakout Session 1	L 504	11:30 a.m.-12:30 p.m.
HBA Breakout Session 2	L 505	11:30 a.m.-12:30 p.m.

PALEOANTHROPOLOGY SOCIETY

Paleoanthropology Society Podium presentations	A 706/707	9 a.m.-12:15 p.m.

PALEOPATHOLOGY ASSOCIATION

Paleopathology Association Registration	Registration 3 - Atrium Level	8 a.m.-noon

Wednesday, All day

AAPA

AAPA COD Ideas Workshop	A 708	7 a.m.-5 p.m.
Speaker Ready/ Press Interview Room	L 502	7:30 a.m.-5 p.m.
Family Respite Room	L 503	7:30 a.m.-10 p.m.
AAPA Executive Committee Meeting	Skyline Level (10)	8 a.m.-5 p.m.
AAPA COD-WIN Graduate Student Women's Professional Development Workshop	A 705	10 a.m. - 3 p.m.

HUMAN BIOLOGY ASSOCIATION

Human Biology Association Posters	Atrium Ballroom A	8 a.m.-5 p.m.
Human Biology Association Registration	Registration 4 - Atrium Level	8 a.m.-5 p.m.

PALEOANTHROPOLOGY SOCIETY

Paleoanthropology Society Registration	Atrium Foyer	7 a.m.-5 p.m.		
PALEOPATHOLOGY ASSOCIATION				
Paleopathology Podium Presentations	A 601/602	8 a.m. – 5 p.m.		
Paleopathology Association Posters	Atrium Ballroom A	8 a.m.-5 p.m.		
DAA				
Dental Anthropology Workshop	A 701	9:00 a.m.- 3:00 p.m.		

Wednesday, Afternoon

AAPA				
AJPA Editorial Board Lunch	Skyline Level (10)	noon-1:30 p.m.		
AAPA Registration	Registration 2 - Marquis Level	2 p.m.-8 p.m.		
Student Committee Meeting	A 702	4 p.m.-5 p.m.		
Student Committee 'Meet and Greet'	A 702	5 p.m.-6 p.m.		
DAA				
Dental Anthropology Working Group	A 701	3:30 p.m.-5:30 p.m.		
HUMAN BIOLOGY ASSOCIATION				
HBA Plenary Session	A 703/704	1 p.m.-6 p.m.		
Other				
AAAG Networking Event (pre-registration required)	L 505	3 p.m.-5 p.m.		
Journal of Human Evolution Workshop	A 705	4 p.m.-5:30 p.m.		
PALEOANTHROPOLOGY SOCIETY				
Paleoanthropology Society Podium presentations	A 706/707	2 p.m.-6 p.m.		

Wednesday, Evening

AAPA				
Student Committee 'Meet and Greet'	A 702	5 p.m.-6 p.m.		
AAPA COD Undergraduate Research Symposium	Atrium Ballroom A	5 p.m.-8 p.m.		
AAPA Opening Reception	Skyline Level (10)	8 p.m.-11 p.m.		

Thursday, Morning

AAPA				
Physical Anthropology Women's Mentoring Network Lunch (reservations required)	A 703	11 a.m.-2 p.m.		
AAPA WILEY				
Hybridization in human evolution: what can other organisms tell us?	Imperial Ballroom B	8 a.m.-noon	1	Invited Podium
AAPA				
Functional Morphology	A 602	8 a.m.-noon	2	Podium
Primatology: Behaviour - Apes and Old World Monkeys	A 706/707	8 a.m.-noon	3	Podium
Skeletal Biology: Bioarchaeology	Imperial Ballroom A	8 a.m.-noon	4	Podium
Reconstructing hominin paleoenvironments and paleoecology in Africa using stable isotopes: an integrative approach	A 701	8 a.m.-noon	5	Invited Poster
Toward a Holistic Forensic Anthropology	A 702	8 a.m.-noon	6	Invited Poster
Bone Microstructure: Imaging, Analysis and Function	Atrium Ballroom C	8 a.m.-noon	7	Invited Poster
HUMAN BIOLOGY ASSOCIATION				

HBA Registration	Registration 4 - Atrium Level	8 a.m.-10 a.m.		
HBA Podium Presentations	A 704	8:30 a.m.-11:45 a.m.		

Thursday, All day

AAPA

AAPA Registration	Registration 2 - Marquis Level	7 a.m.-5 p.m.		
Family Respite Room	L 503	7:30 a.m.-10 p.m.		
Speaker Ready/Press Interview Room	L 502	7:30 a.m.-5 p.m.		
Exhibitors	Atrium BallroomA/B	8 a.m.-6 p.m.		
Primate Behaviour	Atrium BallroomA/B	8 a.m.-6 p.m.	8	Poster
Primate Evolution	Atrium BallroomA/B	8 a.m.-6 p.m.	9	Poster
Paleoanthropology: Genus Homo	Atrium BallroomA/B	8 a.m.-6 p.m.	10	Poster
Forensic Anthropology	Atrium BallroomA/B	8 a.m.-6 p.m.	11	Poster
Skeletal Biology: Growth, Development and Variation	Atrium BallroomA/B	8 a.m.-6 p.m.	12	Poster

Thursday, Afternoon

AAPA

AAPA COD LGBTQQIAA Lunch	A 708	noon-1 p.m.		
AAPA COD AACT Planning Lunch	L 505	Noon-1 p.m.		
Yearbook of Physical Anthropology Editorial Board Meeting	L 504	noon-2 p.m.		

AAPA_ - AAAG

Ancient alleles in modern populations: Ancient structure, introgression and variation-maintaining adaptive forces	Imperial Ballroom B	1 p.m.-4:15 p.m.	13	Invited Podium

AAPA

Primatology: Social and Reproductive Behavior	A 602	1 p.m.-4 p.m.	14	Podium
Skeletal Biology: Paleopathology and Functional Studies	A 706/707	1 p.m.-4 p.m.	15	Podium
Paleoanthropology: Early hominins	Imperial Ballroom A	1 p.m.-4 p.m.	16	Podium
Evolutionary Approaches to Bioarchaeology	A 701	1 p.m.-5 p.m.	17	Invited Poster
Malaria in Antiquity: Methodological and Theoretical Approaches	A 702	1 p.m.-5 p.m.	18	Invited Poster
Old Questions, New Approaches and New Solutions: Celebrating the 30th Anniversary of the Dental Anthropology Association	Atrium Ballroom C	1 p.m.-5 p.m.	19	Invited Poster

HUMAN BIOLOGY ASSOCIATION

HBA Podium Presentations	A 704	1:30 p.m.-4:30 p.m.		

Thursday, Evening

AAPA

AAPA Silent and Live Auctions (silent 4:30 - 6:30; Live 6:30 - 9:30)	A 601	4:30 p.m.-9:30 p.m.		
AAPA COD Title IX Talk	A 706/707	5 p.m.-6:30 p.m.		

AAPA_WILEY

Wiley Reception	Atrium Foyer	8 p.m.-10 p.m.		

HUMAN BIOLOGY ASSOCIATION

HBA Annual Business Meeting	A 704	5 p.m.-6:30 p.m.		

Other

Physical Anthropology Women's Mentoring Network Happy Hour	A 703	5 p.m.-8 p.m.		
JHE Editorial Board	Sear Private Dining Room	7:30 p.m.-10 p.m.		
AAAG Business Meeting and Reception	*A 706/707*	7 p.m.-9 p.m.		

Friday, Morning

AAPA

AAPA COD AACT Teaching in the 21st Century Workshop	A 705	8 a.m.-10 a.m.		
Hands, Brains, and Tools: Integrating concepts in human evolution	Imperial Ballroom B	8 a.m.-noon	20	Invited Podium
Skeletal Biology: Growth and Development	A 703/704	8 a.m.-noon	21	Podium
Primate Ecology	A 706/707	8 a.m.-noon	22	Podium
Human genetic variation	Imperial Ballroom A	8 a.m.-noon	23	Podium
Humans in Marginal Environments	A 701	8 a.m.-noon	24	Invited Poster
Birth, Death, and Migration: Bioarchaeology and Skeletal Biology of the Southeastern United States	A 702	8 a.m.-noon	25	Invited Poster

AAPA – HBA Joint Symposium

Biocultural perspectives on family health within and across generations	Atrium Ballroom C	8 a.m.-noon	26	Invited Poster

Other

NSF 1:1 by appointment (RFERRELL at nsf.gov)	L 505	8 a.m.-9 a.m.		
Using the R Programming Language for Biological Anthropology	A 601	9:30 a.m.-11:30 a.m.		
Mentoring Relationships for Grant Writing: NSF, Wenner-Gren Foundation and Leakey Foundation	A 602	10 a.m.-11 a.m.		

Friday, All day

AAPA

Speaker Ready/Press Interview Room	L 502	7:30 a.m.-5 p.m.		
Family Respite Room	L 503	7:30 a.m.-10 p.m.		
AAPA Registration	Registration 2 - Marquis Level	7:30 a.m.-5 p.m.		
Fossil Casts and Videos	A 708	8 a.m.-5 p.m.		
Exhibitors	Atrium BallroomA/B	8 a.m.-5 p.m.		
Skeletal Biology: Violence, Trauma and Disease	Atrium BallroomA/B	8 a.m.-6 p.m.	27	Poster
Human Biology: Past and Present	Atrium BallroomA/B	8 a.m.-6 p.m.	28	Poster
Skeletal Biology: Non-human Primates	Atrium BallroomA/B	8 a.m.-6 p.m.	29	Poster
Human Skeletal Biology: Functional Studies	Atrium Ballroom /B	8 a.m.-6 p.m.	30	Poster
Skeletal Biology: Bioarchaeology	Atrium Ballroom /B	8 a.m.-6 p.m.	31	Poster

Friday, Afternoon

AAPA

AAPA Ethics Committee	*L 505*	noon-2 p.m.		
AAPA Career Development Workshop: How to meet the career challenges facing Ph.Ds and land a job!	A 602	noon-2 p.m.		
AAPA COD IDEAS	A 705	noon-1 p.m.		
AAPA COD Executive Committee	L 504	1 p.m.-2 p.m.		

AAPA COD AACT Panel: The **A**nthropologist's **AC**Cademic **T**aboo: Discussing alternative opportunities to 'traditional' R1 anthropology faculty positions	A 602	2 p.m.-4 p.m.		
In search of the last common ancestor: perspectives on the ancestral morphotype of hominins	Imperial Ballroom A	1 p.m.-4:15 p.m.	32	Invited Podium
Allomother-infant relationships across the Primate order: biomarkers, bonding, buffering, and other bidirectional effects	Imperial Ballroom B	1 p.m.-4 p.m.	33	Invited Podium
Human Biology: Nutrition and Variation	A 703/704	1 p.m.-4 p.m.	34	Podium
Paleoanthropology: Methods	A 706/707	1 p.m.-4:15 p.m.	35	Podium
Migration: An anthropological perspective	A 701	1 p.m.-5 p.m.	36	Invited Poster
The suite with many names: An exploration of "market integration" and its effects on human biology, health, and behavior	A 702	1 p.m.-5 p.m.	37	Invited Poster
Innovative approaches to human brain evolution: molecules to systems	Atrium Ballroom C	1 p.m.-5 p.m.	38	Invited Poster

Friday, Evening

AAPA

AAPA Business Meeting and Lifetime Awards	Imperial Ballroom B	5:45 p.m.-8 p.m.		
Primate Interest Group	A 703/704	8:15 p.m.-9:15 p.m.		

DAA

Dental Anthropology Assoc. Business Meeting	A 706	8 p.m.-9 p.m.		

Saturday, Morning

AAPA

AAPA COD-MAIN Committee Breakfast	L 504	7 a.m.-9 a.m.		
AAPA Education Committee K - 12 Teacher Workshop	A 705	8 a.m.-noon		
Exhibitors	Atrium Ballroom A/B	8 a.m.-2 p.m.		
NSF 1:1: by appointment (RFERRELLat nsf.gov)	A 708	10 a.m.-noon		
Biology and context of *Homo naledi* from the Rising Star cave system, South Africa	Imperial Ballroom A	8 a.m.-noon	39	Invited Podium
Population Genetics: Human and Non-Human Primates	A 602	8 a.m.-noon	40	Podium
Primate evolution and taxonomy	A 703/704	8 a.m.-noon	41	Podium
Human Biology: Growth, Reproduction and Adaptation	A 706/707	8 a.m.-noon	42	Podium
Bioarchaeology of Indigenous Peoples of Cuba	A 701	8 a.m.-noon	43	Invited Poster
Blood in the Villages: Bioarchaeological and Forensic Evidence for Massacres	A 702	8 a.m.-noon	44	Invited Poster
Forensic applications of human skeletal biology and variation	Atrium Ballroom C	8 a.m.-noon	45	Invited Poster

Saturday, All day

AAPA

AAPA Registration	Registration 2 - Marquis Level	7:30 a.m.-3 p.m.		
Speaker Ready/Press Interview Room	L 502	7:30 a.m.-5 p.m.		
Family Respite Room	L 503	7:30 a.m.-8 p.m.		
Human Variation: Diet, Disease and Morphology	Atrium BallroomA/B	8 a.m.-6 p.m.	46	Poster
Primate ecology and behaviour	Atrium BallroomA/B	8 a.m.-6 p.m.	47	Poster
Human Genetic Variation: Population Studies and Adaptation	Atrium BallroomA/B	8 a.m.-6 p.m.	48	Poster

Dental Anthropology	Atrium BallroomA/B	8 a.m.-6 p.m.	49	Poster
Genetics of Non-human primates	Atrium BallroomA/B	8 a.m.-6 p.m.	50	Poster
Human Biology: Demography	Atrium BallroomA/B	8 a.m.-6 p.m.	51	Poster
Education and Outreach	Atrium BallroomA/B	8 a.m.-6 p.m.	52	Poster

Saturday, Afternoon

AAPA

AAPA Annual Luncheon: Dr. Lee Berger, Speaker. "Almost Human – *Homo naledi* and the implications of new hominin discoveries from southern Africa"	Imperial Ballroom B	noon-2 p.m.		
First Annual Presidential Panel: Working Together to Change the Future: A dialog on harassment in biological anthropology	A 601	2 p.m.-6 p.m.		
AAPA Student Awards Committee	L 504	5 p.m.-6 p.m.		
Early-life stress in the past: bioarchaeological approaches to the evolution, ecology, and cultural contingencies of human life history	Imperial Ballroom A	2 p.m.-5 p.m.	53	Invited Podium
Genetics and Evolution: Non-human Primates	A 602	2 p.m.-5 p.m.	54	Podium
Primatology: Life History	A 703/704	2 p.m.-5 p.m.	55	Podium
Paleoanthropology: Late Homo	A 706/707	2 p.m.-5 p.m.	56	Podium
Human Biology and Skeletal Studies	Atrium Ballroom C	2 p.m.-4 p.m.	57	Podium
Injury Recidivism and Violence: Perspectives from Bioarchaeology and Forensic Anthropology	A 701	2 p.m.-5 p.m.	58	Invited Poster

Saturday, Evening

AAPA

AAPA Student Awards and Closing Reception	Imperial Ballroom B	6 p.m.-9 p.m.		

Thursday, Morning sessions.

Session 1: **Hybridization in human evolution: what can other organisms tell us?**
Wiley Invited Podium Symposium. Chair: Rebecca R. Ackermann.
Co-organizers: Rebecca R Ackermann and Benedikt Hallgrimsson.
Imperial Ballroom B.

Advances in genetics have dramatically influenced our understanding of human evolution in recent years. Nowhere is this more apparent than in the field of ancient DNA, which has almost singlehandedly resurrected the Neanderthals (and others) from "dead-end" status, shifting the tide of public and academic opinion. We now understand that the interplay among late Pleistocene hominin lineages involved the exchange of genes and resulted in the presence of ancient DNA lineages in living humans today. However, the dynamics of this process and its effects on the patterns we see in the fossil and archaeological record remain poorly understood. Gene exchange across divergent lineages can result in myriad outcomes, determined by taxon relationships, the nature of the exchange, and the environmental conditions under which it occurs. Here we draw widely from research in various vertebrate groups to demonstrate the ways that gene flow is known to structure genetic and phenotypic diversity under different climatic, geographic, ecological and phylogenetic scenarios. Our goal is to present and discuss a range of models that might be relevant for considering the process and effects of genetic exchange among our late Pleistocene (and possibly earlier hominin) ancestors. Where appropriate, we will also directly apply these models to examining the record of human evolution.

8:00 **Hybridization in human evolution.** R.R. ACKERMANN.

8:15 **Divergence With Genetic Exchange.** M. ARNOLD.

8:30 **Hybridization in Darwin's Finches.** P.R. GRANT.

8:45 **Consequences of hybridization in Darwin's finches.** B. GRANT.

9:00 **Hybrid speciation in amphibians: synergy, conflict, and sex chromosomes of allopolyploid genomes.** B.J. EVANS.

9:15 **Variation in the skeletal and ectodermal phenotype of mouse hybrids.** R.A. HUMPHREYS, T. RITZMAN, K. WARREN, C.J. PERCIVAL, C.C. ROSEMAN, B. HALLGRIMSSON, R.R. ACKERMANN.

9:30 **Admixture and adaptation in wild and domestic canids.** R.K. WAYNE.

9:45 **Paleogenomics interpretation of admixture between polar bears and brown bears.** J.A. CAHILL, P. HEINTZMAN, M. TEASDALE, A.E. RODRIGUES SORES,, J. KNAPP, C.J. EDWARDS, I.M. STIRLING, D.G. BRADLEY, R.E. GREEN, B. SHAPIRO.

10:00 **Break.**

10:15 **Gene flow and species boundaries in howler monkeys.** L. CORTÉS-ORTIZ, M.D. NIDIFFER.

10:30 **Genetic and morphological variation in natural and anthropogenic marmoset hybrids.** J. MALUKIEWICZ, R.R. ACKERMANN, N.H. CURI, J.A. DERGAM, L.F. FUZESSY, K. GUSCHANSKI, A.D. GRATIVOL, P.A. NICOLA, L.C. PEREIRA, C.R. RUIZ-MIRANDA, M. PASSAMANI, D.L. SILVA, A.C. STONE.

10:45 **The hybrid dynamics of baboons.** D. ZINNER, C. ROOS.

11:00 **An evaluation of integration in the hybrid baboon cranium.** T.B. RITZMAN, R.R. ACKERMANN.

11:15 **Using extant taxa to model variation in hominin hybrid populations.** K.A. WARREN, L. SCHROEDER, T.B. RITZMAN, C.J. PERCIVAL, B. HALLGRIMSSON, R.R. ACKERMANN.

11:30 **Discussion: Fred Smith, Clifford Jolly and Benedikt Hallgrimsson.**

Session 2: Functional Morphology
Contributed Podium Presentations. Chair: Christopher B. Ruff.
A 602.

8:00 **Pelvis shape and hominin walking: Insights from the three-dimensional mechanics of the lesser gluteals and hamstrings in human and chimpanzee bipedalism.** M.C. O'NEILL, B. DEMES, S.G. LARSON, B.R. UMBERGER.

8:15 **Videographic analysis of kinematics in great apes: To what extent are gait and posture conserved?** E.M. FINESTONE, M.H. BROWN, S.R. ROSS, H. PONTZER.

8:30 **The relationship between hindlimb loading and cross-sectional morphology in bipedal rats.** A.D. FOSTER.

8:45 **Phylogenetic and environmental effects on limb bone structure in *Gorilla*.** C.B. RUFF, L. BURGESS, J. JUNNO, S.C. MCFARLIN, A. MUDAKIKWA, T.G. BROMAGE, C.P. ZOLLIKOFER, M.S. PONCE DE LEON.

9:00 **Functional morphology of the metatarsophalangeal joints in chimpanzees and humans: A kinematic and morphometric approach.** N.B. HOLOWKA, P.J. FERNANDEZ.

9:15 **Investigating primate cuboid shape within the context of adaptive evolution, allometry, and locomotion.** O.O. THOMAS, C.C. ROSEMAN, W.E. HARCOURT-SMITH, R.L. RAAUM.

9:30 **Functional differentiation of the propulsive and braking roles of the forelimbs and hindlimbs during quadrupedal locomotion .** M.C. GRANATOSKY, A. ZEININGER, D. SCHMITT.

9:45 **The functional morphology of douc langur (genus *Pygathrix*) brachiation and the justification of the old-world semibrachiator category.** C. BYRON, M. GRANATOSKY, C. HENSEL, J. MORRISON, H. NGUYEN.

10:00 **Break.**

10:15 **Arm swing in bipedally walking chimpanzees.** B.J. SUMNER, N.E. THOMPSON, B. DEMES, S.G. LARSON, J.T. STERN JR..

10:30 **The effect of selection for lower relative encephalization on cranial base morphology.** C.J. PERCIVAL, F. SMITH, B. HALLGRÍMSSON.

10:45 **Craniofacial growth and dietary variability in an experimental model for primate fallback food use.** R.A. MENEGAZ, M.J. RAVOSA.

11:00 **An Eocene primate frontal from the Devil's Graveyard Formation, Texas.** E. KIRK, A.L. ATWATER, C.J. CAMPISANO, S. EGBERTS, I.K. LUNDEEN.

11:15 **Sexual dimorphism in masticatory cranial deformations in Bornean Orangutans (*Pongo pygmaeus*): a finite element analysis and geometric morphometrics study.** M.A. BERTHAUME, E. DICKINSON, C. SHAW, P. O'HIGGINS, K. KUPCZIK.

11:30 **Developmental coordination of the masticatory system constrains molar emergence across primates.** H. GLOWACKA, G.T. SCHWARTZ.

11:45 **Comparative assessment of human enamel tufts.** P.J. CONSTANTINO, M. KELLY, A. KEMPAINEN, N. LEDUE.

Session 3: **Primatology: Behaviour - Apes and Old World Monkeys**
Contributed Podium Presentations. Chair: Linda F. Marchant.
A 706/707.

8:00 **Female power in a male-dominated society: Simulating how female kin reunite in hamadryas baboons.** M.S. EKANAYAKE-WEBER, L. SWEDELL.

8:15 **Temporal stability in social network metrics among wild vervet monkeys.** M.B. BLASZCZYK.

8:30 **Dominance styles of eight alpha male chimpanzees at Gombe National Park, Tanzania.** J. BRAY, A.E. PUSEY, I.C. GILBY.

8:45 **Relationship of dominance ranks to age and coalition formation among male chimpanzees at Ngogo.** D.P. WATTS.

9:00 **Dominance Rank, Male-Female Aggression, and Male Mating Success Among Chimpanzees at Ngogo.** J. WIDNESS, D.P. WATTS.

9:15 **Predation by female chimpanzees at Gombe and Kibale: toward an understanding of sex differences in meat acquisition among early hominins.** I.C. GILBY, Z.P. MACHANDA, R.C. O'MALLEY, C.M. MURRAY, D.C. MJUNGU, E. OTALI, M.N. MULLER, M. EMERY THOMPSON, R.W. WRANGHAM, A.E. PUSEY.

9:30 **The diet of savanna-woodland chimpanzees (*Pan troglodytes schweinfurthii*) at Issa, western Tanzania.** A.K. PIEL, P. STRAMPELLI, E. GREATHEAD, R. HERNANDEZ-AGUILAR, J. MOORE, F.A. STEWART.

9:45 **Chimpanzee laterality redux.** L.F. MARCHANT.

10:00 **Break.**

10:15 **Alternative reproductive tactics among male chimpanzees in Gombe National Park, Tanzania.** J.T. FELDBLUM, E.E. WROBLEWSKI, R.S. RUDICELL, Y. LI, B.H. HAHN, A.E. PUSEY, I.C. GILBY.

10:30 **Chimpanzees and the phylogenetic origins of multi-level sociality in humans.** K.E. LANGERGRABER.

10:45 **Parasite infections reveal costs and benefits of social behavior in a community of wild chimpanzees.** S. FOERSTER, K.L. SCHABER, E.V. LONSDORF, D.A. TRAVIS, A.E. PUSEY, T.R. GILLESPIE.

11:00 **Evidence that anthropoid call frequencies are shaped by sexual selection.** A.K. HILL, D.H. BAILEY, R.S. WALKER, D.A. PUTS.

11:15 **Female White-handed Gibbon Great Call Linked to Resource Holding Potential Measures.** U.H. REICHARD, T.A. TERLEPH, S. MALAIVIJITNOND.

11:30 **Social preference based on direct and third party interactions in captive bonobos.** C. KRUPENYE, B. HARE.

11:45 **Human grooming in phylogenetic perspective: grooming rates and dyad composition in six traditional societies in comparison to other primates.** A.V. JAEGGI, R. HAMES, K. KRAMER, M. GURVEN, C. GOMES, H. KAPLAN.

Session 4: **Skeletal Biology: Bioarchaeology**
Contributed Podium Presentations. Chair: Patricia M. Lambert.
Imperial Ballroom A.

8:00 **Embodying the Goddess: Tattooing and Identity Formation in Bioarchaeology.** A. AUSTIN.

8:15 **Identity in an historic cemetery from Ignacio, Colorado.** D.M. MULHERN, M.C. CHARLES.

8:30 **Challenges in ancient microbiome reconstruction using 16S rRNA gene amplification.** K.A. ZIESEMER, A. MANN, M.L. HOOGLAND, H. SCHROEDER, K. SANKARANARAYANAN, C.L. HOFMAN, C. WARINNER.

8:45 **Anthropologic-radiologic analyses of newly found ancient Egyptian Human Mummies from tomb KV 40, Valley of the Kings (Upper Egypt).** F. RÜHLI, S. MEYER, N. FRATER, L. OEHRSTROEM, R. SEILER, S. BICKEL.

9:00 **Urbanization and Mortality Risk in Late Medieval London.** B.S. WALTER, S. DEWITTE.

9:15 **Socio-ecological determinants of differential childhood morbidity in post-medieval London.** H. SCHUTKOWSKI, L. CALDERWOOD, J. BUCKBERRY.

9:30 **A Comparison of Statistical Techniques to Assess Age-Related Skeletal Disorders in Bioarchaeology.** C.M. CHEVERKO, K.I. DOWNEY, M. HUBBE.

9:45 **Traumatic Injury Risk with Agriculture: Data from the Southeast and Beyond.** P.M. LAMBERT, M.H. WELKER.

10:00 **Break.**

10:15 **The meaning of means: the (mis)use of adult age estimates in bioarcheology.** J. BUCKBERRY.

10:30 **Gender differences in Diet and Health During Eastern Zhou.** K. PECHENKINA, Y. DONG, C. MORGAN, W. FAN.

10:45 **Dietary Patterns in Northern Chile during the Transition to Agriculture (Tarapaca Region, 1000 BC–AD 900).** F. SANTANA SAGREDO, M. URIBE, M. HERRERA, R. RETAMAL, S. FLORES.

11:00 **Tracing Dietary Histories and Social Relationships in a Muisca Population (900-1400 AD, Sabana de Bogotá, Colombia).** M.J. MILLER.

11:15 **Application of Stable Isotope Analysis to Questions of Status and Dietary Disparities at Chalcatzingo, Morelos, Mexico.** S.A. STREULI, A.D. SOMERVILLE, M.J. SCHOENINGER.

11:30 **Isotopic evidence for weaning timing among Formative populations of Caleta Huelén, northern Chile.** W.J. PESTLE, E.K. SMITH, A. CLAROT, F. GALLARDO.

11:45 **Reconstructing daily lives of individuals in ancient mass graves from Greek Sicily: Paleodietary perspectives on the Battles of Himera mortuary assemblages (480 BC, 409 BC).** K.L. REINBERGER, L.J. REITSEMA, B. KYLE, P. FABBRI, S. VASSALLO.

Session 5: **Reconstructing hominin paleoenvironments and paleoecology in Africa using stable isotopes: an integrative approach**

Invited Poster Symposium. Chair: Scott A. Blumenthal.
Co-organizers: Scott A Blumenthal, David B Patterson, and Kendra L Chritz.
A 701.

Relationships between African climate, environment, and human evolution remain poorly understood, largely due to difficulties in inferring selective conditions directly experienced by hominins. Although ocean- and lake-based archives provide critical regional- to global-scale perspectives, these records must be contextualized within a local terrestrial framework. Stable isotope analysis of fossils and sediments has become widespread in paleoanthropology for reconstructing local climates and ecosystems associated with traces of hominin morphology and behavior. This symposium brings together expertise in stable isotopes and paleoecology to explore recent advances and persistent challenges in method and theory for reconstructing hominin environments, particularly the integration of isotopic records with other morphological and geochemical proxies.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
Authors present 10:15 – 11:00

11:00 **Discussion: Richard Potts.**

1 **Isotopic perspectives on the dietary ecology of early Miocene catarrhines.** J. KINGSTON, L. MACLATCHY, S. COTE, W. SANDERS.

2 **Diets of Plio-Pleistocene Cercopithecidae from the Lake Turkana and Lake Victoria regions, Kenya.** T.E. CERLING, S.A. BLUMENTHAL, L.C. BISHOP, K.L. CHRITZ, P.W. DITCHFIELD, M. LEAKEY, F. MANTHI, T.W. PLUMMER.

3 **Spatial variation in paleovegetation in the Turkana Basin: implications for hominin niche shifts in the mid-Pliocene.** A. VILLASEÑOR.

4 **Hominin behavioral landscapes: merging stable isotopes, zooarchaeology and ecometrics for insights into hominin ecology at East Turkana, northern Kenya.** D.B. PATTERSON, D.R. BRAUN, R. BOBE, S.B. LEHMANN, N.E. LEVIN, A.K. BEHRENSMEYER, B.A. WOOD.

5 **Shifting dietary and technological adaptations of the Turkana hominins under static woody cover.** R.L. QUINN, C.J. LEPRE, M. BARCA, L. GODFREY, R.A. MORTLOCK, M. SCHALLER, J.D. WRIGHT.

6 **Small mammal insectivore carbon isotopes as environmental proxies in a South African savanna ecosystem.** J.N. LEICHLITER, M.J. SPONHEIMER, N. AVENANT, P. SANDBERG, O. PAINE, D. CODRON, J. CODRON.

7 **Stable Isotopic Study of Modern and Fossil *Tragelaphus*: interpreting the range of dietary signals within a single genus.** E.W. NEGASH, Z. ALEMSEGED, J.G. WYNN, Z.K. BEDASO, R. BOBE.

8 **Olduvai Gorge paleoecology: a multiproxy approach using bovid ecomorphological, tooth wear, and enamel stable isotopic studies.** T.W. PLUMMER, P.W. DITCHFIELD, L.C. BISHOP, J. LOUYS, F. HERTEL, J.D. KINGSTON, R. LAMELA-LOPEZ, F. FORREST, A. VAUGHAN.

9 **Environmental change in Kenya following a strong-weak monsoon transition: implications for the Pleistocene paleoenvironmental record.** K.L. CHRITZ, E.A. HILDEBRAND, K.H. FREEMAN, T.E. CERLING.

10 **Variation in the $\delta^{18}O$ record of Allia Bay, Kenya hippopotamidae .** M.J. SCHOENINGER, M.M. BEASLEY, I.J. ORLAND, J.W. VALLEY.

11 **Experimental water switch in sheep improves models for seasonal climate reconstruction.** D.R. GREEN, A.S. COLMAN, G.M. GREEN, F.B. BIDLACK, P. TAFFOREAU, T.M. SMITH.

12 **Two proxies from one biomineral: AAR geochronology and isotopic palaeoaridity indices from ostrich eggshell in archaeological sites.** J. LEE-THORP, M. ECKER, M. CRISP, B. DEMARCHI, C. MAREAN, K. PENKMAN.

13 **Reconstruction of Late Pleistocene Paleoenvironments using Stable and Clumped Isotopes from the Lake Victoria Region.** E.J. BEVERLY, K. SNELL, D.J. PEPPE, S.G. DRIESE, J. FAITH, C.A. TRYON.

14 **Understanding landscape variability from stable carbon isotope ratios of paleosols and enamel: a case study from East Turkana, northern Kenya.** M.D. BIERNAT, S. HIMES, F.S. KASSA, D.B. PATTERSON, D.R. BRAUN.

15 **Terrestrial aridity and Plio-Pleistocene hominin environments.** S.A. BLUMENTHAL, N.E. LEVIN, T.E. CERLING, F.H. BROWN, K.L. CHRITZ, J.M. HARRIS, G.E. JEHLE.

16 **Early hominid habitat preferences in the Middle Awash Valley, Ethiopia, from 5.6 to 0.08 Ma: paleosol stable isotope evidence.** S.H. AMBROSE, G. WOLDEGABRIEL, W.K. HART, P.R. RENNE.

Session 6: **Toward a Holistic Forensic Anthropology**

Invited Poster Symposium. Chair: Jared S. Beatrice.

Co-organizers: Angela Soler, Jonathan D. Bethard, Cate E. Bird and Allysha P. Winburn.

A 702.

In the last few decades, forensic anthropology has expanded in scope beyond traditional method-based and applied laboratory osteology to include a diverse range of approaches and analytical frameworks. The field has benefitted from the development of more reliable methods, an emphasis on quantitative analysis and the establishment of error rates, and innovative collaboration with related disciplines. These advances have also been critical to the need to meet evidentiary standards required by the *Daubert* ruling. In addition to scientific and methodological improvements, forensic anthropologists increasingly recognize that practitioners can and *should* critically engage with the field of anthropology as a whole. In fact, numerous examples of deeper and more regular engagement with the broader anthropological literature provide a more holistic perspective on issues of identification, family assistance, and death investigations in a variety of cultural, medicolegal, and humanitarian contexts. This symposium aims to stimulate discussion of how forensic anthropologists incorporate broader anthropological concepts and theory into their approach to routine forensic casework, humanitarian disaster response, and the investigation of human rights violations. Contributors focus on themes that include the use of a population approach in forensic casework, the use of osteobiographies in identification, the application of embodiment theory, integrating sociocultural and religious context into interpretations, and the need to understand local social, economic, and political circumstances to better serve the needs of communities when performing human rights and/or humanitarian aid work. Collectively, these papers reinforce and make more recognizable the merits of a more holistic forensic anthropology.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
Odd numbered poster authors present 9:00 – 10:00/ Even numbered poster authors present 10:00 – 11:00.

11:00 **Discussion: Dawnie Wolfe Steadman and Sarah E. Wagner.**

1 **Coming of age as a discipline: eighty-five years of forensic anthropology in the AAPA.** J.D. BETHARD.

2 **Incorporating all of anthropology into forensic anthropology graduate programs.** C.F. MILLIGAN, A. PERRONE.

3 **Forensic Anthropology *Is* Anthropology: How Participant Observation, Cultural Relativism, and Interviews Inform International Casework.** E.A. DIGANGI.

4 **Accounting for the Missing: Forensic Anthropology, Human Rights, and the Politics of Measurement.** A.R. ROSENBLATT.

5 **Forensic Anthropology For Who? The Experience of Colombian Forensic Practitioners in a Context of More Than Six Decades of Sociopolitical Conflict.** M. LOPEZ CERQUERA, D. CASTELLANOS.

6 **The Use of Physical and Cultural Anthropology in Resolving Medicolegal Cases: Forensic Anthropology at the PCOME.** B.E. ANDERSON, R.C. REINEKE.

7 **The biological consequences of structural violence in a forensic sample of undocumented migrants in southern Arizona.** A. SOLER, J.S. BEATRICE.

8 **Investigating migrant deaths: Viewing a humanitarian crisis through individual life histories.** J.S. BEATRICE, A. SOLER.

9 **The Anthropology of Forensic Identification in Texas.** J.P. FANCHER, M. SPRADLEY, H.A. DUECKER, C.E. SKIPPER, B.S. MCCLAIN, M.E. ISAACKS, C.P. MCDANELD, S.M. MAVROUDAS, A.C. GOOTS, A.D. AYALA BAS.

10 **Population Bias and its Advantages in Forensic Anthropological Casework.** C.E. BIRD.

11 **Investigative Anthropology: Holistic approaches to case resolution.** A.W. BUNCH.

12 **Using Paleopathology Techniques to Detect Childhood Neglect in Forensic Cases.** C.V. ISAAC.

13 **The biocultural signature of Afro-Caribbean religious rituals from a multiregional medicolegal perspective.** A.P. WINBURN, C.W. RAINWATER, G.O. HART, S.K. SCHOFF, N.M. PARR.

14 **Thinking spatially: Human behavioral ecology and forensic anthropology.** D. CONGRAM, M. KENYHERCZ.

Session 7: **Bone Microstructure: Imaging, Analysis and Function**
Invited Poster Symposium. Chair: John D. Polk.
Atrium Ballroom C.

The properties of cortical, trabecular and subchondral bone change in response to the loading conditions that they experience during an animals' lifetime. As a consequence, these bone properties have great potential for inferring functional differences between individuals and species of hominins and other primates. There has been a recent proliferation of techniques used to analyze and infer function from bone microstructure. This symposium brings together researchers from around the world who focus on experimental, ontogenetic, comparative, new analytical and imaging approaches to understanding variation in cortical, subchondral and trabecular bone, and the ways in which this variation can inform our understanding of extant and fossil species' articular function, and behavioral diversity.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
Opening remarks and 5 minute presentations 9:30

11:30 **Discussion: Brigitte Demes.**

1 **Regional variation of bone properties within the human lumbar vertebrae.** A. SU, A.M. BARTOSH, A.S. DICKSON.

2 **Systemic patterns of trabecular structure in *Homo* and *Pan*: Evaluating inter- and intraspecific variability across anatomical sites.** Z.J. TSEGAI, M.M. SKINNER, D.H. PAHR, J. HUBLIN, T.L. KIVELL.

3 **Normal variation in osteocyte lacunar parameters between human skeletal elements in cortical and cancellous bone from adult males - a synchrotron micro-CT approach.** J.M. ANDRONOWSKI, I.V. PRATT, D.M. COOPER.

4 **Radial Maximum Intensity Projection (rMIP): A new method for mapping 3D subchondral bone apparent density on curved joint surfaces .** T.M. RYAN, L.J. DOERSHUK, S.M. SUKHDEO.

5 **Signals of loading and function in the human hand: a multi-method analysis of the external cortical and internal trabecular bone of the metacarpals.** N.B. STEPHENS, T.L. KIVELL, D.H. PAHR, A.H. GEE, G.M. TREECE, J. HUBLIN, M.M. SKINNER.

6 **Subchondral bone radiodensity patterns in the glenoid fossa of the scapula in humans and non-human primates.** B.A. PATEL, K.J. CARLSON.

7 **Trabecular orientation in the 3rd metacarpal head of humans and chimps reveals their difference in locomotion behavior.** M.M. BARAK, E. SHERRATT, D.E. LIEBERMAN.

8 **Trabecular bone adaptations to arboreal and terrestrial environments: experimental evidence from mice .** I.J. WALLACE, S. JUDEX, A. SU, B. DEMES.

9 **Trabecular bone structural variation throughout the lower limb in three human populations.** J.P. SAERS, Y. CAZORLA BAK, C.N. SHAW, T.M. RYAN, J.T. STOCK.

10 **Subchondral properties of the hominoid distal tibia: an indicator of loading during habitually dorsiflexed ankle postures.** K.J. CARLSON, H. CHIRCHIR, B.A. PATEL.

11 **The relationship between patterns of subchondral bone apparent density and trabecular bone structure in the hominoid knee.** S.M. SUKHDEO, T.M. RYAN.

12 **Reconstructing knee posture in humans, chimpanzees and gorillas: subchondral and trabecular signals.** M.C. FOX, K.J. CARLSON, T. RYAN, M. KERSH, J.D. POLK.

13 **Which bone properties provide the best indicators of habitual posture?** J.D. POLK, M.C. FOX, M. KERSH.

14 **A comparative, ontogenetic approach to trabecular architecture with implications for inferring foot function in fossil hominins.** A. ZEININGER.

Thursday, All day sessions.

Session 8: **Primate Behaviour**
Contributed Poster Presentations. Chair: Laurie J. Reitsema.
Atrium Ballroom A/B.
7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Polyspecific associations of red uakaris in northeastern Peru.** R.M. HORES, S.M. FORD.

2 **Isotopic corroborates for wild capuchin (*Sapajus libidinosus*) omnivorous dietary adaptation at Fazenda Boa Vista, Brazil.** L.J. REITSEMA, C.E. JONES, D.M. FRAGASZY, P. IZAR, E. VISALBERGHI.

3 **Quantifying urinary C-peptide levels in wild tufted capuchins: a validation of filter paper storage methods.** J. CHALK, E.R. VOGEL, C.E. WALL, P. IZAR, M. EMERY-THOMPSON.

4 **Group coordination and the distribution of leadership in tufted capuchin monkeys: implications from a natural removal experiment.** C.J. SCARRY, M. TUJAGUE.

5 **Infant mortality in white-faced capuchins: The impact of alpha male replacements.** K.M. JACK, L.M. FEDIGAN.

6 **Maintaining and reinforcing commitment in the pair-bonded Bolivian gray titi monkey,** *Callicebus donacophilus***.** K. DINGESS, Y. GARECA, V. SANDOVAL.

7 **The impact of kinship and social contact on the gut microbiota of wild, black howler monkeys (***Alouatta pigra***).** K.R. AMATO, S. VAN BELLE, A. DI FIORE, A. ESTRADA, R. STUMPF, B. WHITE, K. NELSON, R. KNIGHT, S.R. LEIGH.

8 **Intergroup and Intragroup Vocalizations in the Mantled Howling Monkey (***Alouatta palliata***).** S. PRASHER.

9 **The Ontogeny of Prehensile-tail use in** *Ateles geoffroyi***.** L.T. KUMPAN, K. RUNZEL.

10 **Positional and Postural Behavior of** *Ateles geoffroyi* **at Osa Peninsula, Costa Rica.** H.G. SHOWALTER.

11 **Reproductive seasonality in two sympatric primates (***Ateles belzebuth* **and** *Lagothrix poeppigii***) from Amazonian Ecuador.** K.M. ELLIS, A. LINK, A. DI FIORE.

12 **Feeding and gouging in a wild pygmy marmoset group: Results from a camera trapping pilot study.** C.P. JACKSON, U.H. REICHARD.

13 **Parasite risk influences the water preferences of lemurs.** C.R. AMOROSO, K.C. SMITH, A.G. FRINK, C.L. NUNN.

14 **Do grooming bouts diminish ectoparasite load in wild *Propithecus edwardsi* in the rainforests of Madagascar?** K.J. KLING, M.E. LAUTERBUR, P.C. WRIGHT.

15 **Phenotypic constraints on life cycle evolution in wild Verreaux's sifaka (***Propithecus verreauxi***).** R.R. LAWLER, J. RATSIRARSON, J. RANAIVONASY.

16 *Propithecus* **playing around: Does female leadership influence play?** A.R. LAMB, E. LAUTERBUR, P.C. WRIGHT.

17 **The Relationship of Estradiol to Paternal Care Behavior in Wild-living Red-bellied lemurs (***Eulemur rubriventer***).** J. COSTANZO, A.L. BADEN, S. TECOT.

18 **To care or not to care? Paternal and alloparental infant care in free-ranging male Coquerel's sifaka (***Propithecus coquereli)***.** L.M. MEADOR.

19 **A Study of Habituation in** *Eulemur flavifrons***.** K. MEIER.

20 **Intersexual Affiliation in a Troop of Ring-Tailed Lemurs (***Lemur catta***).** L.E. GOTUACO, C.M. BRAND, C.G. OLIVEIRA, K. ORTIZ, T. KEITH LUCAS, F.J. WHITE.

21 **Ultrasonic vocalizations by montane pygmy tarsiers (***Tarsius pumilus***) in Sulawesi, Indonesia.** N.B. GROW, K. BAILEY, S. GURSKY.

22 **Revisiting carpal vibrissae: Positive identification in adult** *Tarsius tarsier* **and the implications for taxonomy and phylogeny.** A.N. SPRIGGS, B.C. WILHELM, B.J. BRADLEY, J.M. KAMILAR.

23 **Social Network Analysis of Stone Handling and Object Manipulation Among Long-Tailed Macaques (***Macaca fascicularis***) in Bali, Indonesia: A Preliminary Analysis.** J.V. PETERSON, A. FUENTES.

24 **Play behavior in captive black crested mangabeys (***Lophocebus aterrimus***).** N.P. RHOTON, K.L. GRAHAM.

25 **Fatty food or fertile females? Consortships and raiding behavior in male chacma baboons in the Cape Peninsula, South Africa.** M.A. BRYER, L. SWEDELL, S. CHOWDHURY.

26 **Network Position and Human Presence in Barbary Macaques of Gibraltar.** B.A. BEISNER, K.R. FINN, T. BOUSSINA, A. NATHMAN, A. FUENTES, E. SHAW, B. MCCOWAN.

27 **Social network analysis of Barbary macaque (***Macaca sylvanus***) dominance structure.** K.R. FINN, B.A. BEISNER, A. NATHMAN, T. BOUSSINA, A. FUENTES, E. SHAW, B. MCCOWAN.

28 **Object preferences and the function of object play behavior in a provisioned troop of long-tailed macaques (***Macaca fascicularis***) at Wat Khao Takieb, Thailand.** A.M. CARTER, K.P. GRAHAM, S. MALAIVIJITNOND.

29 **Seasonal influences on gelada social networks.** D.J. PAPPANO, T.J. BERGMAN, J.C. BEEHNER, T. BERGER-WOLF, D.I. RUBENSTEIN.

30 **Leaf fracture toughness and foraging efficiency in Angola black and white colobus monkeys (***Colobus angolensis palliatus***) from the Diani Forest of Kenya.** N.T. DUNHAM, A.L. LAMBERT.

31 **Dominance Rank and Nutrition in Forest-Dwelling** *Papio anubis***.** S. CASSALETT, C.A. JOHNSON, J.M. ROTHMAN.

32 **Hands and Feet: Comparative anatomy of apes and Old World Monkeys.** A.L. ZIHLMAN, C.E. UNDERWOOD.

33 **Short- and long-term consequences of intergroup interactions in redtail monkeys (***Cercopithecus ascanius***) and grey-cheeked mangabeys (***Lophocebus albigena***) in Kibale National Park, Uganda .** M. BROWN.

34 **Do site residence time and aggression reflect dietary preference among wild Diana monkeys (*Cercopithecus diana*)?** E.E. KANE.

35 **Male reproductive strategies and paternity success in the multilevel social system of gelada monkeys from Guassa, Menz Highlands, Ethiopia.** C.M. MILLER, N. SNYDER-MACKLER, N. NGUYEN, P.J. FASHING, J. TUNG, M.L. GUSTISON, M.L. WILSON.

36 **Signal trees: testing a theoretical framework and model for the evolution of primate vocal repertoires.** J.L. FULLER.

37 **Female reproductive success in an age-inversed hierarchy: the effects of age, parity, and rank.** A. KOENIG, D. DE VRIES, C. BORRIES.

38 **A multivariate approach to primate socioecology.** K.N. CROUSE.

39 **A New Quantitative Method to Analyze Geospatial Variations in Speech and Vocalization.** S.A. TOWNSEND, D.E. SLICE.

40 **What is a patch? Quantifying resource dispersion in primate studies .** C.A. SHAFFER.

41 **Facial Expressions and Pair-Bonds in Hylobatids.** B.N. FLORKIEWICZ, G. SKOLLAR, U.H. REICHARD.

42 **When borders are contested: methodological and theoretical issues when mapping ranging behavior of territorial species.** L.E. LIGHT, T.Q. BARTLETT, W.Y. BROCKELMAN.

43 **Effects of visitor group size on the number of abnormal behaviors in captive bonobos (*Pan paniscus*) housed in outdoor and indoor zoo exhibits.** J.L. BOLTE, M. WAKEFIELD.

44 **Rearing history and allostatic load in adult western lowland gorillas (*Gorilla gorilla gorilla*) in human care.** A.N. EDES, B.A. WOLFE, D.E. CREWS.

45 **A Review of the Yale Peabody Museum Osteological Collection of *Pan troglodytes*: Behavioral and spatiotemporal markers of ecology, disease, injury and death.** G.P. ARONSEN, M. KIRKHAM.

46 **Adolescent male chimpanzees do not form a linear dominance hierarchy with their peers.** R.B. REDDY, A.A. SANDEL.

47 **Chimpanzees show human-like shifts in cognition during adolescence.** A.G. ROSATI.

48 **Chimpanzee memory for complex events.** K. SAYERS, C.R. MENZEL.

49 **Social bonds in adolescent and young adult male chimpanzees at Ngogo, Kibale National Park, Uganda.** A.A. SANDEL.

Session 9: **Primate Evolution**

Contributed Poster Presentations. Chair: Isaiah Nengo.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Dietary adaptations and variability in occlusal surface shape of mandibular dentition in hominin and non-hominin primates.** K.D. O'NEILL, A.L. RECTOR.

2 **Comparison of molar metric variation and dental microwear among three species of *Parapapio* from the Pliocene cave site of Sterkfontein Member 4, South Africa.** L.C. ADAY, W.G. ANDERSON, F.L. WILLIAMS.

3 **Evolutionary and dietary implications of the internal structure of the dentition of *Anapithecus hernyaki* revealed by synchrotron virtual histology.** A. LE CABEC, C. DEAN, P. TAFFOREAU, D.R. BEGUN.

4 **A large-bodied ape canine from middle Miocene Napudet deposits in the Turkana Basin, Kenya.** I. NENGO, B. BENEFIT, I. ARNEY, M. MCCROSSIN, T. RAE, E. MILLER.

5 **Craniofacial size influences the strength of the molar inhibitory cascade in anthropoid primates.** J.E. SCOTT.

6 **Investigating dietary evolution in crown strepsirrhines using dental topography metrics and ancestral state reconstruction.** E.L. FULWOOD, D.M. BOYER.

7 **New insights into *Alouatta* vocal tract anatomy and functional morphology via CT and MRI.** B.M. SHEARER, L.B. HALENAR, Z.S. KLUKKERT, A.S. PAGANO, C. TANG, J.S. REIDENBERG.

8 **Hard-tissue markers of face flanges in male *Pongo*.** A.R. DECASIEN, J.P. HIGHAM, S.A. WILLIAMS.

9 **Morphological assessment of a putative hybrid species, *Trachypithecus pileatus*, based on a 3D geometric morphometric analysis of cranial morpholgy.** J.L. ARENSON, M. ANDERSON, F.J. WHITE, S.R. FROST.

10 ~~**Primate cranial shape evolution: combining geometric morphometrics and phylogenetic comparative methods.** R.H. GRIFFIN, C.C. GILBERT, A.L. BADEN, J.G. FLEAGLE~~. *Withdrawn*

11 **The influence of brain size on canal radius of curvature.** L.A. GONZALES, M.D. MALINZAK, R.F. KAY.

12 **Exploring Ecogeography, Drift, and Selection on the Macaque Cranium.** S.J. WILLIAMS.

13 **New primate femur from Pedernales Province, the Dominican Republic extends the range of Hispaniolan monkeys.** S.B. COOKE, M. TALLMAN, A. MYCHAJLIW, J. ALMONTE, G. FELIZ.

14 **Predicting platyrrhine locomotor behaviors using principal component regression.** J.T. GLADMAN.

15 **Up in Arms: Early primate proximal ulnae show affinities with non-quadrupedal, non-primate mammalian taxa.** K.R. RAMIREZ.

16 **Elbow morphology and substrate use in the fossil primate community at Hadar, Ethiopia.** M. VERGAMINI, A. RECTOR VERRELLI.

17 **Pedal Functional Morphology of** *Paracolobus chemeroni***.** M. ANDERSON, S.R. FROST.

18 **Phylogenetic analysis of extant hominoid postcranial characters recovers molecular clades.** K.D. PUGH.

19 **Reassessing Sexual Dimorphism in Early and Middle Eocene Notharctine Adapiforms.** B.A. PERCHALSKI, G.F. GUNNELL, D.M. BOYER.

20 **Anthropoid grooming ungues and ancestral state estimations of second pedal unguis form.** S.A. MAIOLINO.

21 **Environmental Variation Explains Mammalian Niche Structure in Central and South America.** J.P. SPRADLEY, J.D. PAMPUSH, R.F. KAY.

22 **New evidence of widespread hunting of giant lemurs on Madagascar.** L.R. GODFREY, V.R. PÉREZ, L.R. MEADOR, B.E. CROWLEY, R.J. BANKOFF, B.J. CULLETON, D.J. KENNETT, G.H. PERRY.

23 **Autopod scaling relationships between primate groups.** J.R. WASHABAUGH.

24 **New palaeontological discoveries from the Middle Miocene site of Napudet, west Turkana, Kenya.** T.C. RAE, I.O. NENGO, E.D. CURRANO, C. FEIBEL, D.L. FOX, E.R. MILLER.

25 **Phylogenetic analysis of** *Paradolichopithecus***: Fossil baboon or macaque?** N. O'SHEA, E. DELSON, K.D. PUGH, C.C. GILBERT.

26 **Avifaunal contributions to the paleoenvironment of** *Kenyapithecus*, *Victoriapithecus***, and other middle Miocene primates from Maboko Island, Kenya.** M.L. MCCROSSIN, B.R. BENEFIT.

Session 10 **Paleoanthropology: Genus Homo**

Contributed Poster Presentations. Chair: Osbjorn M. Pearson.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Does tooth size matter? A dental analysis of StW 252 from Sterkfontein, South Africa.** C.E. MAYER, F.L. WILLIAMS.

2 **The inner structural organization of a (likely) paranthropine patella from Swartkrans Member 2 (SKX 1084): human- and nonhuman-like features.** M. CAZENAVE, A. BEAUDET, J. BRAGA, A. OETTLÉ, J. THACKERAY, J. HOFFMAN, F. DE BEER, R. MACCHIARELLI.

3 **Macromammalian faunas and biostratigraphy of the Drimolen Main Quarry deposits, South Africa.** J.W. ADAMS, D.S. ROVINSKY, C.G. MENTER, A.I. HERRIES.

4 **The large mammal community from Cooper's D and its significance for** *Paranthropus robustus* **ecology.** A.L. RECTOR, K.E. REED, S. MEACHAM, C. STEININGER.

5 **Micromammal community structure of Cooper's D and the paleobiology of** *Paranthropus robustus* **.** D.A. HERNANDEZ, A.A. RECTOR, T. MATTHEWS, C. STEININGER.

6 **Estimating fetal-pelvic disproportion in Australopithecines, with special reference to the MH2 (***Australopithecus sediba***) pelvis.** P. FRÉMONDIÈRE, L. THOLLON, F. MARCHAL, N. FRATER, S. MATHEWS, M. HAEUSLER.

7 **Rearfoot posture of** *Australopithecus sediba* **and the evolution of the hominin longitudinal arch.** T.C. PRANG.

8 **Crural index of immature** *Homo naledi***.** S. TRAYNOR, C.S. WALKER, J. HAWKS.

9 **Proportions among stature, leg length, and foot size in Dinaledi Chamber early** *Homo* **and limb disproportions in Liang Bua LB1.** S. CHAVANAVES, R.B. ECKHARDT, M. HENNEBERG.

10 **Hunter-Schreger band configuration in the molars of modern humans and Plio-Pleistocene hominins.** D. YANG, S. CICCIO, F.E. GRINE.

11 **Skeletal indicators of lower limb flexibility in australopithecines and extant primates.** D.M. GOLDSTEIN.

12 **Comparisons of strength and predictability of Neanderthal and modern human femora under loading conditions simulating traumatic loads.** K.H. TAMVADA, D.S. STRAIT.

13 **The naming of Neandertals: William King, Ernst Haeckel and the rise and fall of "***Homo primigenius.***"** F.H. SMITH.

14 **Digging in the museum: Preliminary report on three unpublished Neanderthal teeth from Carigüela Cave (Píñar, Granada, Spain).** J. JIMÉNEZ-ARENAS, I. TORO-MOYANO, A. MARGVELASHVILI, M. PONCE DE LEÓN, J. ALBA-TERCEDOR, J. CARRIÓN, M. CORTÉS, C. LALUEZA-FOX, J. RIQUELME, C. ZOLLIKOFER.

15 **Reassessing the Genus Homo on the Island of Java through Virtual Reconstruction.** D.E. TYLER, R.P. HARROD, J. JONES, T. PARSONS.

16 **Spatial determinants of mandibular symphyseal morphology in Pleistocene** *Homo***.** J.E. SCOTT.

17 **Using endocranial coefficient of variation (ECV) to assess the place of Dmanisi fossils in the early** *Homo* **lineage.** S.W. GUIMARÃES, H. SILVA.

18 **Variation in parietal bone thickness and structural arrangement in Eastern African *erectus*-like *Homo*: comparative evidence from late Early Pleistocene Uadi Aalad and Mulhuli-Amo, Danakil depression of Eritrea.** C. ZANOLLI, L. BONDIOLI, F. CANDILIO, A. COPPA, D.W. FRAYER, Y. LIBSEKAL, T. MEDIN, L. ROOK, D. TESFAY, R. MACCHIARELLI.

19 **Preliminary zooarchaeological and taphonomic analysis of FwJj70, a butchered bone surface assemblage from the Okote Member of Koobi Fora, Kenya.** S.R. MERRITT, K. FETCHENHIER.

20 **An assessment of great ape mandibular corpus shape with implications for understanding the hominoid fossil record.** M. PITIRRI, D. BEGUN.

21 **The Relationship between Superior Calcaneal Facet Area and Achilles Tendon Length in Primates.** E.J. MCNUTT, J.M. DESILVA.

22 **Testing models of brain size evolution in canids and primates.** N. MAZUMDAR, C. ROSEMAN, J.D. POLK.

23 **Comparing hypothetical patterns of modularity in the modern human cranium.** A. KOLATOROWICZ.

24 **Can fossil hominin pelves be sexed using standards developed for modern humans?** J. EYRE.

25 **Using geometric shape for subfamily level taxonomic attribution in mixed, unassociated fossil cercopithecoid postcranial samples.** M. TALLMAN, A.D. KEGLEY, J.W. ADAMS.

26 **Inner ear morphology of the Cioclovina early modern European calvaria from Romania.** A.D. UHL, H. REYES-CENTENO, D. GRIGORESCU, E.F. KRANIOTI, K. HARVATI.

27 **Ecogeographical adaptations of Tanzanian skeletons from the German colonial period.** O.M. PEARSON, E.T. HILL, J. VALESCA MEYER.

28 **The human brain evolving: a diachronic study of endocranial variation.** L. ALBESSARD, S. DURRLEMAN, A. BALZEAU, D. GRIMAUD-HERVÉ.

29 **Shape analysis of the proximal phalangeal articular surface of pedal phalanges in extant anthropoids and fossil hominins.** P.J. FERNANDEZ, W.T. WIEDEMANN, C.M. ORR, B.A. PATEL, M.M. TOCHERI, W.L. JUNGERS.

30 **Dental microwear turnover rates in a modern hunter- gatherer population.** S.V. LIVENGOOD, A.N. CRITTENDEN, P.S. UNGAR.

31 **Asymmetry of the Modern Human Endocranium.** L.M. KITCHELL.

32 **The ontogenetic trajectory of occipital squama convexity in extant humans.** M.E. KARBAN, R.G. FRANCISCUS.

33 **The relationship between clavicle length and scapula position in living humans.** S. MELILLO, H. COQUEUGNIOT, J. HUBLIN.

34 **What does the fox say? Analysis of fox remains from island and mainland California, and implications for hominin evolution in insular environments.** C.B. YOUNG, L.W. COWGILL.

35 **Assessing the fracture patterns of thermally altered stone: Experimental evidence for distinct fracture patterns.** J. MUSCHINSKI, P. AKUKU, R. CUTTS, S. HLUBIK, D. BRAUN.

36 **Implications and applications of non-penetrating cortical bone modifications by carnivorous scavengers.** C.E. ROWE.

37 **Identifiable properties and accurate identification of hammerstone-broken long bone fragments.** K.M. DAVIS, S. MERRITT.

38 **The use of dye staining methods to distinguish between erythrocytes and fungi in ancient tissue histology.** I. SUNDELL, T.J. SETZER.

Session 11 **Forensic Anthropology**

Contributed Poster Presentations. Chair: Alice Gooding.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Sexual dimorphism of the proximal ulna: An evaluation of metric analyses .** E.J. BRENNAN, D.R. HUNT.

2 **Morphometric Assessment of Sexual Dimorphism and Asymmetry in the Human Scapula.** J.E. FINLAYSON.

3 **A univariate approach to sex estimation for the fragmentary upper limb.** C.B. LEGARDE, R. BONGIOVANNI.

4 **Sex diagnosis of the human dentition after heat exposure: the potential of cementum-enamel junction and root dimensions.** M. GOUVEIA, I. SANTOS, A. SANTOS, D. GONÇALVES.

5 **Sexual Dimorphism of the Oval Window.** S.M. BERGER.

6 **Osteometric Sex Estimation from Pelvis in a Thai Population.** P. MAHAKKANUKRAUH, S. RUENGDIT, D. CASE, S. TUN, A. SINTHUBUA.

7 **The preauricular sulcus and its link to sex and parturition: a test on a British Medieval collection.** S.E. CANTY, C. ELIOPOULOS, M. BORRINI.

8 **Patterns of ossification in macerated thyroid cartilages: Implications for age and sex estimation.** K.L. BOLHOFNER, L.C. FULGINITI.

9 **Frontal Sinus Development and Juvenile Age Estimation.** K.M. MOORE, A.H. ROSS, C.A. JUAREZ.

10 **A Test of the Meindl and Lovejoy Method for Age Estimation from Cranial Suture Closure in a Thai Population.** S. RUENGDIT, S. PRANEATPOLGRANG, P. SINGSUWAN, A. SINTHUBUA, P. MAHAKKANUKRAUH.

11 **A test of seven variables of the adult acetabulum for age estimation in a Thai population.** P. SINGSUWAN, S. PRANEATPOLGRANG, S. RUENGDIT, A. SINTHUBUA, P. MAHAKKANUKRAUH.

12 **Age Estimation from Vertebral Osteophytes in a Thai Population.** S. PRANEATPOLGRANG, S. RUENGDIT, P. SINGSUWAN, A. SINTHUBUA, P. MAHAKKANUKRAUH.

13 **Multiple population-specific age estimation methods or one-size-fits-all single age estimation method: which approach works best?** J. KIM.

14 **Archaeological application of three age-at-death estimation techniques to the Medieval site of La Granède, France: cementochronology, new life tables and Caussinus-Courgeau bayesian procedure.** S. NAJI, B. BERTRAND, T. COLARD.

15 **Testing Transition Analysis Aging Method on a Modern Colombian Skeletal Sample.** D. CASALLAS, M. LOPEZ-CERQUERA.

16 **Examining the Variation of Orbital Shape in Modern Human Populations Using 3D Geometric Morphometrics.** M.G. TORQUATO, M. ŠEŠELJ.

17 **Observer error in digitizing endobasicranial coordinate landmarks.** A.R. DZUBAK, T.P. GOCHA, A. KOLATOROWICZ.

18 **Model-Based Facial Soft Tissue Estimation From Dry Skull.** S. SCHLAGER, M. GOEPPER.

19 **Patterns sex-based shape in the human hipbone among non-metric traits categorized on a 5-point scale.** H.I. ROBERTSON.

20 **Determining Ancestry of Unprovenienced Human Remains from the Grenadines, Southern Caribbean: Dental Morphology and Craniometric Analyses.** T.N. DODRILL, G.C. NELSON, J.H. STONE, S.M. FITZPATRICK.

21 **Peruvian Ancestry: Morphoscopic Trait Frequency Comparisons .** V. BLACK, O. LOYOLA.

22 **Assessing the Precision and Accuracy of Craniometric Measurements: Geomorph versus Caliper Data Collection Methods .** A.N. FRIEND, M.K. STOCK.

23 **Cranial variation and biodistance in three Imperial Roman cemeteries.** S.M. HENS, A.H. ROSS.

24 **rASUDAS: A New Method for Estimating Ancestry from Tooth Crown and Root Morphology.** G. SCOTT, D. NAVEGA, J. COELHO, E. CUNHA, J.D. IRISH.

25 **Patterns of Morphological and Genomic Variation Among Different Regional Groups in Mexico.** C. FIGUEROA SOTO.

26 **Tracing the Origins of Dental Non-Metric Traits in New Mexican Hispanics.** R.L. GEORGE, G. SCOTT.

27 **Shape variation of the human orbital cavity.** A. RÜDELL.

28 **Indicators of Stress within Modern Undocumented Border Crossers Along the South Texas Border.** B.S. MCCLAIN, M.D. HAMILTON, M. SPRADLEY.

29 **Cranial base height as an indicator of developmental stress in native Mexican and American-born Mexican populations.** A. GOOTS, K. SPRADLEY, H. DUECKER.

30 **Identification of osteoporosis with the parabolic index varies based on the method of adjustment for porosity.** M.E. COLE, S.D. STOUT.

31 **Micro-anatomical features specific to metabolic problems found in the 6th left rib: A comparison among samples from the Raymond Dart and the RRP collections.** J.M. TULEY, R.R. PAINE.

32 **Biocultural evidence through taphonomic observations in the Karluk Salmon Cannery Chinese of Kodiak Island, Alaska.** A.S. CUNNINGHAM, D.R. HUNT, R.H. COOLIDGE.

33 **Heavy-handed: Can handedness be detected from bilateral degeneration of the medial end of the clavicle?** S.H. BLATT, E. MOES, K. PETERSEN.

34 **Opportunistic Blitz Research: "What can you tell me about these bones?".** M. FARALDO, L.L. TAYLOR.

35 **Machete and Axe Tool Mark Assessment Using Fully Fleshed Pigs.** M.L. HIGHSMITH, R.R. PAINE.

36 **Thoracic Fracture Patterning as a Result of Blast Trauma.** A.F. GOODING, M. MCCLUNG, S. KIRKPATRICK SMITH.

37 **Cadaver Decomposition and the Persistence of Human DNA in the Underlying Soil.** A.L. EMMONS, J.M. DEBRUYN, A.Z. MUNDORFF, K.L. COBAUGH, G.S. CABANA.

38 **Understanding skeletal decomposition through physical changes caused by bone weathering.** J. PYLE, K. SPRADLEY.

39 **Osteological analysis can still shed light on a recent forensic case.** C. HUMPHREY, M. HENNEBERG, J. KUMARATILAKE.

40 **Windover: An Overview of the Past 30 Years.** G.P. THOMAS, G.H. DORAN.

41 ~~**What level of biogeographical information is available from ^{18}O and ^{13}C signatures in late-erupting molars of modern humans?** A. HOLOBINKO, W. MEIER-AUGENSTEIN, H.F. KEMP, S.M. FORD, P. TURK.~~ *Withdrawn*

42 **Reconstructing the Origins of the Perrins Ledge Cremains.** D.D. GRAHAM.

43 **Assessing the application of dental cementum increment analysis for determining season of death in humans.** C.E. RALSTON.

Session 12

Skeletal Biology: Growth, Development and Variation

Contributed Poster Presentations. Chair: Robert A. Walker.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Effects of age on sexual dimorphism in the adult modern human skull.** C.M. ASTORINO.

2 **Biorhythms, deciduous enamel thickness, and primary bone growth in modern human children: a test of the Havers-Halberg Oscillation hypothesis.** P. MAHONEY, J.J. MISZKIEWICZ, R. PITFIELD, S.H. SCHLECHT, C. DETER, D. GUATELLI-STEINBERG.

3 **Early Life Stress in Colonial Peru: Internal Enamel Micro-Defects and their Influence on Life History Trajectories.** C.J. GARLAND, B.L. TURNER, H.D. KLAUS.

4 **Secular Change and Modularity in Craniofacial Fluctuating Asymmetry as an Indicator of the Demographic Transition in Americans.** K.E. WEISENSEE, R.L. JANTZ.

5 **Enamel Hypoplasia and Longevity as seen in the Antelope Creek and Wolf Creek skeletal sample at the Panhandle-Plains Historical Museum.** E.C. FRIGO, R.R. PAINE.

6 **Re-evaluating the co-occurrence and age of formation of Harris lines and linear enamel hypoplasia.** E.R. DOVE, J.D. IRISH, C. ELIOPOULOS, I. DE GROOTE.

7 **Impact of population-specific dental development on age estimation.** D.M. ADAMS, C. RALSTON, R. SUSSMAN, J.D. BETHARD.

8 **Craniofacial and dental effects shown in rats following** *in utero/***lactational exposure to 2,2',3,4,4',5,5'-heptachlorobiphenyl (PCB-180).** A. ROMERO, S. SHOLTS, H. HÅKANSSON, M. VILUKSELA.

9 **The relationship between ante-mortem tooth loss in molars and the mandibular ramus shape examined using 3-D geometric morphometrics.** H. JUNG, E. WOO, S. PAK.

10 **An Assessment of Sexual Dimorphism in the Crania from Roonka Flat, South Australia.** C.B. YOAKUM, A.C. DURBAND.

11 **Ontogeny of nasal integration in males and females.** N.E. HOLTON, A. ALSAMAWI, T.R. YOKLEY, A.W. FROEHLE.

12 **Cranial Deformation from Two Skulls in Romania.** E.I. COWARD.

13 **Homeotic transformations in the human vertebral column – global or local.** R.G. TAGUE.

14 **Examining childhood stress through vertebral neural canal size: implications for the Developmental Origins of Health and Disease hypothesis.** P. BEAUCHESNE, S.C. AGARWAL, K. KINKOPF, T. TROMBLEY, C. GOODSON, L. FENTRESS, A. COPPA, F. CANDILIO.

15 **Estimating human juvenile age-at-death from bone histology.** R.J. PITFIELD, P. MAHONEY.

16 **Circumferentially drifted osteons: Detailed histology of an unaddressed modeling drift tissue and implications for general histomorphological analyses.** C.M. MAGGIANO, I.M. MAGGIANO.

17 **Patterns in ontogeny of epiphyseal and metaphyseal trabecular bone microstructure in the human proximal tibia.** J.R. GOLIATH, J.H. GOSMAN, Z.R. HUBBELL, T.M. RYAN.

18 **Variation in the trabecular structure of the proximal tibia between obese and non-obese females.** D.S. GLEIBER, C.E. SKIPPER, D.L. CUNNINGHAM, D.J. WESCOTT.

19 **Getting the shaft?: investigating midshaft location in immature femora.** C.D. ELEAZER, R. SCOPA KELSO, F.L. WEST.

20 **"Here's Looking at You, Kid:" Analysis of Longitudinal Growth in Medieval and Postmedieval London Populations.** K.E. MARKLEIN.

21 ~~**Consideration of allometry improves skeletal stature reconstructions from long bones.** I.M. SIERP, M. HENNEBERG.~~ *Withdrawn*

22 *Hoxa11* **and** *Hoxd11* **influence pisiform length through altered growth plate organization.** K.M. KJOSNESS, J.E. HINES, P.L. RENO.

23 **Bilateral cortical bone mass and distribution in the human appendicular skeleton.** R.A. WALKER, K. MENNITTO, K. SIMOUNIAN, A. AZIE.

24 **A method for estimating age of medieval sub-adults from infancy to adulthood based on long bone length.** C. PRIMEAU, L. FRIIS, B. SEJRSEN, N. LYNNERUP.

25 **The effects of environmental conditions and gender on the presence of pathological conditions on children's skeletons from the Industrial Era of Europe.** S. REEDY.

26 **A re-evaluation of the Health Index of Southern Brazil shellmound populations.** M. GREEN, M. HUBBE, W.A. NEVES.

27 **Skeletal growth over the period of intensification of agriculture at the late prehistoric site of Ban Non Wat, Northeast Thailand.** N. DHAVALE, S. HALCROW, H. BUCKLEY, N. TAYLES, A. GRAY.

28 **The woman in blue: using modern analytical methods to investigate a Viking Age burial from Iceland.** J.W. WALSER III, T. JAKOB, M.H. SMITH, J. TUBMAN, F.H. ÓMARSDÓTTIR, S.S. EINARSDÓTTIR, K. SMITH, J. MONTGOMERY, S.J. KRISTJÁNSDÓTTIR, S.S. EBENESERDÓTTIR, K. FREI.

29 **Isotopic Analysis of Prehistoric Human Diet at Chelechol ra Orrak, Palau.** J.H. STONE, J. KRIGBAUM, S.M. FITZPATRICK.

30 **Better with age: Diet and social identity of the elderly at Kellis, Egypt through stable isotope analysis.** K.E. EAST, T.L. DUPRAS, L. WILLIAMS, S.M. WHEELER.

31 **Bootstrap-based comparison of the elevations of reduced major axis (RMA) regression lines.** T.M. COLE III, M.S. COLE, W.L. JUNGERS.

32 **Variation in ontogenetic growth patterns with shifts in a small town economy: Intra-population assessment of body size and bone strength (Barton-upon-Humber, Lincolnshire UK).** E.M. GAROFALO.

33 **Children and Childhood in Prehistoric Peru: A Mortuary Analysis of Infants and Children at Estuquiña.** M. LUTEY, S.R. WILLIAMS.

34 **What's the Difference? A Comparison of the Skeletal Remains of Castrated Individuals.** K. REUSCH.

35 **Multiple perinatal burial from the 2nd to 1st c. B.C.E. at Kopila, Korčula Island, Croatia.** P. MITCHELL, D. RADOVČIĆ, I. BORZIĆ, D. RADIĆ.

Thursday, Afternoon sessions.

Session 13

Ancient alleles in modern populations: Ancient structure, introgression and variation-maintaining adaptive forces

Invited Joint AAPA-AAAG Podium Symposium. Chair: Omer Gokcumen.
Co-organizers: Omer Gokcumen and Aaron Sams.
Imperial Ballroom B.

It was an amazing decade for anthropological genetics. Improvements in sequencing technologies have, on the one hand, provided thousands of whole modern human genomes readily available for analysis, and on the other hand, allowed sequencing of whole ancient genomes, a feat that revolutionized the way in which we study human evolution. One of the most fascinating areas of research that has developed from these new resources is the observation that modern humans share derived alleles with archaic populations, such as Neandertals and Denisovans, and some of these alleles remain variable in human populations. This observation is concordant with three scenarios: (i) recent introgression events from the archaic humans into modern human populations; (ii) ancient structure in the ancestral human population(s); and (iii) recurrent mutations at orthologous loci. It is now clear that all these scenarios have considerable influence on shaping the landscape of modern human genomic variation. In addition, some of these ancient variants have been maintained through adaptive forces, especially involving variation-maintaining adaptive forces (i.e., different ramifications of balancing selection). These adaptations relate to evolutionarily important functional categories, such as immunity, metabolism, growth, and climatic adaptation. This symposium will bring together paleoanthropologists, genetic anthropologists and population geneticists who are leaders in the field to lay out state-of-the-art methodological and theoretical developments involving genetic variation that has been maintained for hundreds of thousands of years in the human lineage. We hope that this symposium will lead to novel discussion regarding recent human evolution, the ancient migrations that shaped contemporary genetic structure in humans, and the adaptive impact of ancient human variation.

1:00 **The high-quality genomes of a Neandertal and a Denisovan.** K. PRÜFER.

1:15 **A discriminative model for inferring genome-wide maps of Neandertal and Denisovan ancestry.** S. SANKARARAMAN, S. MALLICK, N. PATTERSON, D. REICH.

1:30 **The genomic footprints of Stone-Age Europeans.** M. JAKOBSSON.

1:45 **Ancient introgression in Africa and the evolutionary genetics of hybrid fitness effects.** J. LACHANCE.

2:00 **A novel approach for detecting adaptive introgression in modern humans.** E. HUERTA-SANCHEZ, F. RACIMO.

2:15 **A novel, probabilistically interpretable framework for localizing genomic elements underlying adaptive evolution .** S. RAMACHANDRAN.(*additional author: L.A. SUGDEN)*

2:30 **Adaptive maintenance of ancient alleles: likelihood approaches for detecting balancing selection.** M. DEGIORGIO, K.E. LOHMUELLER, R. NIELSEN.

2:45 **Balancing selection and adaptive introgression as sources of advantageous genetic diversity in populations.** A.M. ANDRÉS, M. DANNEMANN, J. TEIXEIRA, J. KELSO.

3:00 **Effects of adaptive Neandertal introgression at the OAS locus on the modern human innate immune response.** A.J. SAMS, J. NEDELEC, A. DUMAIN, V. YOTOVA, P.W. MESSER, L.B. BARREIRO.

3:15 **Ancient alleles and complex structural variation of pathogen receptors at the glycophorin locus.** E.M. LEFFLER, G. BAND, K.A. ROCKETT, Q. LE, D.P. KWIATKOWSKI, C.C. SPENCER.

3:30 **Ancient genetic diversity and an evolutionary medicine perspective on Neandertal extinction.** A.P. SULLIVAN, G. PERRY.

3:45 **Millennial-scale population dynamics and the anthropology of introgression.** J. HAWKS.

4:00 **Discussion: Omer Gokcumen.**

4:15 **Break.**

Session 14 **Primatology: Social and Reproductive Behavior**
Contributed Podium Presentations. Chair: Anthony Di Fiore.
A 602.

1:00 **Ethoinformatics I: Developing a Standard Vocabulary and Data Model for Behavioral Field Research.** K.L. CHIOU, A. DI FIORE, R. OVERSTREET, M. CHEVETT, T. IGOE.

1:15 **Ethoinformatics II: Developing Open-Source Digital Data Services for Behavioral Field Research.** A. DI FIORE, K.L. CHIOU, M. CHEVETT, R. OVERSTREET, T. IGOE.

1:30 **Operational sex ratio, dominance rank and mating success of group and non-group male ring-tailed lemurs (***Lemur catta***).** A.D. WALKER-BOLTON, J.A. PARGA.

1:45 **Effects of sociality on the evolution of olfactory systems in mammals.** E.C. GARRETT, A.D. MELIN.

2:00 **Dichromacy as an adaptation for foraging in red-bellied lemurs (***Eulemur rubriventer***).** R.L. JACOBS, C.C. VEILLEUX, A.D. MELIN.

2:15 **The roots of all evil: aggression and below-ground feeding in female geladas.** J.C. JARVEY, B.S. LOW, T.J. BERGMAN, J.C. BEEHNER.

2:30 **Thermal Benefits of Grooming in Primates.** R. MCFARLAND, P. HENZI, L. BARRETT, A. FULLER, R.S. HETEM, D. MITCHELL, S.K. MALONEY.

2:45 **Social status, seasonality, and stress: Variation in glucocorticoid concentrations of high-ranking male rhesus macaques (***Macaca mulatta***).** K.M. MILICH, A.V. GEORGIEV, R. PETERSEN, M. EMERY THOMPSON, D. MAESTRIPIERI.

3:00 **Stabilizing selection and optimal group size in geladas.** E. TINSLEY JOHNSON, N. SNYDER-MACKLER, T.J. BERGMAN, J.C. BEEHNER.

3:15 **Does male rank trajectory influence male-female associations in olive baboons?** J.T. WALZ, D.M. KITCHEN.

3:30 **Baboon social neurobiology: Comparing the distributions of oxytocin and arginine vasopressin receptors in hamadryas (***Papio hamadryas hamadryas***) and anubis (***Papio hamadryas anubis***) baboon brains.** D.J. COPPETO, J.K. RILLING, T.M. PREUSS, G.L. WHITE, R.F. WOLF, P.R. MORALES, J.L. WAGNER, L.J. YOUNG.

3:45 **Energy balance across the estrus cycle and its relation to reproductive function in female chacma baboons.** T. STEINICHE, L. SWEDELL, S. FOERSTER.

4:00 **Break.**

Session 15 **Skeletal Biology: Paleopathology and Functional Studies**
Contributed Podium Presentations. Chair: Bruno M. Magalhães.
A 706/707.

1:00 **Battle vs Massacre – the use of perimortem injuries to differentiate between violent encounters.** M. KLJAJIC, J. PERIC PERUCIC, M. WOJCINSKI, M. SLAUS.

1:15 **Bioarchaeological analysis of juvenile remains from a mass sacrifice at Huanchaquito-Las Llamas, Peru, circa AD 1400.** B.L. DEMENT, J.W. VERANO, G. PRIETO, M. LUND.

1:30 **Fracture patterns of early first Millennium B.C. mounted Pastoralists in the Kunlun Mountains, China.** J. GRESKY, T. SCHMIDT-SCHULTZ, L. SCHWARZ, M. SCHULTZ.

1:45 **Hip fractures: an investigation of perimortem criteria.** M.L. MANT, C. DE LA COVA, R. IVES, M. BRICKLEY.

2:00 **Porotic hyperostosis and cribra orbitalia over the Mesolithic-Neolithic transition in the Danube Gorges, Serbia.** M. EDINBOROUGH, K. EDINBOROUGH.

2:15 **High Osteoporosis Risk among Physically Active Forager-Horticulturalists.** J. STIEGLITZ, F. MADIMENOS, H. KAPLAN, M. GURVEN.

2:30 **Middle nasal *concha bullosa* in a Portuguese identified skull collection and its association with nasal septal deviation and respiratory disease.** B.M. MAGALHÃES, S. MAYS, A.L. SANTOS.

2:45 **Experimental Mummification Project for Radiological Detection of Cancer.** J.L. WILLOUGHBY, C.L. KIRKPATRICK, J. KOROPATNICK, A. NELSON.

3:00 **Paleoparasitology of 1300 year-old human mummies from Nubia.** J.E. LOUDON, R.B. ADAMS, D.P. VAN GERVEN, V.J. MCKENZIE.

3:15 **Is entheseal change a marker of activity?** B. MULDER, B.V. RIETBERGEN, A. WATERS-RIST.

3:30 **Entheseal changes as a reflection of activity patterns at 1st century B.C./A.D. Petra.** T. STANKO, M. PERRY.

3:45 **Relationship between macroscopic morphology of thenar and hypothenar entheses and their microstructural design in modern humans.** K.N. RABEY, S. HILES, E. WILLIAMS-HATALA.

4:00 **Break.**

Session 16 **Paleoanthropology: Early hominins**
Contributed Podium Presentations. Chair: Melanie M. Beasley.

Imperial Ballroom A.

1:00 **Reconstructing early hominin brain evolution from South African *Australopithecus* endocasts.** A. BEAUDET, J. DUMONCEL, L. BAM, S. DURRLEMAN, E. GILISSEN, J. HOFFMAN, A. OETTLÉ, J. THACKERAY, J. BRAGA.

1:15 **First steps of bipedality in hominids: evidence from the pelvis of *Proconsul* and atelids.** A.L. MACHNICKI, L.B. SPURLOCK, K.B. STRIER, P.L. RENO, C. LOVEJOY.

1:30 **Virtual reconstruction of the MH2 pelvis (*Australopithecus sediba)* and obstetrical implications.** M. HAEUSLER, P. FRÉMONDIÈRE, C. FORNAI, N. FRATER, S. MATHEWS, L. THOLLON, F. MARCHAL.

1:45 **Body mass and femur length of *Orrorin tugenensis*.** T.W. HOLLIDAY, L. FRIEDL.

2:00 **Shape Variation in the Distal Femur of Modern Humans and Hominins.** N. SQUYRES, A. SYLVESTER, M. LANKIEWICZ, C. RUFF.

2:15 **Ratios of humeral to femoral mid-shaft cortical area reflect differences in locomotor behavior in primates, including fossil hominins.** A.J. ZACHWIEJA, B. DEMES, W.L. JUNGERS, K.J. CARLSON, F.E. GRINE, O.M. PEARSON, L.L. SHACKELFORD, J.D. POLK.

2:30 **Wading, and seeing, through mud: A biplanar x-ray study of human foot motion and footprint formation within deformable substrates.** K.G. HATALA, D. PERRY, S.M. GATESY.

2:45 **Testing biomechanical models for lumbar lordosis variation in hominins.** E.R. CASTILLO, C. HSU, R.W. MAIR, D.E. LIEBERMAN.

3:00 **Birth since the LCA: Reconstructing the twisted evolution of human parturition.** M. GRABOWSKI, S.A. WILLIAMS.

3:15 **The KSD-VP-1/1 postcranial skeleton from Woranso Mille, Ethiopia: brachial plexus enlargement and the capacity for fine motor skills in *Australopithecus afarensis*.** M.R. MEYER, Y. HAILE-SELASSIE.

3:30 **Exploring C_4 plant foods: the nutritional properties of South African savanna vegetation .** O. PAINE, M. SPONHEIMER, A. HENRY, A. HUTSCHENREUTHER, J. LEICHLITER, J. CODRON, D. CODRON, J. LOUDON, I. VINSONHALER.

3:45 **Seasonal variation in rainfall at Allia Bay, Kenya 3.97 Ma.** M.M. BEASLEY, I.J. ORLAND, J.W. VALLEY, M.J. SCHOENINGER.

4:00 **Break.**

Session 17 **Evolutionary Approaches to Bioarchaeology**
Invited Poster Symposium. Chair: Jim Watson.
Co-organizers: James T. Watson and Rachael M. Byrd.
A 701.

Although a sub-discipline of physical anthropology, bioarchaeological research is often missing an evolutionary perspective. Advances in the application of social theory regularly reject integrative interpretations of human biocultural adaptations and their consequences. Some exceptions to this observation include the application of molecular and morphological approaches to tracing modern human variation across time and geographical space using ancient population samples to understand migration. However, these studies often focus on the proximate interpretations rather than ultimate causations or consequences. This symposium seeks to highlight the ways in which a modern synthetic evolutionary approach can not only better inform our understanding of human biology among (pre)historic groups, but demonstrate how social and behavioral systems are affected by and reflect these relationships. Participants seek to approach bioarchaeological datasets from an evolutionary perspective to answer questions about how human biocultural diversity is shaped by both social and evolutionary processes.

12:45 – 1:00 Poster set-up/ 4:45 – 5:00 Poster take down
Even numbered poster authors present 2:30 – 3:00; odd numbered poster authors present 3:00 -3:30

3:30 **Discussion: John H. Relethford.**

1 **Sex, topography, and anatomical variation in the femoral notch: non-contact ACL injury in evolutionary perspective.** J.T. WATSON, B. HERNDON, C. SMITH.

2 **Deconstructing human cranial phenotypes to clarify individual prehistoric population histories.** R.M. BYRD.

3 **Skeletal adaptability in response to thermal stress: the paradox of inferring mechanisms of human adaptation.** J.T. STOCK.

4 **Northern genomes: Ancient mitogenomes and Arctic prehistory.** J.C. TACKNEY, A.M. JENSEN, W.S. WATKINS, E. FAIR, J. BRENNER-COLTRAIN, D. ANDERSON, D.H. O'ROURKE.

5 ~~**Rethinking Environmental Effects on Diachronic Change in Adult Human Stature.**~~ ~~B.M. AUERBACH.~~ *Withdrawn*

6 **Climate and diet signatures in human skull shape: a mixed model approach.** D.C. KATZ, M.N. GROTE, T.D. WEAVER.

7 **Population genetic evaluation of tooth size reduction in Late Pleistocene and Holocene Europe: A reappraisal of Brace's hypothesis using modern human teeth.** A.N. EMMERT, D.H. TEMPLE.

8 **Paleoamerican cranial variation in global microevolutionary perspective: Implications for the settlement of the Americas.** M. HUBBE, A. STRAUSS, N. VON CRAMON-TAUBADEL.

9 **A biohistory of Mexico from ~1250 to the present.** C.S. RAGSDALE, H.J. EDGAR, A. CUCINA.

10 **Applying modern human population models to estimate variance/covariance structure in bioarchaeology: assessing drift and selection in prehistoric skeletal populations.** N. VON CRAMON-TAUBADEL, L. SCHROEDER.

11 **The New World settlement as seen from different craniofacial morphospaces: An Evo-Devo approach.** M. GALLAND, S. DE AZEVEDO, N. MARTÍNEZ-ABADÍAS, R. GONZÁLEZ-JOSÉ.

12 **Genomic validation of the differential preservation of population history in modern human cranial anatomy.** H. REYES-CENTENO, S. GHIROTTO, K. HARVATI.

Session 18 **Malaria in Antiquity: Methodological and Theoretical Approaches**
Invited Poster Symposium. Chair: Nicole E. Smith-Guzmán.
Co-organizers: Teddi Setzer,
A 702.

Malaria, one of the oldest known human infectious diseases, continues to be a major health problem in spite of increases in eradication efforts and distribution of anti-malarial drugs. The World Health Organization (2014) estimates that there were 198 million cases of malaria in 2013, resulting in 584,000 deaths worldwide. With predicted increases in malaria prevalence due to climate change and drug resistance, knowledge of the evolution and history of the disease is more important now than ever. Anthropologists are uniquely poised to provide new perspectives to the global effort to eradicate malaria by contributing to the understanding of its social and historical aspects. Recent research has shed light on the presence and impact of malaria on ancient human societies through various approaches to paleopathology, including ancient DNA, immunology, histology, and bioarchaeology. This symposium brings together individuals with these diverse skill sets to improve our efforts at diagnosing malaria in ancient human remains through which the complex questions about the biocultural co-evolution of *Homo sapiens* and *Plasmodium spp.* can be explored.

12:45 – 1:00 Poster set-up/ 4:45 – 5:00 Poster take down
Odd numbered poster authors present 2:00 -2:30; Even numbered poster authors present 2:30 – 3:00

3:00 **Discussion: Nicole E. Smith-Guzman and Teddi Setzer.**

1 **Detecting malaria parasites postmortem: experiments, results, and implications.** T.J. SETZER, I. SUNDELL-RANBY, C. LES, C. PECHY, S. BESTE.

2 **Skeletal evidence of malaria at Tombos: Disease patterns from the New Kingdom through Napatan Periods in Upper Nubia.** M.R. BUZON, K.S. SANDERS.

3 **Malaria at Amarna, Egypt: Evidence from the South Tombs Cemetery.** N.E. SMITH-GUZMÁN, J.C. ROSE, H.S. DAVIS.

4 **Evidence of malaria in a preliminary sample from the Amarna North Tombs Cemetery.** G.R. DABBS, H.S. DAVIS, A.E. SHIDNER, J.C. ROSE.

5 **Pathophysiological isotopic fractionation: Assessing the impact of anemia on enamel apatite and bone collagen $\delta^{15}N$, $\delta^{18}O$ and $\delta^{13}C$ values.** G.M. CARROLL, S. INSKIP, A. WATERS-RIST.

Session 19 **Old Questions, New Approaches and New Solutions: Celebrating the 30th Anniversary of the Dental Anthropology Association**
Invited Poster Symposium. Chair: Brian E. Hemphill.
Co-organizers: Brian E. Hemphill and Heather J. Edgar.
Atrium Ballroom C.

The 1986 annual meetings of the American Association of Physical Anthropologists witnessed the founding of the Dental Anthropology Association. This association was formed to encourage communication among scholars with diverse interests, but who shared an interest in using investigations of the teeth and supporting structures to address anthropological questions. Over the course of the last three decades, dental anthropology has become an increasingly integral avenue of biological investigation within anthropology. Symposium participants will reflect upon where dental anthropology was three decades ago and where it stands now by highlighting investigations in four critical areas: 1) Growth and Development; 2) Odontometrics and Applications of Dental Field Theory; 3) Dental Morphology; and 4) Bioarchaeological and Forensic Applications. We will consider recent technological breakthroughs, including 3-dimensional imaging and the use of micro-CT scanning. These investigations demonstrate that old questions asked by dental anthropologists 30 years ago are now being addressed with new theoretical, statistical and technological approaches. These innovations yield new and often more complex insights into lifeways of the past and the evolution of patterns and processes of dental development at the level of the individual, population, species, and beyond.

12:45 – 1:00 Poster set-up/ 4:45 – 5:00 Poster take down.

1:30 **Presentations: Posters 1 - 9.**

2:30 **Presentations: Posters 10 - 18.**

3:15 **Discussion: Clark S. Larsen and Richard G. Scott.**

1 **Using the periodicity of enamel incremental structures to provide new insights into the initiation, development and timing of crown formation.** D. ANTOINE, S. HILLSON.

2 **Recent analytical developments yield new insights into the timing of tooth formation and standards for age estimation.** H.M. LIVERSIDGE, L.W. KONIGSBERG.

3 **Perikymata distribution relative to total perikymata number within the genus *Homo*.** D. GUATELLI-STEINBERG, M. O'HARA, S. XING, D.J. REID.

4 **New insights on the evolution of third molar agenesis and impaction.** K.E. CARTER.

5 **Big questions, microscopic solutions: the utility of linear enamel hypoplasia to studies of stress over the past 30 years.** J.A. THOMAS, R. ALEXANDER, D.H. TEMPLE.

6 **The modern human dentition: insights from three decades of studies on twins.** T.E. HUGHES, G.C. TOWNSEND, A.H. BROOK, M.R. BOCKMANN, S. MIHAILIDIS.

7 **Evolution of the Human Dentition: 5,000 years in the San Francisco Bay Area.** S.B. SHOLTS, M. HUFFMAN, L.J. HLUSKO.

8 **A morphometric approach to Butler's field concept: the deciduous and permanent molars.** S.E. BAILEY, S. BENAZZI, L. BUTI, K. PAUL, C. ASTORINO, J. HUBLIN.

9 **A 30-year perspective on the eclipse and rejuvenation of tooth size allocation analysis for reconstruction of population affinities.** B.E. HEMPHILL.

10 **Dental anthropology in the Eocene: Using modern approaches to answer long-standing questions in the study of fossil primates.** R.L. ANEMONE, B. NACHMAN, W. DIRKS.

11 **Tracing the "Bantu Expansion" from its source: Dental nonmetric affinities among West African and neighboring populations.** J.D. IRISH.

12 **Can dental morphology contribute to the identification of undocumented border crossers?** H.J. EDGAR, A. CUCINA, S.R. DANESHVARI.

13 **Revisiting the Caries Hypothesis as a mechanism of tooth size selection.** S.A. LACY, J.M. CALCAGNO.

14 **The teeth of Tell el-Amarna, Egypt: A reconstruction of past lifeways from the perspective of a century of Nile Valley research and 30 years advancement in dental anthropology.** J.C. ROSE, E.L. MOREY.

15 **Being a Royal: Dental Anthropology of Ancient Maya Paramounts.** A. CUCINA, V. TIESLER.

16 **The relationship between dental topography and dental microwear in *Sapajus apella*.** A.N. WIMBERLY, C.A. HEALY, C.L. HARTGROVE, M.F. TEAFORD, P.S. UNGAR.

17 **History of the study of the enamel-dentine junction and new insights using microtomography.** R.M. MARTIN, M.M. SKINNER.

18 **Why in 3-4D? What new insights virtual imaging are revealing in dental (palaeo)anthropology.** R. MACCHIARELLI, P. BAYLE, C. ZANOLLI, J. BRAGA.

Friday, Morning sessions.

Session 20

Hands, Brains, and Tools: Integrating concepts in human evolution

Invited Podium Symposium. Chair: Dietrich W. Stout.

Imperial Ballroom B.

Physical anthropology has a long history of positing interaction between bodies, brains, and culture in human evolution, but (sub)disciplinary insularity and a lack of overarching theory has limited the concrete exploration of such interactions. Meanwhile, fields such as evolutionary biology, neuroscience and psychology are being revolutionized by new theory and methods explicitly focusing on the interaction of organisms and environments over time. An "extended evolutionary synthesis" incorporating concepts such as niche construction, the evolution of development, phenotypic accommodation, and gene-culture co-evolution is paralleled by psychological and neuroscientific recognition of the bodily and environmental "grounding" of cognitive processes and the emergence of structure from extended brain-body-behavior networks operating on multiple time-scales. These innovations provide a promising framework for renewed integration in human evolutionary studies. The aim of this session is to promote theoretical and methodological integration by bringing together researchers working across key elements of the classic "bio-cultural feedback" model of human evolution: hands, brains and tools. These topics benefit from theoretical relevance as well as the practical availability of data from fossil, comparative, experimental, and archaeological evidence. This provides a practical focus for exploring the complex inter-relations between brains, bodies, social and physical environments in human evolution. In particular, participants will address evolutionary interactions between upper limb functional morphology and biomechanics; neural systems for perception, action, and social learning; social and environmental scaffolding of technological skill acquisition; and the evolution of brain development. To achieve this interdisciplinary synthesis, the session includes contributions from physical anthropologists, primatologists, archaeologists, developmental and comparative psychologists, evolutionary biologists and neuroscientists, ranging from integrative syntheses to primary research reports.

8:00 **An integrated perspective on the origin and evolution of *Homo*.** S.C. ANTÓN, R. POTTS, L.C. AIELLO.

8:15 **Evolutionary consequences of learning, culture and complex behaviors.** T.J. MORGAN, T.L. GRIFFITHS.

8:30 **Simple gifts aid others to learn to use tools: a platyrrhine example.** Y. ESHCHAR, D.M. FRAGASZY.

8:45 **Rethinking chimpanzee tool use: Niche construction and developmental bias in maintaining technological traditions among African apes.** C.M. SANZ, D.B. MORGAN.

9:00 **Hands and the origins of socially shared attention in human infants.** L.B. SMITH.

9:15 **Neural basis of tool-making skill learning: structure, function and evolution.** D.W. STOUT, N. KHREISHEH, E. HECHT, Z. LI, X. HU.

9:30 **Constructions: From Hands and Tools to the Evolution of Language.** M. ARBIB.

9:45 **Action Grammars - Extraction, recognition and prediction of movement primitives in tool-making.** A.A. FAISAL.

10:00 **Break.**

10:15 **Embodied foundations of stone tool use shared by humans and bearded capuchin monkeys.** M. MANGALAM, D.M. FRAGASZY.

10:30 **New questions about tools raised by recent finds of fossil hominin hands.** M.W. MARZKE.

10:45 **Predictions for an osteological signature of stone tool behaviors in hard tissue anatomy.** E. WILLIAMS-HATALA, A. KEY, N.B. STEPHENS, T. KIVELL.

11:00 **The human cognitive-motor action interface: integration of central and peripheral nervous systems for tool use.** L.A. WHEATON.

11:15 **Endocranial asymmetry and brain-lateralization: a comprehensive geometric morphometric approach.** S. NEUBAUER, P. MITTEROECKER, N. SCOTT, J. HUBLIN, P. GUNZ.

11:30 **Evidence for precuneus expansion in recent human evolution.** E. BRUNER, T.M. PREUSS, X. CHEN, J.K. RILLING.

11:45 **Discussion: Agustin Fuentes.**

Session 21 **Skeletal Biology: Growth and Development**
Contributed Podium Presentations. Chair: Daniel García-martínez.
A 703/704.

8:00 **Pelvic shape variation through growth and its implications for subadult sexing.** S.L. COX, J.T. STOCK, J.E. ROBB.

8:15 **Temporal variation in the neural canal among southern African foragers: implications for dynamic foraging strategies and social conditions in the later Holocene.** L. DOYLE.

8:30 **A Proposed Model of Postnatal Ontogeny in the Human Craniofacial Complex.** A.D. WHEAT.

8:45 **Developmental control and stabilizing selection in the human cranium: a novel morphometric approach.** P. MITTEROECKER, C. MATIASCH.

9:00 **A Metric Approach to Sex Estimation Using Fragmented Os Coxae.** S.E. BAUMGARTEN.

9:15 **A Computational Method for Age-at-Death Estimation Based on the Surface and Outline Analysis of 3D Laser Scans of the Human Pubic Symphysis.** D. STOYANOVA, B.F. ALGEE-HEWITT, J. KIM, D.E. SLICE.

9:30 **Multivariate ordinal probit analysis of the McKern and Stewart pubic symphysis scoring system.** M.C. GO, L.W. KONIGSBERG.

9:45 **A geometric morphometric approach to the study of juvenile long bones from medieval Wharram Percy.** S. STARK, S. MAYS, J. SOFAER, S. ZAKRZEWSKI.

10:00 **Break.**

10:15 **The application of volumetric x-ray technology to skeletal biology.** H. CHO, D. BOYE, R. KOZLOWSKI, P. WALL, S. KELLER.

10:30 **Multivariate regression analysis of human diaphyseal growth.** L.W. KONIGSBERG, K.E. STULL.

10:45 **Ontogeny of modern human longitudinal body and transverse shoulder proportions: implications for the Upper Paleolithic Sunghir children.** M.A. FRELAT, M. COQUERELLE, E. TRINKAUS.

11:00 **Secular change in the timing of epiphyseal fusion in the bones of the hand-wrist.** M.E. BOEYER, R.J. SHERWOOD, D.L. DUREN.

11:15 **Insights into developmental stress exposure from the bony labyrinth.** D.L. WARD, E. POMEROY, J.T. STOCK.

11:30 **Cold exposure decreases trabecular bone mass in young mice: implications for human bone acquisition.** M.J. DEVLIN, A. ROBBINS, L. SHIPP, K. ALAJBEGOVIC.

11:45 **Understanding developmental factors in the ontogeny of 3D rib curvature and its importance for human thorax growth.** D. GARCÍA-MARTÍNEZ, M. BASTIR.

Session 22 **Primate Ecology**
Contributed Podium Presentations. Chair: Rebecca M. Stumpf.
A 706/707.

8:00 **Foiled again!: Playback experimental evidence that saki and titi monkey alarm calls deter ambush predators.** D.B. ADAMS, D.M. KITCHEN.

8:15 **A preliminary analysis of the behavioral contexts of red langur (*Presbytis rubicunda*) loud calls in the Wehea Forest, East Kalimantan, Indonesia.** J. D'AGOSTINO, S.N. SPEHAR, R.A. DELGADO.

8:30 **Vervet monkey (*Chlorocebus pygerythrus*) alarm calls affect leopard (*Panthera pardus)* behavior.** L.A. ISBELL, L.R. BIDNER, E.K. VAN CLEAVE.

8:45 **The Microbiome and Primate Conservation: New Tools and Applications.** R.M. STUMPF, A. GOMEZ, K. AMATO, J.D. POLK, S.R. LEIGH.

9:00 **Intestinal parasites of wild orangutans in Gunung Palung National Park, Borneo, Indonesia.** C.A. O'CONNELL, C.D. KNOTT, I. FOITOVA.

9:15 **Nutritional and isotopic correlates of diet in forest-living olive baboons (*Papio anubis*).** C.A. JOHNSON, S.A. BLUMENTHAL, K.L. CHRITZ, T.E. CERLING, J.M. ROTHMAN.

9:30 **A multi-species approach to elucidating the ecological function of primate geophagy.** B.P. SEMEL, M.T. IRWIN, M.A. KEELEY, M. KONEN.

9:45 **The strategy of cognitive buffering to deal with environmental seasonality is unique to higher primates.** S.M. GRABER, C. VAN SCHAIK, K. ISLER.

10:00 **Break.**

10:15 **Toward a working model of chimpanzee ecology in anthropogenic landscapes.** A.R. HALLORAN.

10:30 **Howler monkey foraging ecology suggests convergent evolution of routine trichromacy as an adaptation for folivory.** V. KHETPAL, B. WELKER, Y. MATSUSHITA, S. KAWAMURA, A.D. MELIN.

10:45 **Testing the adaptive radiation theory for the evolution of lemurs on Madagascar.** J. HERRERA.

11:00 **Comparing the spatial dimensions of gorilla and chimpanzee sleeping sites: Nearest-neighbor nest distances of sympatric apes along a conservation gradient.** D.B. MORGAN, W. WINSTON, C.M. SANZ.

11:15 **An analysis of factors affecting surili (Genus: *Presbytis*) population densities.** L.M. PACIULLI, R.F. PHAN, L.S. BENDER.

11:30 **Communication for conservation: reducing disease transmission to mountain gorillas (*Gorilla beringei*) through better message framing to tourists.** S.J. GESSA, J.M. ROTHMAN.

11:45 **Life in a new world: The Silver River rhesus macaques' feeding ecology and encounters with humans.** E.P. RILEY, T.W. WADE.

Session 23 **Human genetic variation**
Contributed Podium Presentations. Chair: Jada P. Benn Torres.
Imperial Ballroom A.

8:00 **Variation of skin in recent human evolution: Loss of function and structural variation affecting *filaggrin* gene.** E. MUTHUKRISHNAN, D. XU, M. RZHETSKAYA, G. HAYES, O. GOKCUMEN.

8:15 **Unravelling the evolutionary forces driving skin color diversity in India.** F. ILIESCU, G. CHAPLIN, C. BASU MALLICK, N. RAI, A. MISHRA, R. GOTO, R. TAMANG, G. CHAUBEY, I. GALLEGO ROMERO, F. CRIVELLARO, R. PITCHAPPAN, L. SINGH, M. MIRAZON-LAHR, M. METSPALU, K. THANGARAJ, N.G. JABLONSKI, T. KIVISILD.

8:30 **Genetic History of the Major Tribes of Pakistan.** T.G. SCHURR, M. TARIQ, H. AHMAD.

8:45 **The legacy of slavery in the Middle East has been underappreciated by a factor of two.** J.A. HODGSON, V. CHUNDRU, R.L. RAAUM.

9:00 **Two-way gene-flow and ancestry-related assortative mating in African American populations.** J.M. GROSS, J.C. LONG.

9:15 **On the Trail of the First Caribbean Islanders: Genomic data from indigenous Trinidadians and St. Vincentians.** J.P. BENN TORRES, M.G. VILAR, T.G. SCHURR.

9:30 **Insight into the population history of the Chilean Patagonia through the analysis of ancient and modern genomic data.** C. DE LA FUENTE, M. AVILA-ARCOS, M.L. CARPENTER, J. HOMBURGER, A. BLANCO, P. CONTRERAS, A. MORENO-ESTRADA, P. F. CAMPOS, C. ENG, S. HUNTSMAN, E.G. BURCHARD, C. BUSTAMANTE, E. WILLERSLEV, E. LLOP, R. VERDUGO, M. MORAGA.

9:45 **Genome from Early Holocene Remains from Patagonia Suggest Demographic Shift, Supporting the Material Culture Transition.** M.G. VILAR, M. ALFONSO-DURRUTY, C. DE LA FUENTE CASTRO, F. MORELLO, P. CAMPOS, S. WELLS, E. WILLERSLEV.

10:00 **Break.**

10:15 **Telomere length: A possible mechanism linking racial discrimination and blood pressure.** P.H. REJ, C.C. GRAVLEE, C.J. MULLIGAN.

10:30 **Human nose shape variation can be explained, in part, by local adaptation to temperature.** A.A. ZAIDI, B.C. MATTERN, P. CLAES, C. HUGHES.

10:45 **Genetic and dental variation: Complementary data for understanding the population history of the Americas .** M.M. HUFFMAN, L.J. HLUSKO.

11:00 **Ancient Native American Exomes Reveal Immune-Based Adaptation to the Americas.** J. LINDO, E. HUERTA-SANCHEZ, M. DEGIORGIO, R.S. MALHI.

11:15 **Ancient pathogen genomics: a strategy for the parallel detection of multiple pathogens in archaeological samples.** S. MARCINIAK, A.T. DUGGAN, M. KUCH, J. ALLEN, C. JAING, S. GARDNER, K. MCLOUGHLIN, M. BORUCKI, H.N. POINAR.

11:30 **Impact of *Yersinia pestis* on immune response variation in humans.** J.F. BRINKWORTH, A. DUMAINE, V. YOTOVA, J. GRENIER, L.B. BARREIRO.

11:45 **Unambiguous assignment of male sex to a human tooth: use of proteomics when DNA is unavailable for sex assignment.** G.J. PARKER, K.E. MASON, L.A. REGAN, H.D. KLAUS, D.S. ANEX, B. HART.

Session 24

Humans in Marginal Environments

Invited Poster Symposium. Chair: Sara L. Juengst.
Co-organizers: Elizabeth Berger
A 701.

Studies of human adaptation have often focused on populations who make a living in so-called "marginal environments": from the tropics to arid steppelands, from high altitude mountain habitats to the Arctic circle, people have influenced and exploited a wide variety of ecosystems. Exploration of disease ecologies, diets, and evolution in these places reveals how human interaction with biotic and abiotic elements of ecosystems has shaped our species. Research on both living and past populations also challenges the narrative of deprivation and precarity often implied by the term "marginal", by building a better understandings of ecosystem dynamics, human-animal relationships, and human-environment interaction.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.

11:00 **Discussion: Lauren Butaric.**

1 **The Biological Consequences of Social and Political-Economic Marginalization in Antebellum Warren County, North Carolina.** S.C. DENT.

2 **Altitude Sickness: Health in the Titicaca Basin of the Bolivia.** S.L. JUENGST.

3 **Can marginalization be politically and economically beneficial? A case study from Late Ottoman-period Hesban (Jordan).** M.A. PERRY.

4 **Food, fire, and free space: New tests of the Numic Expansion.** K. MAGARGAL, A. PARKER, W. RATH, K.B. VERNON, B. CODDING.

5 **Risky business: Subsistence change and reproductive decision making in an uncertain environment.** J.P. ZIKER, D.A. NOLIN, E. MOES.

6 **Not just a fallback food: Global patterns of insect consumption.** J.J. LESNIK.

7 **Growing up with altitude: patterns of stunting and wasting in Tibetan children living in rural and urban communities in Nepal.** E.A. QUINN, G. CHILDS.

8 **Dental health and dietary indicators in the Bronze Age Hexi Corridor of Western China.** E.S. BERGER, H. WANG.

Session 25

Birth, Death, and Migration: Bioarchaeology and Skeletal Biology of the Southeastern United States

Invited Poster Symposium. Chair: Kathryn A. King.
Co-organizers: Kathryn A. King and Tracy K. Betsinger.
A 705.

Archaeological work in the southeastern United States has produced several large, well preserved, and well documented skeletal collections ranging in age from the Archaic period (10,000 to 3,000 rcbp) to the historic (mid-16th century to early 20th century) era. These collections have been used for decades to answer questions about the lives and biology of these past populations. Primarily, bioarchaeological studies have focused on the reconstruction of lifeways, while projects focused on skeletal biology view these collections from an adaptivist or evolutionary perspective. Collectively, however, these varied studies can provide greater insight into the history of this region. The purpose of this symposium is to bring together biological anthropologists with a variety of specializations who study southeastern skeletal collections, thereby fostering discussions and collaborations. By encouraging greater interaction among researchers with an interest in this region, a more complete picture of the history of the southeastern United States, one that acknowledges the interplay between biology and culture, can be obtained.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
Even numbered poster authors present 8:00 – 9:30; Odd numbered poster authors present 9:30 – 11:00

11:15 **Discussion: Maria O. Smith.**

1 **Population affinities and postcranial variation in the southeastern Archaic.** K.A. KING, M.S. HARLE.

2 **Babies, Culture, and Identity: An Analysis of Perinatal Mortuary Patterns.** T.K. BETSINGER, M.S. HARLE.

3 **The Shady Grove Ossuary (22QU525), Quitman County, Mississippi: Issues in Reconstructing Health Patterns.** R. HALFHILL, B. DAVIS, M. DANFORTH, S. OMBRE.

4 **The Complexities of Life in Death: A Comparison of Single and Multiple Burials from the Middle Tennessee Valley.** A.N. STEWART.

5 **Congenital Conditions and Genetic Traits in the Prehistoric Middle Tennessee River Valley.** B.S. THOMPSON.

6 **Skeletal Anomalies and Paleopathology of DeArmond (40Re12), a Mississippian Site in Eastern Tennessee.** D. MCCARTHY, K. HUFNAGL.

7 **Cribra Orbitalia and Porotic Hyperostosis: A Reanalysis of their Relationship.** T. SOMOGYI.

8 **Physiological stress in the Middle Cumberland Region of Tennessee: Mortality and survivorship differences during the Mississippian Period.** C.L. FOJAS.

9 **Salt, Spirits and the Soul: Exploring the Relationship between Health and the Use of Ceramics in the Mortuary Context, Savannah, GA.** R. BLACK.

10 **Assessing Geographic Origins Using Isotope Analysis of Skeletal Remains from a Colonial Period Cemetery, New Orleans, Louisiana.** G.A. LISTI, K.L. DELONG, M.H. MANHEIN.

Session 26 **Biocultural perspectives on family health within and across generations**
Invited Joint AAPA-HBA Poster Symposium. Chair: Melanie A. Martin.
Co-organizers: Lisa McAllister
Atrium Ballroom C.

Families impact child and adult health within and across generations. Biocultural perspectives recognize families as derived but highly plastic features of human evolution, varying in structure and function across time and cultures, and serving as units of intergenerational transfer and filters for early environments. While medicine and public health increasingly emphasize the importance of family health histories and integrated child, adult, and reproductive health services, the familial roles and behaviors that these practices target can be limited, generation-specific, or sociohistorically constructed. Biocultural perspectives offer expanded approaches to understanding and improving health of family members intergenerationally and across diverse environments. Anthropological research relevant to family health includes work in genetics, epigenetics, life history, reproductive ecology, parental investment, and kin structure, among other areas. Such research broadens our understanding of the dynamic genetic, somatic, and experiential exchanges that impact current and future health of family members. This symposium draws together researchers working across these fields in order to addresses the following themes: (1) how the plasticity of family structure, parental investment, and reproduction affects health behaviors and outcomes; (2) how different environmental challenges evoke proportional or divergent responses among individual family members across the lifespan; and (3) how epigenetic and intergenerational influences affect health outcomes of current and future generations. The research presented in this symposium addresses family health challenges both broadly and across diverse local environments. By merging these perspectives, we aim to provide a comprehensive framework for examining how family relationships and shared environments affect health and development of all family members, now and in subsequent generations. Ultimately, this integrated approach may be harnessed to inform family health policies that are more reflective of evolved physiological mechanisms, and cultural and environmental diversity.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
9:30 – 10:45 5 minute presentations by authors

10:45 **Discussion and Q &A: Carol Worthman.**

1 **“What beautiful days we lived in the past”: Untangling the conundrum of increased perception of mortality and morbidity risk in rural Bangladesh.** M.K. SHENK, M.C. TOWNER.

2 **Too sick to have another baby: Effects of perceived health on family planning in the Bolivian Amazon.** L.S. MCALLISTER, M.D. GURVEN.

3 **Effects of Different Family Economic Strategies on Individual Family Members' Health Among the Boat-Dwelling Shodagor.** K. STARKWEATHER.

4 **Cooperative breeding among Agta foragers: How reproduction, health and transition intersect today.** A.E. PAGE, S. VIGUIER, M. DYBLE, D. SMITH, N. CHAUDHARY, G. SALALI, J. THOMPSON, L. VINICIUS, R. MACE, A.B. MIGLIANO.

5 **"I don’t have any friends”: Narrative Self-Reports of Social Support and Resource Management, and Assessments of Nutritional Status in Jamaicans Across the Lifespan.** R.G. NELSON.

6 **Substitution or Augmentation: is early complementary feeding that does not reduce breastfeeding intensity really “suboptimal”?** M.A. MARTIN, M. GURVEN.

7 **Androgen receptor gene CAG repeats, testosterone, and male life history.** L.T. GETTLER, D.T. EISENBERG, M. HAYES, A.B. FERANIL, C.W. KUZAWA.

8 **When Do Fathers Matter? Father Absence and Child Health in Northern Tanzania.** D.W. LAWSON, A. HASSAN, S. SCHAFFNIT, S. JAMES, M. BORGERHOFF MULDER.

9 **Male migration, family structure and children's health in a seasonal agricultural community in Veracruz, Mexico.** A. NUNEZ-DE LA MORA.

10 **Down through the generations: the role of developmental programming in the intergenerational inheritance of cardiometabolic disease risk among high-prevalence populations.** D.C. BENYSHEK.

11 **Epigenetic analysis of intergenerational effects of maternal stress and war trauma in the Democratic Republic of Congo.** J. QUINLAN, C. CLUKAY, D.A. HUGHES, N.C. RODNEY, F.M. MAISHA, C.J. MULLIGAN.

12 **Grandparent Contribution to Child Nutritional Status: Evidence from the Young Lives Study.** M.E. COSTA.

13 **Understanding child obesity risk at the household level: The influence of parental and grandparental health beliefs and practices in Chinese families.** A.L. THOMPSON.

Friday, All day sessions.

Session 27

Skeletal Biology: Violence, Trauma and Disease

Contributed Poster Presentations. Chair: Treena M. Swanston.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Wearing the marks of violence: Unusual trauma patterning at Coyo Oriente, northern Chile (AD 400-1000).** C. TORRES-ROUFF, W.J. PESTLE, M. HUBBE, G. PIMENTEL, E. SMITH.

2 **Subadult Human Sacrifices in Midnight Terror Cave, Belize.** M.G. PROUT.

3 **Injury-Related Morbidity and Mortality in Neolithic Syria.** S.P. DOUGHERTY, A. TSUNEKI.

4 **In the Wake of War: Population Health and Ottoman-Occupation in 14th – 16th Century Croatia.** S.J. CALDWELL, M. ŠLAUS.

5 **Little Indiana vs. Big Kentucky: Violence in the Middle-Late Archaic.** F.B. ZALZALA, R.L. QUATAERT.

6 **Women in war: A multi-isotopic analysis of females discovered in a mass grave with Napoleonic soldiers.** S. HOLDER, L.J. REITSEMA, T. DUPRAS, R. JANKAUSKAS.

7 **Stable isotopic evidence for diet and nutritional stress in a potentially cannibalized human skeletal sample from Ana Manuku, Mangaia, Cook Islands.** M. BARCA, R.L. QUINN, S.C. ANTÓN.

8 **A case of neolithic cranial trepanation in Qinghai, China.** Q. ZHANG, Q. ZHANG, X. GAO, Z. SUN, H. ZHU.

9 **Troubled Times in Late Prehistoric Wisconsin: Violent Skeletal Trauma Among the Winnebago Phase Oneota.** A.M. OEMIG, J.K. KARSTEN.

10 **Fragmentary skeletal remains, trauma, and sampling biases: Quantifying antemortem traumatic data lost due to fragmentation in samples from Hasanlu Teppe, Iran (12th-9th Centuries B.C.E).** V. HUTTON ESTABROOK, H.D. POLASKY, J.M. MONGE.

11 **Deviant burials and social identity in a post-medieval Polish cemetery as interpreted using stable oxygen and carbon isotopes.** L.A. GREGORICKA, A.B. SCOTT, T.K. BETSINGER, M. POLCYN.

12 **Children's Health and Social Changes in Ancient Albania.** M.J. WARNE, B. KYLE.

13 **Comorbidity of linear enamel hypoplasia, periosteal lesions, and cribra orbitalia in medieval and post-medieval central European populations.** L.L. WILLIAMS, K.E. QUAVE.

14 **The diseased, the disabled and vampires in early medieval Culmine in Poland.** M.D. MATCZAK, T. KOZŁOWSKI.

15 **Occupational Stress on Oaxaca's Pacific Coast, a Bioarchaeological Analysis of the Rio Viejo Weaver.** A.T. MAYES, S. BARBER, A. JOYCE.

16 **Change in Nonspecific Stress through Time in Durres, Albania.** M. CHOWNING, B.R. KYLE.

17 **A Mortuary Profile Analysis of Cerro de la Cruz, Oaxaca, Mexico as an Investigation into Formative Period Regional Interactions.** C. SPESSARD, A.T. MAYES, A. JOYCE.

18 **Changing Economic Landscapes in Late Antique Tuscany: Osteological Analysis of Burials from an Abandoned Workshop.** E. STREETMAN, C.C. VOGELSBERG, M.I. ISA, T.W. FENTON, A. SEBASTIANI.

19 **Musculoskeletal manifestations of diabetes mellitus in the William M. Bass Donated Skeletal Collection.** C.F. UPSON-TABOAS.

20 **Sex and Famine: Mortality Differentials in Medieval London.** S.L. YAUSSY, S.N. DEWITTE.

21 **Biological Stress Status and Survivorship in Historical Populations.** J.D. MINSKY-ROWLAND.

22 **Keeping Up with the Kids: Mobility patterns of young individuals from the St. Mary Magdalen Leprosy Hospital (Winchester).** K. FILIPEK-OGDEN, C. ROBERTS, J. MONTGOMERY, J. EVANS, R. GOWLAND, K. TUCKER.

23 **Osteochondritis Dissecans, Osteoarthritis, and Enthesopathies: Physical Activity and Microtraumas among a post-Wari Population from the Peruvian Andes.** T.A. TUNG, E. NELSON, K. KILLGROVE, J. VELEZ VAZQUEZ.

24 **Degenerative Joint Disease and its Relation to the Osteological Paradox: A Study of Modern Geriatric Cypriot Skeletons.** L.C. HIGHSMITH, R.R. PAINE.

25 **Bone-years: Accounting for differences in preservation and age distribution when comparing lesion prevalence between skeletal collections.** J.N. CAHN.

26 **Mining and Mercury: An Examination of Entheseal Changes and Skeletal Deformities at the Santa Bárbara Encampment.** T.K. PROCTOR, D.K. SMIT.

27 **A Case Study of Skeletal Dysplasia Inheritance and Maternal/Fetal Health from a Middle Woodland Context at the Elizabeth Site (11PK512), Illinois.** A.A. CORMIER, J.E. BUIKSTRA.

28 **Artificial Cranial Modification on the Copacabana Peninsula.** D.W. HANSEN II, S.L. JUENGST, S.J. CHAVEZ.

29 **An evaluation of skeletal fractures in an adult community from Medieval Nubia.** V.A. LEAH.

30 **Femoroacetabular impingement: relationship to non-metric pathologies of the proximal femur.** A.B. LAWRENCE, P.A. SANDBERG.

31 **Multiple Paleopathological Indicators on Individuals in a Lower Status Compound of the Ancient City of Teotihuacan, Mexico.** R. STOREY.

32 **An Investigation of the Relationship Between Cranial Porosity and Cranial Modification Intensity in Late Intermediate Period (AD 1000-AD 1400) Andahuaylas, Peru.** D.N. GADISON, B.L. TURNER, D.S. KURIN.

33 **Bioarchaeology of Cremated Human Remains from the McQueen Shell Ring (9Li1648) on St. Catherines Island, Georgia.** B.D. PADGETT, C.S. LARSEN, D.H. THOMAS, M. SANGER, A.R. COMSTOCK.

34 **Bioarchaeological profile of three ancient high altitude sites in Mustang and Manang districts, Nepal.** J.T. ENG, M. ALDENDERFER.

35 **Anthropological studies of past societies from the Hualfín valley in northern Argentina: A preliminary report.** H. DRUBE, B. DESÁNTOLO, G. LAMENZA, E. SILVERA, S. MARTÍNEZ, S. SALCEDA.

36 **Brushing Off the Dust: A Dietary Study of a Forgotten Collection.** B.A. HUNDMAN, B.L. TURNER, N. SHARRATT.

37 **A Morphometric Approach for Assessing Cranial Vault Modification in Middle Cumberland Region Crania.** G.J. WEHRMAN.

38 **Metabolic Bone Disease of Infancy and Early Childhood in the Pre-Historic Atacama Desert, Northern Chile (2350 – 1500 BP).** A.E. SOHLER-SNODDY, S.E. HALCROW, H.R. BUCKLEY, V. STANDEN, B. ARRIAZA.

39 **Identifying Scurvy on Infant Remains on the Southern Plains.** C. ELLIS.

40 **Sex and site based differences in subsistence procurement and daily activities amongst the Ipiutak and Tigara of Point Hope, Alaska.** M. PANAKHYO, J.R. SPENCER, L.G. ROBERTS, G.R. DABBS.

41 **Fermentation Mechanisms and Possible Antibiotics in Ethiopian T'ej: Bioarchaeological Implications.** J.B. MARSHALL, B.L. TURNER, B.A. STUBBLEFIELD.

42 **Lead Uptake in the 19th Century: High Resolution Imaging Uncovers Details Associated with the Franklin Expedition and Contemporary Populations.** T.M. SWANSTON, B. BEWER, A. KEENLEYSIDE, A. NELSON, R.R. MARTIN, D.R. STENTON, T. VARNEY, I. COULTHARD, M.J. PUSHIE, D.M. COOPER.

43 **I C(T) Dead People.** B. PEARE BARTHOLDY.

44 **Spinal Pathologies and Morphological Alterations in Native Populations of the Lower Tennessee River Valley.** S.A. BONCAL.

45 **A probable case of rheumatoid arthritis from medieval transylvania.** S.L. BAILEY, S.B. KONDOR, J.D. BETHARD, Z. NYARADI, A. GONCIAR.

46 **More than meets the eye: Paget's Disease within archaeological remains.** C.L. BURRELL, S. GONZALEZ, L. SMITH, M.M. EMERY, J.D. IRISH.

47 **Metastatic Carcinoma... and other Differential Diagnoses.** A.C. CAINE, D.S. KURIN.

48 **The origin of** *Mycobacterium leprae***: A comprehensive meta-analysis of the paleopathological literature.** M.A. SCHREIER.

49 **Molecular Identification of Mycobacterium tuberculosis in the Milwaukee County Institution Grounds Cemetery.** H.M. WERNER.

50 **Dissection Practices Observed from Analysis of Remains from the Tukthuset Poorhouse Cemetery, Oslo, Norway: Contextualization of dissection practices around the turn of the 19th century.** G.D. MADDEN, R. DREW, P. HOLCK.

51 **Segregation of burial areas in the Riga Dome Church cemetery (13th-17th centuries) in Riga, Latvia.** E. PETERSONE-GORDINA, G. GERHARDS, T. JAKOB.

52 **Iterative Closest Point (ICP) Algorithm Application for Intentional Cranial Modification Determination: Developing an Automated Classification Method to Assess Cranial Shape from Fragmentary Remains.** K.O. MIYAR, B. POMIDOR, D.E. SLICE.

53 **A possible case of unilateral cleft lip and palate from the late Neolithic site of Verteba Cave, Ukraine.** M.C. WOJCINSKI, J.K. KARSTEN, S.E. HEINS, G.D. MADDEN, W.M. KARRIGER.

Session 28 **Human Biology: Past and Present**
Contributed Poster Presentations. Chair: Corina M. Kellner.

Atrium Ballroom A/B.
7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Sex differences in hair cortisol and self-reports of stress in college freshmen during their first final exam period.** D.E. BROWN, D.T. KOOMOA, E.R. TSUJI, A. CHING, A. DAUB, C. CAULEY.

2 **Maternal environment, prenatal stress, and offspring cortisol reactivity: A meta-analysis.** S.A. FARDI, R.M. BERNSTEIN.

3 **Early-Life Stress and Adult Mortality Patterns During Natufian Economic Intensification: The Linear Enamel Hypoplasia Evidence.** A.J. STUTZ, F. BOCQUENTIN.

4 **An Epigenetic Investigation of Methylation Complex Genes in Relation to Stress in Mothers-Newborn Dyads.** C.J. CLUKAY, D.A. HUGHES, N.C. RODNEY, C.J. MULLIGAN.

5 **The impact of illness behavior of patients and caregivers on the spread of an influenza epidemic.** J. DIMKA, L. SATTENSPIEL.

6 **The interrelationship of cytomegalovirus and Epstein-Barr virus antibodies among Shuar of Amazonian Ecuador.** T.M. BARRETT, M.A. LIEBERT, G. EICK, J.G. RIDGEWAY-DIAZ, F.C. MADIMENOS, A.D. BLACKWELL, L.S. SUGIYAMA, J. SNODGRASS.

7 **Tattooing to "toughen up": Reduced immunological depression among the heavily tattooed as a signal of biological quality.** C.D. LYNN, J.T. DOMINGUEZ, J.A. DECARO.

8 **Secular belongingness in religious congregation leads to lower stress.** I. RIVERA, A.N. ROSATO, C.D. LYNN.

9 **Environmental and Dietary Factors Shaping African Gut Microbiomes.** M. RUBEL, M.E. HANSEN, A. BAILEY, K. BITTINGER, A. LAUGHLIN, W.R. BEGGS, A. RANCIARO, S.R. THOMPSON, F. BUSHMAN, S.A. TISHKOFF.

10 **Prenatal supplementation, breast milk composition, and infant growth in rural Gambia.** M.A. GRUCA, S. MOORE, M. DARBOE, R. BERNSTEIN.

11 **Globalized diet and individual choices: stable isotopic analysis of hair keratin from a modern population.** C.M. KELLNER.

12 **Nutrition and proportionality: A study of undocumented migrants from the Texas-Mexico border.** A. AYALA BAS, M. SPRADLEY.

13 **Migration in Imperial Roman contexts (ca. 1st to 3rd c. CE): a multi-isotopic investigation of human mobility at Isola Sacra and Velia, Italy.** R.J. STARK, T. PROWSE, A. SPERDUTI, L. BONDIOLI.

14 **Metabolic Limits and Adaptation in Humans: Daily Energy Expenditure in** *Race Across the USA* **Athletes.** C. THURBER, B. CARLSON, C. OCOBOCK, L. DUGAS, H. PONTZER.

15 **Refugee presence is positively correlated with host community energetic status in Turkana County, Kenya.** R.G. GENGO, R.C. OKA, L.T. GETTLER.

16 **Time to kick the treadmill habit? How self-selected walking speed and minimum cost of transport differ between treadmill and overground walking during load carrying.** M.J. MYERS, C.M. WALL-SCHEFFLER.

17 **Gait ontogeny and the avoidance of impact forces.** J.T. WEBBER, A.D. FOSTER, D.A. RAICHLEN.

18 **Human female pelvic dimensions are adapted for load carrying.** C.M. WALL-SCHEFFLER, M.J. MYERS.

19 **Development in adolescent girls: physiological, social, and life history factors.** S.R. SANFORD, M. ROGERS, C.D. HUNTER, J. AMOS, K.B. CLANCY.

20 **Comparative analysis of the growth and development of the temporal bone in mice and humans.** A.M. VARVARES, M.A. MCNULTY, M.A. HOLMES, V.B. DELEON.

21 **Developmental age and size variation in mouse embryos from embryonic days 12-16 as a window to heterochronic processes.** K. FLAHERTY, V. MAZOCCO, J. RICHTSMEIER.

22 **Facial width-to-height ratio (fWHR) is not associated with pubertal testosterone.** C.R. HODGES-SIMEON, K.N. HANSON SOBRASKE, T. SAMORE, M. GURVEN, S.J. GAULIN.

23 **Male Excess Infant Mortality In Four Post-Medieval London Populations.** H.S. HAYDOCK.

24 **Genetic structure of the Chilean population.** F.I. MARTINEZ, S. EYHERAMENDY.

25 ~~**On the correlation between latitude and orbital volume in humans.**~~ ~~J.H. SENJEM, M.P. MASTERS, S.E. TRAYNOR.~~ *Withdrawn*

26 **Predicting language ability from cortical surface morphology.** I.D. GEORGE, K. ALDRIDGE.

27 **Analysis of Craniofacial Variation and Sexual Dimorphism using the 3D Facial Norms Database.** M.J. KESTERKE, S.M. WEINBERG.

28 **Cold acclimation among residents of the Chicago Metro Area: Changes in brown adipose tissue thermogenesis, energy expenditure and vasoconstriction.** S.B. LEVY, D. ATALLAH, M. BONDY, W.R. LEONARD.

29 ~~**Faces by the fire: Investigating facial affect around daytime and nighttime campfires.**~~ ~~A.S. BOATWRIGHT, E. DUNCAN, C.D. LYNN~~. *Withdrawn*

30 **Sexual Fluidity Positively Influences Group-Oriented Prosocial Behavior.** A.S. DAUGHERTY, N.D. ROY, C.M. WALKER, C.D. LYNN.

31 **Autism related endophenotypes in a healthy random sample: En2, HOXA1 and NLGN3 common variants and differences in regional brain volumes.** J. STARNES.

32 **Evaluating Deamination-based Approaches for Inferring DNA Methylation: Insights from Two Ancient Genomes.** R.W. SMITH, E.K. MALLOTT, J. LINDO, M. ROGERS, D.A. BOLNICK, A.L. NON, T.A. TUNG, R.S. MALHI.

33 **Social Organization and Biological Relatedness of the Burials from Naton Beach Site, Tumon Bay, Guam.** C.K. WALTH.

34 **Population Dynamics of Ancient Egypt and the Neighboring World: A Craniometric Analysis.** K.E. SANDERS.

35 **Sex, age, and reproduction: tooth loss among the Tsimané in lowland Bolivia.** M.R. SCHWARTZ, B.C. TRUMBLE, M.D. GURVEN, H. KAPLAN.

Session 29

Skeletal Biology: Non-human Primates

Contributed Poster Presentations. Chair: Andrea B. Taylor.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **A new approach for comparison of cranial ontogenetic trajectories, using cercopithecine monkeys as an example.** E.A. SIMONS, S.R. FROST, M. SINGLETON.

2 **Supporting big eyes: bone or no bone?** B.M. HARVEY, K.P. BHATNAGAR, V.B. DELEON, A.M. BURROWS, S.J. REHOREK, T.D. SMITH.

3 **Preliminary analysis of zygomaticotemporal sutural complexity in relation to diet in haplorhine primates.** H.M. EDMONDS.

4 **Skulls of Orangutans with unilateral divided zygoma .** Q. WANG, P.C. DECHOW.

5 **Comparative morphology of the glottis in the hylobatids using a high-resolution MRI.** T. NISHIMURA, H. IMAI, T. MATSUDA.

6 **Osteocyte Morphology in the Primate Craniofacial Skeleton.** L.C. PRYOR, J. FENG, P.C. DECHOW.

7 **Quantitative Occlusal Surface Complexity Metrics and Dental Wear in** *Alouatta palliata***.** J.D. PAMPUSH, A.R. HARRINGTON, J.P. SPRADLEY, A.Q. VINING, K.L. ALLEN, R.F. KAY.

8 **Use of Standard Perikymata Profiles to Estimate Chronologies of Linear Enamel Hypoplasia (LEH) .** M. O'HARA, D. GUATELLI-STEINBERG.

9 **Fiber phenotype of the jaw adductors in the hard-object feeding sooty mangabey (***Cercocebus atys***).** A.B. TAYLOR, M. TOLER, C.E. WALL.

10 **Inhomogeneous nature of canine composition does not affect their isostress shape.** A.J. RAPOFF, J.W. COULL, S. MCGRAW, D.J. DAEGLING.

11 **Tooth Size and Diet among the Extinct Monkeys of the Caribbean.** Z.S. KLUKKERT.

12 **Relationship of molar root and mandibular size in extant great apes.** M. BAEUCHLE.

13 **Ectopic eruption in a zoo chimpanzee and its implications for testing the jaw spatial constraints hypothesis.** M.A. KUNKEL, R.C. MCCARTHY.

14 **Eating seeds or cracking hard food? Mechanically-informed dietary categories and the dental topography of anthropoid primates.** G. THIERY, V. LAZZARI, F. GUY.

15 **Zygomaxillary shape variation in** *Lophocebus* **and** *Papio***: a comparative allometric analysis.** M. SINGLETON, J.R. KRECIOCH, O. FURSOV.

16 **Dental maturity ages in** *Pan***: can estimation error be improved?** K.L. KUYKENDALL, J.C. BOUGHNER, C.S. BRIMACOMBE.

17 **Patterns of Mandibular Molar Expansion in Megadont Primates.** E.S. GLAZE, S.E. BAILEY.

18 **Geometric morphometric analysis of strepsirrhine upper second molars.** E.M. ST CLAIR.

19 **Topographic complexity of second mandibular molars increases with a wear proxy in five species of cercopithecoid primates.** J.M. WINCHESTER.

20 **Relationship between macrowear and dentin hardness in** *Macaca fascicularis* **molars.** E. GEISSLER, D.J. DAEGLING, W.S. MCGRAW.

21 **Ontogenetic shifts in the pattern and magnitude of mandibular covariance.** M.A. HOLMES, V.B. DELEON, M.A. MCNULTY, J. MUSSEL.

22 **Patterns of variation in the hominoid appendicular skeleton: implications for fossil hominins.** V.C. POWELL, S. ALMÉCIJA, A. BARR, B.A. WOOD.

23 **Distal humerus morphology and ecological variation among** *Gorilla* **subspecies.** R.S. JABBOUR, R. BAYNES.

24 **Patterns of joint congruence in the primate elbow.** M.E. MACIAS.

25 **Olecranon and trochlear notch orientation is related to extended limb postures during locomotion.** M.S. SELBY, C. LOVEJOY.

26 **3D Morphometrics of the cercopithecoid distal humerus: implications for the reconstruction of paleohabitats.** E.K. CURTIS.

27 **Carpal kinematics and morphological correlates of ulnar deviation mobility in anthropoids.** C.M. ORR, R. ATKINSON.

28 **The effects of posture on neck and trunk musculature in** *Hylobates lar* **and** *Macaca fuscata***.** N. GRIDER-POTTER, R. GOTO, Y. NAKANO.

29 **Scapular morphology and its implications for the study of locomotor behaviors in primates and carnivorans.** R. LAMELA LOPEZ, E. KOZMA, S.A. WILLIAMS.

30 **Skeletal Development with Reference to Ontogeny and Phenotypic Plasticity; A Cross-Sectional Study of Primate Limb Bones.** J.A. NADELL, K. KOVAROVIC, S. ELTON.

31 **Ontogenetic variation in limb bone structure in** *Pan paniscus* **compared to** *P. troglodytes***.** M. BURGESS, J. JUNNO, C.B. RUFF.

32 **Secondary bone distribution in the humerus and femur of four West African cercopithecid monkeys.** S.E. LAD, W. MCGRAW, D.J. DAEGLING.

33 **Gorilla limb kinematics and hominoid locomotor diversity: Implications for hominin locomotor evolution.** D. SCHMITT, A. ZEININGER, E. HAMRICK, M.L. SNYDER, T.L. KIVELL, R.E. WUNDERLICH.

34 **Developmental shift or postnatal plasticity? Manual and pedal variation in two populations of** *Microcebus griseorufus* **at Bezà Mahafaly.** G. AGOSTINI, E. RASOAZANABARY, L.R. GODFREY.

35 **A Matter of Perspective: The Influence of Anatomical Reference Frame Construction on Cross-Species Biomechanical Comparisons.** T.M. GREINER.

36 **History of Exercise, Cross-sectional Geometry, and Bending Mechanics: Inferences Based on Three Strains of Mice.** S.J. PEACOCK, B.R. COATS, J.K. KIRKLAND, C.A. TANNER, T. GARLAND JR., K.M. MIDDLETON.

37 **Intraspecific variation in hominoid lumbar vertebral morphology.** A.D. KEMP, L. SHAPIRO.

38 **Tail kinematics during asymmetrical gaits in mouse lemurs (***Microcebus murinus***).** L.J. SHAPIRO, B.A. CHADWELL, J.W. YOUNG.

39 **Characterizing the trabecular bone of the primate ischium and its relationship to locomotion in** *Rudapithecus hungaricus***.** D. SHAPIRO, D.R. BEGUN.

40 **Effects of exercise-induced loading on internal bone morphology of the mouse ilium: implications for lower ilium robusticity in primates.** K.L. LEWTON, T. RITZMAN, L.E. COPES, T. GARLAND, JR, T.D. CAPELLINI.

41 **Interspecific variation in pubic bone morphology and its association with body size, locomotor classification, and phylogeny.** D. DURAND, J. PLAVCAN.

42 **The ontogeny of pelvic sexual dimorphism: Age, parity, and pelvic form in** *Macaca mulatta***.** E.A. MOFFETT.

43 **A preliminary investigation into the femoral neck cortical thickness of another obligate biped.** A.G. CLAXTON.

44 **The impact of proximal femoral shape on midshaft cross-sectional properties: A case study involving** *Pongo***.** T.R. REIN.

45 **Relationship of proximal femoral morphology to leaping in two African colobine monkeys.** T.A. POLVADORE, W.S. MCGRAW, D.J. DAEGLING.

46 **Hierarchical variation of bone hardness in the colobine femoral midshaft.** R.M. GALLUSCIO, W.S. MCGRAW, A.J. RAPOFF, D.J. DAEGLING.

47 Moved to poster #26, Session #30

48 **Dental and hind limb development in the sifaka and ring-tailed lemur: how they get up and go.** M.E. MILLEN, M.J. MCMAHON, C.M. FICORILLI, K.D. JANKORD, C.J. VINYARD, V.B. DELEON, J.W. YOUNG, T.D. SMITH.

49 **Pattern of ossification in tarsals reflects locomotor specialization in Primates.** C. LLERA, T. SMITH, J. YOUNG, V. DELEON.

50 **Congruence of articular surface curvature and dynamic range of motion in the subtalar joints of lorisids and cheirogaleids.** G.S. YAPUNCICH, M.C. GRANATOSKY.

51 **Functional morphology of the fourth metatarsal in monkeys, apes, and** *Australopithecus afarensis***.** S. KUO, C.V. WARD, W.H. KIMBEL, K.A. CONGDON, D.C. JOHANSON.

52 **Trabecular mapping: Leveraging sliding landmarks for analyses of bone microstructure.** A.D. SYLVESTER, C.E. TERHUNE, A.B. TAYLOR.

53 **Biology trumps mechanics: bone adaptation to exercise correlates more closely to bone marrow stem cell responsivity than peak forces.** J. RUBIN-SIGLER, G.M. PAGNOTTI, I.J. WALLACE.

54 **Combining data from multiple sources: A cautionary tale.** C.A. ROBINSON, C.E. TERHUNE.

55 **Black-mantled pacifists: Skeletal trauma in free-ranging** *Saguinus nigricollis***.** S.S. LEGGE, R. LUTHER, C. MAYER.

56 **The penalty for brawling: Patterns of healed skeletal trauma in free-ranging** *Saimiri sciureus***.** R.L. LUTHER, C. MAYER, S.S. LEGGE.

57 **How tough is the grey-cheeked mangabey: Patterns of trauma in *Lophocebus albigena*.** C. MAYER, R. LUTHER, S.S. LEGGE.

58 **Forgotten but not Lost: Utilising underused museum collections for research.** W. BIRCH, M. CLEGG, H. CHATTERJEE.

Session 30 **Human Skeletal Biology: Functional Studies**

Contributed Poster Presentations. Chair: David Agoada.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Trabecular bone density in recent modern humans.** H. CHIRCHIR, C.B. RUFF.

2 **Spatial Patterning (or lack thereof) in Osteon Population Density in the Human Rib.** T.P. GOCHA, V.M. DOMINGUEZ, A.M. AGNEW.

3 **Sealed osteons do not increase in the human femur with aging or in association with a total hip replacement.** M.S. DOUTRE, M.G. ADONDAKIS, R.D. BLOEBAUM, J.G. SKEDROS.

4 **Histological age determination using the micro-anatomy of 3rd metatarsal and metacarpal bones.** H. SMITH, R.R. PAINE, J.A. BYTHEWAY.

5 **Do disparities in ex vivo strain data for the human fibula reflect heterogeneous load conditions or limitations of experimental designs?** D.J. WEAVER, J.G. SKEDROS.

6 **Patterns of collagen fiber orientation in the human fibula middle-to-proximal diaphysis suggest a history of anterior-posterior bending and torsion consistent with "intermediate complexity" loading.** J.G. SKEDROS, K.E. KEENAN.

7 **Gape cycle kinematic variance and occlusal topography in modern humans.** M.F. LAIRD, H. PONTZER.

8 **Investigating the relationship between cranial superstructures and activity in modern humans.** A.M. TAYLOR, H.M. GARVIN.

9 **A 2D Geometric Morphometric Analysis of Changes in the Basicranium in Relation to Trunk Posture in Mammals.** A. PEÑA.

10 **Assessing the relationship between mandibular shape and endocranial volume.** S.E. EDLUND, J. UY, S.E. TRAYNOR, J. HAWKS.

11 **Ancestral and Sex Differences in the Posterior Nasal Aperture.** J. CONLEY, S. OUSLEY.

12 **A comparative analysis of upper limb cross-sectional properties in the Lake Mungo 3 skeleton from the Willandra Lakes, Australia.** E.C. HILL, O.M. PEARSON, A.C. DURBAND.

13 **Clavicle length and shoulder breadth in hominoid evolution.** N.M. LAUDICINA, M. CARTMILL.

14 **Obesity-related cross-sectional changes in the femur due to body proportion changes.** R.A. JOHNSTON, L.W. COWGILL.

15 **Three-dimensional finite element analysis of femoral neck stress.** P.A. KRAMER, A.D. SYLVESTER.

16 **Femoral bone remodeling comparisons between adult males and females from medieval England.** J.J. MISZKIEWICZ, C. BENNETT, S.E. JOHNS, P. MAHONEY.

17 **Size-related and Demographic Effects on the Morphology of the Lateral Meniscal Notch of the Proximal Tibia.** C. RUSSELL.

18 **Comparison of different quantitative data acquisition methods for the bony knee joint within the same sample.** S. MEYER, D. GASCHO, T. BÖNI, F. RÜHLI.

19 **Exploring the relationship between radiographic and osteologic measurements of the human talus.** D. AGOADA, P.A. KRAMER.

20 **Does a mobile foot become more rigid when walking?** S.G. LAUTZENHEISER, P.A. KRAMER.

21 **Plantar pressure distribution in Pacific Island and Malagasy populations: implications of variation for the interpretation of the fossil record.** R.E. WUNDERLICH.

22 **The effect of natural substrate inclination on foot strike position in a habitually unshod population.** E.K. BOYLE, D.M. BERNARDONI, A.L. SCHNEIDER.

23 **Variation in Lateral Plantar Process Position and Functional Implications in Living Humans.** Z.S. SWANSON, J.M. DESILVA, E.K. BOYLE, K.M. JOSEPH, E.J. MCNUTT.

24 **Social identity through the life-course at historical Middenbeemster: A biocultural approach.** C. CHILCOTE, S. AGARWAL.

25 **Integration of contextual information with bioanthropological data from skeletal collections.** F. ENGEL, S. SCHLAGER, S. DROTZIGER.

26 **Femoral angles and cross-sectional geometry across subsistence economies.** S.L. CHILD, L.W. COWGILL.

Session 31 **Skeletal Biology: Bioarchaeology**

Contributed Poster Presentations. Chair: Nicholas P. Herrmann.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Childhood diet at medieval (1240s AD) Solt-Tételhegy, Hungary as reconstructed from stable carbon and nitrogen isotope analyses.** A.D. GUGORA, T.L. DUPRAS, E. FÓTHI.

2 **How Diet Influences Mortality: Dietary reconstruction of epidemic and non-epidemic populations in 19th century Italy.** A.K. SMITH, L.J. REITSEMA, F.L. WILLIAMS, A. FORNACIARI, G. FORNACIARI.

3 **Fetal and infant health in prehistoric and colonial Ifugao.** A.N. FRANCOIS, A. LAUER.

4 **Nutritional change following social change in Illyria (modern Albania).** C.J. PFLEIDERER, B.R. KYLE.

5 **Isotopic profiling of diet, health, and mobility amongst the non-adult Gepid population buried at the Archuid Cemetery in Transylvania, Romania (4th – 7th centuries AD).** K.D. CROWDER, J. MONTGOMERY, K.L. FILIPEK-OGDEN, J. EVANS, D.R. GRÖCKE.

6 **Dietary trends in early medieval Croatia as evidenced by stable isotope analysis.** M. NOVAK, R. HOWCROFT, R. PINHASI, M. SLAUS.

7 **Subsistence and mobility at Morton Shell Mound (16IB3): Analysis of femoral cross-sectional properties.** S.M. ZALESKI, N.P. HERRMANN.

8 **Paleodiet of Rural and Urban Medieval English Populations: Further Studies of Extracting Stable Carbon and Nitrogen Isotopes from Dental Calculus.** E.A. CHAMBERLAIN, S.R. POULSON, C. DAVENPORT, C. BURRELL, S. GONZALEZ, G. SCOTT.

9 **Evidence of C_4 plant intake and dietary heterogeneity in Late Prehistoric burial populations of Spain and Portugal.** A.J. WATERMAN, P. DÍAZ-DEL-RÍO, R.H. TYKOT.

10 **Carbon and nitrogen stable isotope ratios of anadromous fish: Is there a distinctive isotopic signature?** C.M. HALFFMAN.

11 **Investigating heterogeneity in diet across early Iron Age assemblages from Slovenia using stable isotopes.** H.E. KOON, R.A. NICHOLLS.

12 **An examination of biological distance between Late Woodland and Mississippian individuals using non-metric dental trait analysis.** K. ZEJDLIK.

13 **Phenotypic variability, cemetery structure, and kinship in an early Iron Age mortuary complex at Wadi Fidan, Jordan.** A.R. HOFF, M.M. BEASLEY, C.M. STOJANOWSKI, T.E. LEVY.

14 **Morphological and genetic analysis of Nubian populations from the Early to Late Holocene.** K.A. SIRAK, M. GALLAND, D.M. FERNANDES, D.P. VAN GERVEN, R. PINHASI.

15 **A Bioarchaeological Approach to Ancient Maya Social Organization at Copan, Honduras using Biodistance and Radiogenic Strontium Isotope Analysis.** K.A. MILLER WOLF.

16 **On the edge of the empire: A craniometric analysis of group affinities from an Ottoman garrison in western Romania.** K.G. ALLEN, N. VON CRAMON-TAUBADEL.

17 **Biological relationships of the Early and Middle Neolithic of the Taiwan Strait using skulls and teeth.** A.J. LAUER.

18 **High terrestrial mobility is geographically widespread among southern African Later Stone Age populations.** M.E. CAMERON, J.T. STOCK.

19 **Bodies in motion: Isotopic analyses of mobility and diet at Marroquíes Bajos, Spain.** J. BECK, M. DÍAZ-ZORITA BONILLA.

20 **Sorting the fragments and assessing the relationships of the Ayioi Omoloyites tombs of Hellenistic to Roman Period Cyprus.** N.P. HERRMANN, D. PILIDES, Y. VIOLARIS.

21 **Cross-sectional geometry vs traditional indices: capturing tibial morphology as a means of studying mobility in the Nile Valley.** S.L. HACKNER, D. ANTOINE.

22 **Musculoskeletal Stress Markers of Humerii from Two Lower Mississippi Valley Populations: Implications for Subsistence-Based Activity Patterns.** B.M. THIBODEAUX.

23 **Asymmetric Femoral Torsion Among the Oneota of Illinois.** A. TREMBLAY, M. VERES.

24 **Does Industrialization Always Result in a Reduction in Skeletal Robusticity?** J.G. CLEMENTZ, A.L. MAGENNIS.

25 **Computerized cementochronology - taking the *(16)*bit between the teeth.** B. BERTRAND, J. RAMOS MAGALHAES, H. PHELIPPEAU, F. GERMAIN, S. NAJI, T. COLARD.

26 **Intentional Cranial Vault Modification and the Biomechanics of Head Balance.** J.E. ROTHWELL.

27 **Practical reality of taking semi-landmark data on archaeological human remains.** N. SEGUCHI, M. MURPHY, S. YONEMOTO, B. DUDZIK.

28 **Craniometric analysis of unaffiliated Native American remains from Texas.** C.C. SIEGERT, K. SPRADLEY, A. GOOTS, M.D. HAMILTON.

29 **Vertebral neural canal (VNC) diameters and their association with earlier age at death in a Medieval Polish population.** R.L. HUNTER, H.M. JUSTUS, A.M. AGNEW.

30 **Sex differences in dental caries in medieval Alkmaar, The Netherlands.** L. ZACHARY, S. INSKIP, A. WATERS, M. HOOGLAND.

31 **The influence of sex and allometry on subnasal prognathism in modern humans.** K.M. LESCIOTTO, L.L. CABO, H.M. GARVIN.

32 **Variation in human lower limb morphology and the relative influence of neutral and selective evolutionary processes.** M.B. RIVERA, L. BETTI, J.T. STOCK.

33 **Central Saharan Population History as Inferred from Postcranial Limb Proportionality.** R. BOOKMAN, C. STOJANOWSKI.

34 **The Degree of Limb Bones Asymmetry in Relation with Health and Environmental Stress in Medieval Lower Socioeconomic Society.** L. ČERVENKOVÁ, L. BIGONI, J. DUPEJ, P. VELEMÍNSKÝ, J. VELEMÍNSKÁ.

35 **Preliminary osteological analysis and stature estimates of adults in an early Medieval Prussian population at Bezławki, Poland.** M. RAMSIER, A. GRUENTHAL-RANKIN, A. KOPERKIEWICZ, M. POLCYN.

36 **Analysis of Long Bone Osteometrics in a Commingled Skeletal Sample from a High Altitude Site in the Ancient Peruvian Andes.** K. YARLAGADDA, T.A. TUNG.

37 **Coalition frequencies in the feet of modern Thai.** L.A. WINTERS, S.E. BURNETT, D. CASE, S. RUENGDIT, P. MAHAKKANUKRAUH.

38 **Bioarchaeology of the Wall of the Crow Cemetery, Giza: Changes in the Levels of Systemic Stress from the Saite to the Roman Period.** J.E. KAISER.

39 **Socioeconomic status, bioarchaeology, and space: Using ArcGIS to examine mortuary behavior in a medieval Italian cemetery.** M.C. STEWART, G. VERCELLOTTI, J.S. FIELD.

40 **Tracking adaptations in sexual dimorphism between subgroups of an historic population.** D.L. HARRISON.

41 **Sailors lost in time: A Pathological study of Dead Man's Island.** K.E. TSCHINKEL.

42 **Effects of X-ray microtomography on stable isotope values and sample quality.** L.E. CIRILLO, A.T. MACKINNON, J.R. PRINCE, E.J. BARTELINK, G.D. RICHARDS.

43 **Did Potters Urn? Potential Skeletal Evidence of Ceramic Production from the Ch'iji Jawira Site in Tiwanaku, Bolivia.** S.K. BECKER.

Friday, Afternoon sessions.

Session 32

In search of the last common ancestor: perspectives on the ancestral morphotype of hominins

Invited Podium Symposium. Chair: Scott A. Williams.
Co-organizers: Mark Grabowski.
Imperial Ballroom A.

Reconstructing the morphology and behavior of the last common ancestor (LCA) of hominins and our closest relatives has been a primary area of interest for anthropologists since the origins of the discipline. Darwin drew our attention to the African great apes, as did Huxley, and more explicitly, Weinert and Keith, but it was not until molecular studies on blood proteins and later phylogenetic studies placed humans firmly within the African ape clade that paleoanthropologists began to consider models based on great apes for reconstructing the LCA. In the interim period and ever since, various models based on lesser apes (hylobatids), Old World monkeys, and even more distantly related taxa (e.g., tarsiers) were proposed. Along with great ape models and even those based on living humans, these have often been proposed as "best extant models" and more rarely as "living fossils." Models based on extinct taxa represented by fossils have also been proposed. These include various Miocene hominoids, such as *Ramapithecus* (now recognized as female *Sivapithecus*), *Kenyapithecus*, and *Proconsul*, and more recently, new species such as *Pierolapithecus* and *Orrorin*, and are often reliant on the interpretation of partial skeletons and fragmentary remains. It is of primary importance to recognize that each taxon, extant and extinct, is derived in various ways and therefore does not represent the primitive condition, although some may be argued to approximate it in some cases. Finally, within the extant great ape category, orangutan, gorilla, chimpanzee, bonobo, and more generalized "African great ape" models have each been favored (and criticized) over the years. This symposium provides a historical perspective on these models and at the same time explores new models and new data, including recent fossil, skeletal, behavioral, and theoretical advances.

1:00 **Elucidating the evolutionary pathways of hominoid and hominin basicranial morphology using a formal phylogenetic comparative primate approach.** G.A. RUSSO, E. KIRK, J.B. SMAERS.

1:15 **The evolutionary history of the hominin cervical vertebral column.** T.K. NALLEY, N. GRIDER-POTTER.

1:30 **Standing on the shoulders of apes: evidence for the hominin ancestral morphotype from the limbs and girdles.** N.M. YOUNG.

1:45 **The hominoid wrist and the role of developmental perspectives on inferring homoplasy.** P.L. RENO, K.M. KJOSNESS.

2:00 **The foot of the last common ancestor of humans and chimpanzees.** J.M. DESILVA, B. ZIPFEL.

2:15 **The enigmatic Burtele partial foot: further evidence for middle Pliocene hominin locomotor diversity.** Y. HAILE-SELASSIE.

2:30 **Body shape and hominin origins.** C.V. WARD, E.R. MIDDLETON.

2:45 **Models for, and predictions about, the head, neck, pectoral and upper limb musculature of the last common ancestor of hominins, and notes on the myth of human morphological complexity.** R. DIOGO, J. MOLNAR, B. WOOD.

3:00 **Frontal plane trunk mechanics in humans and chimpanzees, and implications for the bipedal gait of the last common ancestor.** N.E. THOMPSON, B. DEMES, M.C. O'NEILL.

3:15 **Implications of the interpretation of homoplasies in *Oreopithecus* and other Miocene ape genera for elucidating the chimpanzee-human LCA.** J. CARLSON.

3:30 **Mosaic and homoplastic evolution of the hominoid skeleton precludes 'overall' ancestral reconstructions based on single-taxon models.** S. ALMÉCIJA, S. MOYÀ-SOLÀ, D.M. ALBA, A.S. HAMMOND, M. TALLMAN, W.L. JUNGERS.

3:45 **Is the chimpanzee a living fossil?** D.R. BEGUN.

4:00 **Discussion: Scott Williams and Mark Grabowski.**

Session 33 **Allomother-infant relationships across the Primate order: biomarkers, bonding, buffering, and other bidirectional effects**

Invited Podium Symposium. Chair: Stacy Rosenbaum.
Co-organizers: Lee Gettler.
Imperial Ballroom B.

Advances in molecular genetics and endocrinology have meaningfully broadened anthropologists' understanding of the role that social partners other than mothers have on infant survival, growth, and development, and the effects that infants have on their allomaternal (sub)adult social partners. Understanding the fitness consequences of such relationships is crucial for modeling primate life histories and social group structure. The goal of this symposium is to bring together work that incorporates behavioral and biomarker data to better understand proximate and ultimate causation of the complex, oft-overlooked relationships that occur between infants and their allomaternal caretakers. Participants use a range of methods to address questions from a comparative perspective, providing insight into the range of behaviors that occurs in the Primate order and the functional consequences of such variation.

1:00 **Profiling caregivers: hormonal variation underlying allomaternal care in wild red-bellied lemurs.** S.R. TECOT, J. COSTANZO, E. EADIE, C. HAWLEY, S. RAZANAJATOVO, A.S. ARROYO, A.L. BADEN.

1:15 **Father's parenting style influences infant development in common marmosets, *Callithrix jacchus*.** T.E. ZIEGLER.

1:30 **Could male *Colobus vellerosus* be using behavioural cues to estimate paternity?** S.A. FOX, E.C. WIKBERG, J. VAYRO, N.D. SIMONS, M.J. RUIZ-LOPEZ, A. CROTTY, D. CHRISTIE, E. POTVIN-ROSSELET, N. TING, P. SICOTTE.

1:45 **Dads *and* cads? Male reproductive success, androgen profiles, and male-infant social bonds in wild mountain gorillas (*Gorilla beringei beringei*).** S. ROSENBAUM, J. HIRWA, L. VIGILANT, R. SANTYMIRE, T.S. STOINSKI.

2:00 **Infant handling and urinary oxytocin in sub-adult bonobos (*Pan paniscus*): support for the learning to mother hypothesis.** K.J. BOOSE, F.J. WHITE, E. SQUIRES, A. MEINELT, J.J. SNODGRASS.

2:15 **Men's reproductive ecology and diminished hormonal regulation of skeletal muscle phenotype: An analysis of between- and within-individual variation among rural Polish men.** L.C. ALVARADO, M.N. MULLER, M. EMERY THOMPSON, M. KLIMEK, I. NENKO, G. JASIENSKA.

2:30 **Hormones and behavior in same-sex male parents: implications for the evolution of paternal care in humans.** E.E. BURKE, R.G. BRIBIESCAS.

2:45 **Early Life Social Influences on Men's Testosterone & Parenting Behavior.** M.S. SARMA, C.W. KUZAWA, A.B. FERANIL, L.T. GETTLER.

3:00 **The impact of a natural disaster on physical and mental health: Offspring morbidity and crop loss as mediators of paternal testosterone, cortisol, and depression among Bolivian forager-farmers.** B.C. TRUMBLE, J. STIEGLITZ, A. JAEGGI, B. BEHEIM, M. SCHWARTZ, H. KAPLAN, M. GURVEN.

3:15 **Paternal investment and child well-being in two small-scale human societies.** C.R. VON RUEDEN, T. BROESCH.

3:30 **Cooperative Breeding and the Costs and Benefits of Infant Allocare in Hunter-Gatherers and Agriculturalists.** K.L. KRAMER, A. VEILE.

3:45 **Discussion: James McKenna.**

4:00 **Break.**

Session 34 **Human Biology: Nutrition and Variation**

Contributed Podium Presentations. Chair: Pablo A. Nepomnaschy.
A 703/704.

1:00 **The Financial Hunter-Gatherer: How do Foragers Diversify their Dietary Portfolios?** E.R. OTÁROLA-CASTILLO, R.D. GREAVES, T.S. KRAFT, A.J. VEILE, V.V. VENKATARAMAN, K.L. KRAMER.

1:15 **Physical activity, sedentary behavior and pubertal maturation among the Tsimane'.** A.E. CALDWELL HOOPER, P.L. HOOPER.

1:30 **Physical activity and anthropometry effects on bone turnover biomarkers in rural Polish women.** K.M. LEE, M.P. ROGERS, A. GALBARCZYK, G. JASIENSKA, J.D. POLK, K.B. CLANCY.

1:45 *E. coli* **exposure, intestinal barrier function and immune health in Galapagos, Ecuador.** K.M. HOUCK, A.L. THOMPSON, M.V. SORENSEN.

2:00 **Sleep duration, quality and timing in a non-electric population in Madagascar.** D.R. SAMSON, M. MANUS, C.L. NUNN.

2:15 **The role of obesity on water intake and hydration status in U.S. adults: 2009-2012.** A. ROSINGER, C. OGDEN.

2:30 **Reproductive History and the Pace of Aging in Women.** P.A. NEPOMNASCHY, C.K. BARHA, K.G. SALVANTE.

2:45 **Sitting, squatting, and the evolution of human inactivity.** D.A. RAICHLEN, H. PONTZER, J.A. HARRIS, T.W. ZDERIC, M.T. HAMILTON, B.M. WOOD.

3:00 **Multivariate asymmetry in the femur as a basis for "pair-matching".** A.B. LEE, L.W. KONIGSBERG.

3:15 **Procrustes-based vector-moving average models allow patterns of motion to be statistically distinguished.** K.J. SODA, P.H. MORRIS, D.E. SLICE.

3:30 **The sex difference in depression is explained by the sexual dimorphism in upper body strength.** E.H. HAGEN, T. ROSENSTRÖM.

3:45 **Anthropologists under pressure: perceptions of stress, conflict and support in the pursuit of career-family balance.** M. HOWELLS, C. LYNN, B. HALL.

4:00 **Break.**

Session 35 **Paleoanthropology: Methods**
Contributed Podium Presentations. Chair: Michael J. Plavcan.
A 706/707.

1:00 **Statistical Analysis of 3D Measurements: A Look into the World of Pleistocene Hand Modeling.** S.E. LOVE.

1:15 **Using geometric morphometric visualizations of directional selection gradients to investigate morphological differentiation.** T.D. WEAVER, P. GUNZ.

1:30 **Asymmetry of Broca's cap using GIS.** L.M. RUCK, K.H. MACDOWELL, R.L. HOLLOWAY, D.C. BROADFIELD.

1:45 **Craniodental versus postcranial variables as estimators of body mass in extinct taxa.** J. PLAVCAN, A.D. GORDON.

2:00 **Examining the fundamental niche parameters of Neanderthals and Modern Humans in Iberia.** R.C. BIBLE.

2:15 **Super-ordination is a simple method to build consensus from alternative taxonomic ordinations.** J.J. MAGARO, T.J. DEWITT.

2:30 **Hominin Taxic Diversity: Fact or Fantasy?** B. WOOD, E. BOYLE.

2:45 **The paleontology "connectome" project: Predicting the location of fossiliferous sediments using Remote Sensing (RS) and Geographical Information System (GIS) techniques.** G.C. CONROY, G.F. GUNNELL, R.L. ANEMONE.

3:00 **Spatial taphonomic reconstruction of the Dinaledi Chamber, Rising Star Cave, by the use of high resolution three-dimensional modalities lends support to the deliberate disposal of hominin remains.** A. KRUGER, P. RANDOLPH-QUINNEY, J. HAWKS, P. DIRKS, E. ROBERTS, M. ELLIOTT, L. BERGER.

3:15 **The deposits of Jacovec Cavern, Sterkfontein: A high resolution application of sedimentological analyses for palaeanthropological studies.** S.S. MAVUSO, D.J. STRATFORD.

3:30 **Forensic Residue Analysis at Olduvai Gorge, Tanzania: Methodological Challenges in the Study of Tool Use and Diet 1.8-1.3Ma.** J. MERCADER, P. CHRISTAKIS, J. FAVREAU, S. IKAYO, M. ITAMBU, P. LEE, R. PATALANO, L. TUCKER.

3:45 **Establishing Philopatry and Home Range Size with Strontium Isotopes: An Extant Model from Kibale National Park.** M.I. HAMILTON.

4:00 **Isotopic variability in chimpanzee and baboon plant foods at Gombe National Park, Tanzania.** R.S. NOCKERTS, R.C. O'MALLEY, M.L. WILSON, D.L. FOX, D. COLLINS.

4:15 **Break.**

Session 36 **Migration: An anthropological perspective**
Invited Poster Symposium. Chair: Lorena Madrigal.
Co-organizers: Lorena Madrigal and Rachel Caspari
A 701.

Migration has always been a critical part of the human condition, with far reaching biological and cultural consequences. As a major driver of gene flow, migration is a fundamental evolutionary force, the conduit of continuing evolutionary change in human and non-human primate species. The cultural impacts of migration and the biocultural interactions it promotes have always had a profound effect; however, the volume and impact of migration today are historically unprecedented. As environmental and political turmoil force displaced peoples across political borders, we are witnessing global problems with political, environmental, legal, ethical, medical, cultural, educational, linguistic implications, to name only a few. Anthropology, with its holistic, biocultural approach, can provide unique perspectives to the current crises by contextualizing migration within the broader human experience while bringing attention to the lived experiences of migrants and the ecological and social impacts of migration. In an effort to extend a hand of solidarity across associations, and honoring anthropology's holistic perspective, the AAA and the AAPA are pleased to sponsor a symposium, which brings to the AAPA a variety of anthropological perspectives on migration and contributions from experts who would not usually attend these meetings. The organizers of the symposium and its participants

hope to explore not only how anthropology has studied migration but also how anthropology may offer real world answers to policy makers. We hope to encourage holistic studies on migration so that anthropology is visible and relevant in the public arena. Precisely because we see migration from such a multitude of perspectives, anthropologists should be part of governmental and non-governmental entities which seek to mitigate its associated problems. Our associations should join forces to educate the public and policy makers on how we understand and can contribute to alleviate these problems.

12:45 – 1:00 Poster set-up/ 4:45 – 5:00 Poster take down

1:00 **Introduction: Lorena Madrigal.**

3:30 **Discussion: Edward Liebow.**

1 **The Importance of Culture and Biology in the Analysis of Contemporary Migration: Approaching stress among Latino immigrants to Columbus, Ohio.** J.H. COHEN, D.E. CREWS.

2 **Nonhuman Primate Migration: Phylogeny, Demography, and Social Consequences of Dispersal.** K.B. STRIER.

3 **Dynamic contact: examining histories of migration, hunting, and conflict at the human-nonhuman primate interface.** C.A. JOST ROBINSON.

4 **Dispersal, constraint, and the evolutionary niche of early *Homo*.** A.P. VAN ARSDALE.

5 **Tracking hominin mobility in late Pleistocene Central Asia with an agent based approach.** E. HATCHER, M. GLANTZ, A. BLISS, R. BOONE.

6 **Causes and evolutionary consequences of human migration: Anthropological genetic perspectives.** M.H. CRAWFORD, K.G. BEATY.

7 **Human Migration Across the US/Mexico Border.** L.E. BAKER.

8 **Life, Death, and Time: Rethinking the Social Process of Undocumented Migration in the 21st Century.** J. DE LEÓN.

Session 37 **The suite with many names: An exploration of "market integration" and its effects on human biology, health, and behavior**

Invited Poster Symposium. Chair: Anne C. Pisor.

A 705.

For almost three decades, human biologists and increasingly, human behaviorists have been mapping how changes in a suite of phenomena -- alternatively called acculturation, globalization, market integration, social change, and urbanization -- impact health and behavior, from heart disease and chronic stress to cooperation and family structure. While this suite, called "market integration" here for brevity, has a great deal of predictive power, research on the subject is difficult to amalgamate due to a lack of shared terminology and methodology, further compounded by limited communication between human biologists and behaviorists. Addressing how these approaches intersect can pave the way for cross-population comparisons of the processes of market integration and associated outcomes. This symposium begins the conversation by asking, first, what is the state of knowledge on market integration, in terms of its impact on both human biology and behavior? Second, how do we arrive at a working definition of market integration? Though researchers tend to utilize locally appropriate measures that have predictive power within their study populations, those that are not predictive in a given context can be equally informative for comparative work. Third, do aggregate measures of market integration predict different outcomes than more fine-grained measures? For example, market integration measured at the population- or community-level may have different effects on health and behavior than market integration measured at the household- or individual-level. This symposium unites human biologists and behaviorists working under a variety of terminologies to detail how market integration affects health, physiology, and behavior in transitioning populations around the globe. We will address the above questions and discuss how to best foster cross-population comparisons of market integration and its effects on biology and behavior.

12:45 – 1:00 Poster set-up/ 4:45 – 5:00 Poster take down
Poster visiting and Q & A 2:35 - 3:00

1:00 **Discussion: Josh J. Snodgrass.**

1:15 **Poster Synopses.**

3:00 **Discussion: William Dressler.**

3:15 **Roundtable discussion.**

1 **Levels of Analysis: What unit is the most appropriate for understanding the effects of market integration?** S.M. MATTISON, B. BEHEIM.

2 **From foraging to Facebook: Market integration and health among the Shuar of Southeastern Ecuador.** L.S. SUGIYAMA, M.A. LIEBERT, F.C. MADIMENOS, A.D. BLACKWELL, S.S. URLACHER, T.J. CEPON-ROBINS, T. GILDNER, R.G. BRIBIESCAS, J.J. SNODGRASS.

3 **The embodiment of market integration: Modeling cultural consonance among Shuar children of Amazonian Ecuador.** M.A. LIEBERT, F.C. MADIMENOS, S.S. URLACHER, T.E. GILDNER, T.J. CEPON-ROBINS, J. SNODGRASS, L.S. SUGIYAMA.

4 **Influence of acculturation and lifestyle change on metabolic health among the Sakha (Yakut) of Northeastern Siberia.** H.J. WILSON, W.R. LEONARD, S.B. LEVY, J.J. SNODGRASS, L.A. TARSKAIA, T.M. KLIMOVA, V.I. FEDOROVA, M.E. BALTAKHINOVA.

5 **Valid/relevant correlates and meaningful outcomes: How has market integration affected the Toba/Qom of Argentina.** C.R. VALEGGIA.

6 **Is market integration associated with physical, mental, and social wellbeing among Ethiopian young adults? It all depends on the measure.** C. HADLEY.

7 **Market integration and out-group valuation among three horticultural populations: The effect depends on the measure.** A.C. PISOR, M. GURVEN.

8 **Mechanisms of collective action in transitioning economies: A case study from the Peruvian Altiplano.** C. MOYA.

Session 38

Innovative approaches to human brain evolution: molecules to systems

Invited Poster Symposium. Chair: Todd M. Preuss.

Co-organizers: Todd M. Preuss, Daniel J. Miller, Aida Gomez-Robles, and Chet C. Sherwood.

Atrium Ballroom C.

The pronounced diversity of primate behavior reflects variation in the structure and function of the brain as it is shaped throughout life by selective pressures acting at multiple levels of organization. Recent years have witnessed the development of novel methods that are now transforming our ability to relate primate neurobiological evolution to processes underlying human behavior. Specifically, contemporary tools to investigate the brain at the molecular, cellular and systems levels of organization provide data to complement results from comparative analyses of the fossil record to deepen our understanding of the human phenotype. In particular, cutting-edge tools have revolutionized our understanding of the relationship between the brain and behavior, from correlated changes in molecular networks to the neural circuits underlying the emergence of tool manufacturing and language. Indeed, work from multiple levels of organization substantiates the stark contrast between the seemingly modest changes in DNA but striking behavioral differences observed in humans relative to our closest extant relatives. Accordingly, this symposium's multidisciplinary investigations of human brain evolution impact a variety of topics of interest in primate behavior. Specific contributions to the symposium address important aspects of human brain evolution and include studies of development, allometry, gene expression, social interaction and anatomical reorganization using approaches drawn from genomics, proteomics, neuroimaging, multivariate morphometrics and quantitative phylogenetic analysis. This symposium serves to demonstrate the efficacy of interdisciplinary research focused on the evolution of the human brain to deepen our understanding of human behavior and suggests novel approaches capable of furthering our knowledge of other critical aspects of hominin evolution.

12:45 – 1:00 Poster set-up/ 4:45 – 5:00 Poster take down
Odd numbered poster authors present 2:00 -2:30; Even numbered poster authors present 2:30 – 3:00

3:30 **Discussion: Leslie Aiello.**

1 **Comparative approaches to human brain evolution: New methods, resources, and discoveries.** T.M. PREUSS.

2 **Evolution of human-specific gene coexpression networks in neocortex.** G. KONOPKA.

3 **Evolution of human language circuits revealed with comparative diffusion tensor imaging.** J.K. RILLING.

4 **Neurodevelopmental disorders as models for developmental interactions between brain and skull in human evolution.** K. ALDRIDGE, J.R. AUSTIN, C.A. HILL, J.T. RICHTSMEIER.

5 **Evolutionary neurocartography: mapping sensory system organization in human brain evolution.** D.J. MILLER, R. BIJLANI, J.H. KAAS.

6 **Brain evolution and the evo-devo of endocranial shape.** P. GUNZ, B. DREWS, S. NEUBAUER, N.A. SCOTT, T. HILDEBRANDT, J. HUBLIN.

7 **A comparison of high-throughput genomic and proteomic techniques in quantitative molecular analyses of primate brain.** A.L. BAUERNFEIND.

8 **From action perception to toolmaking: adaptations to fronto-parietal circuits in human brain evolution.** E.E. HECHT, D. STOUT, T.M. PREUSS.

9 **The neural correlates of multimodal communication in chimpanzees** *(Pan troglodytes) and bonobos (Pan paniscus)* **and their implications for the evolution of human language.** J.P. TAGLIALATELA.

10 **Brain size evolution in primates - testing effects of social vs. ecological complexity.** C. VAN SCHAIK, S.M. GRABER, C. SCHUPPLI, S.A. HELDSTAB, K. ISLER.

11 **The heritability and plasticity of chimpanzee and human brain asymmetry.** C.C. SHERWOOD, W.D. HOPKINS, S.J. SCHAPIRO, A. GÓMEZ-ROBLES.

12 **Why Paleoneurology Needs the Lunate Sulcus.** R.L. HOLLOWAY, P.T. SCHOENEMANN, D.C. BROADFIELD.

13 **An ALE meta-analysis of shared and unique neural activation in the human brain during speech production and tool-use.** L.D. REYES, S. BIANCHI, C.C. SHERWOOD.

14 **The social brain in human evolution: neuron density in the prefrontal cortex in Williams Syndrome.** C.F. HORTON, C. BROWN, U. BELLUGI, K. SEMENDEFERI.

15 **Increased dopaminergic innervation of the medial caudate nucleus in humans: implications for the evolution of speech and language.** M. RAGHANTI, M.K. EDLER, A.R. STEPHENSON, L.J. WILSON, W.D. HOPKINS, J.J. ELY, J.M. ERWIN, B. JACOBS, P.R. HOF, C.C. SHERWOOD.

16 **Co-variation in the maturational timing of cortical GABAergtic interneurons and pyramidal neurons in primate brain evolution** C.J. CHARVET, S.J. MONGOLD, F.M. KRIENEN, C.C. SHERWOOD.

17 **Reorganization of Temporal Association Cortico-cortical Connectivity in Hominoids.** K.L. BRYANT, L. LI, T.M. PREUSS.

18 **Brain function and Broca's Cap: A meta-analysis of fMRI studies.** P. SCHOENEMANN, R.L. HOLLOWAY.

Saturday, Morning sessions.

Session 39

Biology and context of *Homo naledi* from the Rising Star cave system, South Africa

Invited Podium Symposium. Chair: John Hawks.
Co-organizers: John Hawks and Lee R. Berger.
Imperial Ballroom A.

Hominin remains were discovered in October, 2013 within the Rising Star cave system, inside the Cradle of Humankind World Heritage Site, South Africa, within a remote chamber of the cave system, named the Dinaledi Chamber, presently accessible only through a narrow vertical shaft. Lee Berger organized excavations with a skilled team of archaeologists and support of local cavers, which have to date uncovered 1550 hominin skeletal specimens. In May and June, 2014, the University of the Witwatersrand held a workshop to analyze these remains, bringing together 35 early career scientists grouped with mentors to prepare initial description and taxonomic assessment of the remains. The hominin remains from Rising Star represent a minimum of 15 individuals of a previously undiscovered hominin species, which has been named *Homo naledi*. At the time of submission of this symposium, the age of the Dinaledi fossil deposit is unknown. This symposium reports results from the Rising Star workshop and subsequent work undertaken by the team. The papers include detailed description of the skeletal biology of *Homo naledi* focusing on the functional and phylogenetic implications of each region of the skeleton: cranium, dentition, upper limb, hand, trunk, pelvis, lower limb and foot. Study of the sample has illuminated aspects of population biology, adaptation, and growth and development, and the geological and taphonomic context of the Dinaledi Chamber. This is a comprehensive initial description of the biology of a new hominin species, and all papers present new and (at the time of submission) unpublished material by early career first authors. The discussion period in the symposium will allow additional coverage of the design of the excavation and workshop, and will provide flexibility to describe findings on new skeletal material and geological context of the Rising Star site that may emerge after the abstract submission deadline.

8:00 **Geological and taphonomic context of excavations within the Rising Star cave system.** M.C. ELLIOTT, P.H. DIRKS, L.R. BERGER, E.M. ROBERTS, J.D. KRAMERS, J. HAWKS, P.S. RANDOLPH-QUINNEY, C.M. MUSIBA, S.E. CHURCHILL, D.J. DE RUITER, P. SCHMID, L.R. BACKWELL, G.A. BELYANIN, P. BOSHOFF, K. HUNTER, E.M. FEUERRIEGEL, A. GURTOV, J.D. G HARRISON, R. HUNTER, A. KRUGER, H. MORRIS, B. PEIXOTTO.

8:15 **Skull diversity within the *Homo* lineage and the relative position of *Homo naledi*.** L. SCHROEDER, J.E. SCOTT, H.M. GARVIN, M.F. LAIRD, M. DEMBO, D. RADOVČIĆ, L.R. BERGER, D.J. DE RUITER, R.R. ACKERMANN.

8:30 **Metric and nonmetric features of the *Homo naledi* dentition.** L.K. DELEZENE, J.K. BROPHY, M.M. SKINNER, A.N. GURTOV, J. HAWKS, J.D. IRISH, L.R. BERGER, D.J. DE RUITER.

8:45 **Enamel-dentine junction morphology and enamel thickness of the Dinaledi dental collection.** M.M. SKINNER, A.L. LOCKEY, P. GUNZ, J. HAWKS, L.K. DELEZENE.

9:00 **The shoulder and upper limb of Homo naledi.** E.M. FEUERRIEGEL, D.J. GREEN, C.S. WALKER, P. SCHMID, J. HAWKS, L.R. BERGER, S.E. CHURCHILL.

9:15 **Functional interpretation of the Homo naledi hand.** T.L. KIVELL, A.S. DEANE, M.W. TOCHERI, C.M. ORR, P. SCHMID, J. HAWKS, L.R. BERGER, S.E. CHURCHILL.

9:30 **Primitive pelvic features in a new species of *Homo*.** C. VANSICKLE, Z.D. COFRAN, D. GARCIA-MARTINEZ, S.A. WILLIAMS, S.E. CHURCHILL, L.R. BERGER, J. HAWKS.

9:45 **The axial skeleton and scaling of the trunk in Homo naledi.** S.A. WILLIAMS, D. GARCÍA-MARTÍNEZ, M.R. MEYER, S. NALLA, P. SCHMID, J. HAWKS, S.E. CHURCHILL, L.R. BERGER, M. BASTIR.

10:00 **Break.**

10:15 **Thigh and leg remains of Homo naledi.** D. MARCHI, C.S. WALKER, P. WEI, T.W. HOLLIDAY, S.E. CHURCHILL, L.R. BERGER, J.M. DESILVA.

10:30 **Relative length of the immature *Homo naledi* tibia U.W. 101-1070: evidence for elongation of the leg.** C.S. WALKER, J.M. DESILVA, T.W. HOLLIDAY, D. MARCHI, H.M. GARVIN, Z. COFRAN, J. HAWKS, L.R. BERGER, S.E. CHURCHILL.

10:45 ***Homo naledi* strides again: preliminary reconstructions of an extinct hominin's gait.** Z. THROCKMORTON, W.E. HARCOURT-SMITH, K. CONGDON, B. ZIPFEL, J. DESILVA, C. VANSICKLE, S. WILLIAMS, M. MEYER, T. PRANG, C. WALKER, D. MARCHI, D. GARCIA-MARTINEZ, S. CHURCHILL, J. HAWKS, L. BERGER.

11:00 **Body size and sexual dimorphism in *H. naledi*.** H.M. GARVIN, M.C. ELLIOTT, L.K. DELEZENE, J.D. HAWKS, S.E. CHURCHILL, L.R. BERGER, T.W. HOLLIDAY.

11:15 **Assessment of life stages of the individuals at Rising Star.** D.R. BOLTER, Z. COFRAN, C.S. WALKER, M.M. SKINNER, B. BOGIN, N. CAMERON, L.R. BERGER, J. HAWKS.

11:30 **Discussion: Darryl de Ruiter and Steve Churchill.**

Session 40 **Population Genetics: Human and Non-Human Primates**
Contributed Podium Presentations. Chair: Christina Warinner.
A 602.

8:00 **A new *Cheirogaleus* (Cheirogaleidae) species from Ankarana, Madagascar.** A.T. MCLAIN, R. LEI, C.L. FRASIER, J.M. TAYLOR, C.A. BAILEY, S.E. ENGBERG, A.L. GINTER, S.D. NASH, R. RANDRIAMAMPIONONA, C.P. GROVES, R.A. MITTERMEIER, E.E. LOUIS, JR..

8:15 **No evidence for genomic convergence between true echolocating mammals and the aye-aye (Daubentonia madagascariensis), a primate percussive foraging and auditory specialist.** R.J. BANKOFF, B. HOHMAN, E. LAUTERBUR, L. KISTLER, G. PERRY.

8:30 **Using ancient DNA from museum specimens for phylogenetic correction to interpret island dwarfing in *Macaca fascicularis*.** L. YAO, H. LI, R.D. MARTIN, R.S. MALHI.

8:45 **Neurophysiological differences between hamadryas and anubis baboons are maintained by natural selection.** C.M. BERGEY, J.E. PHILLIPS-CONROY, T.R. DISOTELL, C.J. JOLLY.

9:00 **The application of gene tree-based phylogenetic methods to primate morphological data sets.** M.E. STEIPER, E.E. GUEVARA, K.D. PUGH.

9:15 **Mating asymmetry in the formation of the Kinda x chacma baboon hybrid zone.** M.M. MCDONALD, J. PHILLIPS-CONROY, C.J. JOLLY.

9:30 **Loss of MHC immunogenetic diversity in bonobos (*Pan paniscus*) .** E.E. WROBLEWSKI, L.A. GUETHLEIN, Y. LI, C. SHAW, S. AHUKA-MUNDEKE, M. PEETERS, B.H. HAHN, P. PARHAM.

9:45 **Genetic Variation between the Population of the Ancient Xiongnu and Modern Populations in Central Mongolia.** L.L. ROGERS, T. D., F. KAESTLE.

10:00 **Break.**

10:15 **Archaeogenomic analysis of ancient Anatolians: first genetic indication for Neolithic cultural diffusion in the Near East.** M. SOMEL, G.M. KILINC, F. OZER, A. OMRAK, R. YAKA, M. DONERTAS, N.D. DAGTAS, E. YUNCU, D. KOPTEKIN, A.M. BÜYÜKKARAKAYA, S.C. AÇAN, C. ALKAN, I. HODDER, S. HADDOW, C. KNÜSEL, C.S. LARSEN, Y.S. ERDAL, E. BICAKCI, D. BAIRD, M. JAKOBSSON, I. TOGAN, A. GÖTHERSTRÖM.

10:30 **Ancient DNA and isotope analyses from Misión Salesiana, Tierra del Fuego.** A.C. STONE, J.M. MOTTI, K. HARKINS, P. GARCÍA LABORDE, L.O. VALENZUELA, M. CUELLO, M.A. NIEVES COLÓN, J.E. BUIKSTRA, C.M. BRAVI, R.A. GUICHÓN.

10:45 **Reconstructing the Population Genetics of Hakkari Mountains: A mtDNA Study of Assyrian Highlanders.** M. SHAMOON POUR, N. AL-JELOO, D. MERRIWETHER.

11:00 **Allele Sharing between Archaic and Modern Humans.** A.R. ROGERS, R.J. BOHLENDER.

11:15 **Long-term genetic stability and a high altitude East Asian origin for the peoples of the high valleys of the Himalayan arc.** C. JEONG, A.T. OZGA, D. WITONSKY, H. MALMSTROM, M. JAKOBSSON, C.M. LEWIS, M. ALDENDERFER, A.D. RIENZO, C. WARINNER.

11:30 **Cultural and Demographic Influences on Native American mtDNA Diversity in the Southern United States.** A.T. MIRÓ-HERRANS, M. BRIGGS-CLOUD, A. SYLESTINE, D.A. BOLNICK.

11:45 **Using coalescent simulation to understand the bias inherent in maximum likelihood estimation of ancestry proportions.** A.J. KOEHL, J.C. LONG.

Session 41 **Primate evolution and taxonomy**
Contributed Podium Presentations. Chair: Andrew S. Deane.
A 703/704.

8:00 **Dietary inference from P_4 topography in prosimians.** D. DE VRIES, J.M. WINCHESTER, E.M. ST CLAIR, D.M. BOYER.

8:15 **Canine sexual dimorphism in "*Micropithecus*" *leakeyorum* from Maboko Island, Kenya and other African Miocene small-bodied non-cercopithecoid catarrhines.** B.R. BENEFIT, M.L. MCCROSSIN, E. DAVIS.

8:30 **Phenotypic integration of the cranium and face in fossil Cercopithecidae with implications for interpreting species in the Old World Monkey fossil record.** T.A. MONSON, M.F. BRASIL, D.J. STRATFORD, L.J. HLUSKO.

8:45 **A phylogenetic hypothesis of fossil colobine relationships.** S.L. CARNATION.

9:00 **A reevaluation of taxonomic divisions within South African *Parapapio*.** M.F. BRASIL, T.A. MONSON, D.J. STRATFORD, L.J. HLUSKO.

9:15 **Another partial skull from the early Miocene: the first cranial fragments associated with both upper and lower dentition of *Limnopithecus legetet*.** R.J. JANSMA, K.P. MCNULTY, H.M. DUNSWORTH, W.E. HARCOURT-SMITH, K.E. JENKINS, T. LEHMANN, D.J. PEPPE.

9:30 **Taxonomic affinities of catarrhine capitates from Songhor, early Miocene, Kenya.** C. WUTHRICH, C.M. ORR, B.A. PATEL, I.O. NENGO.

9:45 **A hominoid-like femur from the late Oligocene of Kenya.** A.S. HAMMOND, E.R. SEIFFERT.

10:00 **Break.**

10:15 **Mathematical model of spinal curvature: implications to human evolution.** E. BEEN, A. GÓMEZ-OLIVENCIA, P. KRAMER, M. ARLEGI, A. BARASH, Y. RAK.

10:30 **Characterizing differences in seminal plasma proteomes among hominids.** A.M. COLVIN, J.A. THOMAS, P. CHOVANEC, P. BASU, M.I. JENSEN-SEAMAN.

10:45 **A primate viewpoint on mandibular reduction in *Homo*: the impact of allometry and encephalisation.** A. VENEZIANO, C. MELORO, J.D. IRISH, C. STRINGER, I. DE GROOTE.

11:00 **A fully terrestrial lifestyle allowed humans to become both fat and smart: Comparative evidence.** S.A. HELDSTAB, C. VAN SCHAIK, K. ISLER.

11:15 **Looking for suspensory apes and climbing hominins (in all the wrong places): Evaluating multivariate approaches to inferring fossil hominoid locomotor behavior from manual phalangeal shaft length and curvature.** A.S. DEANE.

11:30 **Cranial contrasts: thin ideas about vault bone thickness in LB1 and robust inferences about Down syndrome diagnosis.** M. HENNEBERG, S. CHAVANAVES, R.B. ECKHARDT.

11:45 **Dinaledi Chamber hominins do not support hypothesis of early African *Homo* ancestry for "Homo floresiensis" taxon based on LB1 specimen.** R.B. ECKHARDT, S. CHAVANAVES, A.N. KUKOROWSKI, M. HENNEBERG.

Session 42 **Human Biology: Growth, Reproduction and Adaptation**
Contributed Podium Presentations. Chair: Kathryn B.H. Clancy.
A 706/707.

8:00 **Prenatal androgen exposure (2D:4D) and its relationship to early growth and adult reproductive effort in men from Cebu, The Philippines.** A.V. GEORGIEV, C.P. RYAN, L.T. GETTLER, T.W. MCDADE, C.W. KUZAWA.

8:15 **Does puberty influence systolic blood pressure independent of the effects of adolescent growth and body size?** B.I. STRASSMANN, C.S. SMITH, C. VINCENZ.

8:30 **Environmental factors associated with luteal phase endometrial thickness in a sample of rural Polish women.** K.B. CLANCY, M.P. ROGERS, K.M. LEE, A. GALBARCZYK, G. JASIENSKA.

8:45 **Strategic trade-offs between immune and reproductive functions during the ovarian cycle: Empirical tests of an evolutionary hypothesis.** V.J. VITZTHUM, T.K. LORENZ, J. THORNBURG, C.M. WORTHMAN.

9:00 **Paternal age at conception predicts offspring telomere length in chimpanzees to a greater degree than in humans.** D.T. EISENBERG, J. TACKNEY, R.M. CAWTHON, C.T. CLOUTIER, H. BETHANCOURT, K. HAWKES.

9:15 **Obstetric pressures as a driving force of differences in trunk modularity between recent humans and chimpanzees?** E.R. MIDDLETON.

9:30 **Evidence of adaptation? Human tooth size and sexual dimorphism covary with elevation in India and Pakistan.** E. MUZZALL, L.J. HLUSKO, B. HEMPHILL.

9:45 **Dominance and intelligence: Testing two sexual selection theories of leadership against the ethnographic record.** Z.H. GARFIELD, E.H. HAGEN.

10:00 **Break.**

10:15 **Epigenetic signatures of high-altitude adaptation in the Andes.** A. CHILDEBAYEVA, D.C. DOLINOY, T.R. JONES, F. LEON-VALERDE, M. RIVERA-CH, M. KIYAMU, T.D. BRUTSAERT, A.W. BIGHAM.

10:30 **Sociodemographic and lifestyle factors associated with lung function in five countries.** J.M. SCHROCK, M.A. LIEBERT, P. KOWAL, J. SNODGRASS.

10:45 **Shining Evolutionary Light on Human Sleep: Sleep Intensity and Human Cognition.** C.L. NUNN, D.R. SAMSON.

11:00 **Sleeping exposed to the elements: Tsimane sleep conditions reduce sleep efficiency.** G. YETISH, H. KAPLAN, M. GURVEN.

11:15 **The emergence of inequality: An analysis of fifty years of anthropometric data from Nuñoa, Peru.** M.K. HOKE, T.L. LEATHERMAN, W.R. LEONARD.

11:30 **Delayed reciprocity in sharing networks of Batek hunter-gatherers in Peninsular Malaysia.** T.S. KRAFT, V.V. VENKATARAMAN, I. TACEY, A. KAWAI, K.M. ENDICOTT.

11:45 **Linking individual foraging and residential mobility: testing the marginal value theorem with data from southeast Asian tropical rainforest foragers.** V.V. VENKATARAMAN, T.S. KRAFT, K.M. ENDICOTT.

Session 43 **Bioarchaeology of Indigenous Peoples of Cuba**
Invited Poster Symposium. Chair: Mirjana Roksandic.
Co-organizers: Alfredo Coppa and Mirjana Roksandic.

A 701.

Our session brings forth the much needed Cuban evidence to main points of controversy in archaeological debates in the region: 1) the source and direction of migrations, 2) the origins of food production in the Circum-Caribbean and 3) the fate of indigenous groups after the contact. Caribbean archaeology has experienced a remarkable growth over the last 30 years, contributing to and leading the debate on critical issues such as colonization, migration, identity, subsistence, and human-landscape-climate interaction. Although Cuba joined this debate only recently, its sustained contribution is critical for further advancement of the field. Cuba is not only the largest and most ecologically varied Caribbean island – whose population remained diverse throughout its past and well into the contact times – but it is also geographically the most centrally positioned one in the archipelago. The emphasis on bioarchaeology and its multidisciplinary nature, allows us to weave Cuban evidence into multidirectional networks of trade, migration and cultural influences in the ancient Caribbean, whose complexity is not at this point completely understood.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
Poster authors present 10:15 – 10:45

10:45 **Discussion: Odlanyer Hernández de Lara.**

1 **Dental morphological variation in autochthonous Cuban populations.** A. COPPA, A. CUCINA, M. HOOGLAND, G. TAVAREZ, R. VALCÁRCEL ROJAS, F. CANDILIO.

2 **Biological and cultural approaches to the study of population affinity among contemporary Pre-Columbian Cuban burial populations, through the analysis of cultural dental modifications and dental non-metric trait analysis.** K.R. ALARIE, M. ROKSANDIC.

3 **Dental wear and pathology at Chorro de Maíta, Cuba.** H.L. MICKLEBURGH.

4 **Bioarchaeology at the site of Canímar Abajo: The issue of identity.** M. ROKSANDIC, A. COPPA.

5 **Reconstruction of breastfeeding and weaning practices in aboriginal populations from Western Cuba.** Y. CHINIQUE DE ARMAS, M. ROKSANDIC, R. RODRÍGUEZ, D. SMITH, D. NIKITOVIC, D. GARCIA-JORDA, W. BUHAY.

6 **Isotopic insights into indigenous diets in early colonial Cuba.** J. LAFFOON, R. VALCÁRCEL ROJAS, D. WESTON, G. DAVIES, C. HOFMAN.

7 **Prehistoric Vertebrate Faunal Exploitation On Cuba.** R. COLTEN, B. WORTHINGTON.

8 **Life under early colonial occupation: the encomienda as experienced by the people of El Chorro de Maíta, Cuba.** D.A. WESTON, R. VALCÁRCEL ROJAS, M.L. HOOGLAND.

9 **The Cuban Infectious disease experience: 2000 ybp Ciboneys treponemal virgins and SAPHO.** B. ROTHSCHILD, C. ROTHSCHILD, J. GARCELL DOMINGUEZ, R. TRAVIESO RUIZ.

Session 44 **Blood in the Villages: Bioarchaeological and Forensic Evidence for Massacres**
Invited Poster Symposium. Chair: Cheryl P. Anderson.
Co-organizers: Cheryl P. Anderson and Debra L. Martin.
A 702.

Bioarchaeology and forensic anthropology offer unique perspectives on studies of mass violence and present opportunities to interpret human skeletal remains in a broader cultural context. Massacres and other forms of large-scale violence have been documented in many different ancient and modern contexts. Moving the analysis from the victims to the broader political and cultural context necessitates using social theories about the nature of mass violence. Massacres can be seen as a process, that is as the unfolding of nonrandom patterns or chain of events that precede the events and continue long after. Mass violence has a cultural logic of its own that is shaped by social and historical dynamics. Massacres can have varying aims including subjugation or total eradication of a group based on status, ethnicity or religion. Important research has been performed interpreting lethal skeletal trauma but a broad spectrum of different types of violence exists that must be taken into consideration. This includes incidents where multiple individuals are massacred as part of some larger cultural performance or cases of ethnocide where certain groups are targeted. Massacres can be part of large scale warfare, or they can be isolated incidents. It is an important part of violence studies to be able to explore the cultural history that may lead to a specific manifestation of massacre. The goal of this session is to present case studies that integrate the evidence from human remains with the broader cultural and historical context through the utilization of social theory to provide a framework for interpretation. This organized session will highlight case studies of massacres across time and space that stress innovative theoretical models that help make sense of this unique form of violence. The primary focus will be on how massacres are used as a strategy of violence across time and cultural/geopolitical landscapes.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
Poster authors present 10:15 – 11:30

11:30 **Discussion: Ryan Harrod.**

1 **Blood in the Villages: Situating Massacres within Broader Social Processes.** C.P. ANDERSON, D.L. MARTIN.

2 **Rethinking Massacres: Bioarchaeological and Forensic Investigation of Prehistoric Multiple Burials in the Tennessee Valley.** W.E. DEVORE, D.H. DYE, K.P. JACOBI.

3 **Disturbing the massacred dead: clues to Archaic Period socio-politics.** M.O. SMITH.

4 **Each one the same: performance, demography, and violence at Sacred Ridge.** A.J. OSTERHOLTZ.

5 **Mesa of Sorrows: A History of the Awat'ovi Massacre.** J.F. BROOKS.

6 **Bones in the village: Indications of the Crow Creek massacre from scattered human remains found in the habitation area.** P. WILLEY.

7 **Using Big Data to Assess Patterns of Traumatic Injury: Skeletal Trauma on the North American Great Plains.** A.E. KENDELL.

8 **Forensic perspectives on mass violence in prehistoric California.** M.A. PILLOUD, A.W. SCHWITALLA.

9 **Only the men will do. Exploring sex and gender in Andean mass death assemblages.** J. TOYNE.

10 **Khmer Rouge massacres: Skeletal evidence of violent trauma in Cambodia.** J.M. FLEISCHMAN.

11 **Sowing the Dead: Massacres and the Missing in Northern Uganda.** T. HEPNER, D.W. STEADMAN.

12 **Applying Sociopolitical Theory to Better Understand Processes of Migrant Death along the Texas-Mexico Border.** J. MAIERS, K.E. LATHAM, A. O'DANIEL.

Session 45 **Forensic applications of human skeletal biology and variation**
Invited Poster Symposium. Chair: Nicholas V. Passalacqua.
Co-organizers: Alexandra R. Klales, Kyra E. Stull and Christopher W. Rainwater.
Atrium Ballroom C.

Forensic anthropology is a diverse scientific discipline initially derived from physical anthropology. Modern forensic anthropology necessitates a more holistic anthropological approach often utilizing aspects of cultural anthropology, archaeology, physical anthropology, and human biology within a medicolegal context. Though drawing on the theoretical basis of many anthropological disciplines, forensic anthropology is frequently disregarded in the field due to its applied nature. The goal of this symposium is two-fold: (1) to increase the visibility of the theoretical and scientific nature of forensic anthropology within the larger anthropological community and (2) to encourage collaboration among professionals utilizing physical anthropology principles within the context of forensic anthropology. Presentations focus on hypothesis-driven, original research augmented with case study examples demonstrating how forensic anthropologists routinely rely on a thorough understanding of human evolution, variation, biology, physiology, and functional morphology when interpreting unknown skeletal remains and archaeological and taphonomic principles when responding to a scene. Emphasis will be placed on the scientific theories that permit the application of various skeletal methods in a medicolegal setting and the underlying nature of their derived analytical conclusions. Research topics include biological profile estimation, skeletal health and pathology, secular variation, skeletal trauma, and taphonomic site reconstruction. These topics will not only be addressed at the macroscopic, skeletal level but will also through histological, isotopic, and genetic analyses.

7:45 – 8:00 Poster set-up/ 11:45 – 12:00 Poster take down.
Even numbered poster authors present 9:30 – 10:00; odd numbered poster authors present 10:30 – 11:00

11:00 **Discussion: Susan Anton.**

1 **Are we using the appropriate reference samples to develop juvenile age estimation methods for a forensic context in developed nations?** L. SPAKE, H.F. CARDOSO.

2 **To Lump or to Split: Age Estimation in Forensic Anthropology.** N.R. LANGLEY, B. DUDZIK.

3 **Estimating Age from Adult Skeletons: New Directions in Transition Analysis Using a Wide Array of Traits.** G.R. MILNER, J.L. BOLDSEN, S.D. OUSLEY, S.M. GETZ, S. WEISE, P. TARP.

4 **The mental eminence as a marker of sexual dimorphism in dentate and edentulous individuals: An analysis using geometric morphometry.** B. DUDZIK, H. MAIJANEN, K. HAUTHER.

5 **Molar Morphometric Variation Within Modern U.S. Populations.** M.W. KENYHERCZ.

6 **A geometric morphometric comparison of within-individual levels of pelvic and cranial sexual dimorphism.** K.C. BEST, L.L. CABO, H.M. GARVIN.

7 **Worldwide population variation in pelvic sexual dimorphism.** A.R. KLALES, M.W. KENYHERCZ, K.E. STULL, K.A. MCCORMICK, S.J. CALL.

8 **Evaluating the use of long bone segments to estimate bone lengths for stature estimation.** M.E. CHAPIN, L.L. CABO, H.M. GARVIN.

9 **Contextualizing body size assessments in the genus *Homo*.** C.W. RAINWATER, N.M. UHL.

10 **Using Non-metric Traits to Estimate Ancestry in the 21st Century.** M. SPRADLEY, J.T. HEFNER.

11 **Biological health as a possible factor in the estimation of biological parameters from the human skeleton.** N.V. PASSALACQUA, N. MARQUEZ-GRANT, V. RICHARDS, J. TRUESDELL.

12 **The foundational principles of human biological variation in forensic DNA comparisons.** K.E. LATHAM, J. MAIERS.

13 ***A priori* postulates, immanent properties, diluted inferential confidence and unexplainable residues: a consideration of the scientific basis of taphonomic theory.** M.O. BEARY.

14 **Forensic Taphonomy: Research Wanted!** D.C. DIRKMAAT, L.L. CABO.

Saturday, All day sessions.

Session 46

Human Variation: Diet, Disease and Morphology

Contributed Poster Presentations. Chair: Richard J. Sherwood.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Meat or potatoes?: Re-evaluating the role of plant foods in human evolution.** C. LEONARD, S. ADOLPH, A. HENRY.

2 **The impact of food insecurity and food-based coping on serum folate status: A case study among breastfeeding Ariaal women in northern Kenya.** A. APLAND, M. FUJITA, T. CHANG.

3 **Modeling the impact of coping through animal milk rationing on dietary quality of Ariaal agro-pastoral mothers facing food insecurity and poverty in drought-prone northern Kenya.** M. FUJITA, A. APLAND, T. CHANG.

4 **Supermarket Produce Nutritional Properties across Socioeconomic Areas and Seasons.** I.M. VINSONHALER, A. COWPER, J. LEICHLITER, O. PAINE, M. SPONHEIMER.

5 **Food Preferences and Social Change in Highland New Guinea: Biological and Cultural Implications.** A.D. SOMERVILLE, M. MARTIN, M.J. SCHOENINGER.

6 **Eating oneself? Stable isotopic enrichment during weight loss and tissue turnover in humans.** J.A. CANTERBURY, C.W. BECK, C.A. DOZIER, M.L. GREENFELDER, J. MAGARO, A. MENDHA, A. PEROTTI, C.W. RIGGS, A. TAYLOR, L.E. WRIGHT.

7 **Lipid metabolism and nutritive factors of the gut microbiota in human foragers.** S.L. SCHNORR, A.G. HENRY, A.N. CRITTENDEN.

8 **Basal Metabolic Rates among Rural Agriculturalists of Ngilo Ilo, East Java.** A.A. MILLER, E. INDRIATI, W.R. LEONARD.

9 **Comparative study of metabolic disease risk factors during nutritional transitions among traditional populations.** K. ARSLANIAN, C. VALEGGIA.

10 **Effects of Human Maternal Placentophagy on Postpartum Iron-Status.** L.K. GRYDER, S.M. YOUNG, D. ZAVA, D. KIMBALL, D.C. BENYSHEK.

11 **Experimental Coevolution with Bacteria and Phage Provide Insights into Human-Pathogen Coevolutionary Dynamics.** L.R. WILLIAMS, R.S. SCOTT, S. DUFFY.

12 **Hair cortisol levels in prehispanic populations of San Pedro de Atacama, northern Chile.** R. LÓPEZ-BARRALES, M. HUBBE, E. ASPILLAGA, H.M. NIEMEYER.

13 **Factors associated with generalised and abdominal obesity among Bangladeshi migrants in UK.** N. AKHTER, P. NAHAR, K. BEGUM, G.D. COOPER, A. KASIM, G.R. BENTLEY.

14 **Vitamin D Intake and Serum Leptin Levels in Central Kansas Mennonite: The Kansas Nutrition Project.** C.E. BARRETT, M. CRAWFORD, M. MOSHER.

15 **Leprosy and plague interaction in Medieval Europe: revisiting the paradoxical cross-immunity hypothesis.** C.L. DENNISON, F.A. CRESPO.

16 **Chronic Non-Communicable Diseases among Urban and Rural Deorukhe Brahmin Women of Maharashtra, India: A Comparative Analysis.** G. PITALE, R. CORRUCCINI, U. REICHARD, Y. NANYAM, P. VADDADI.

17 **Investigating musculoskeletal health and limb biomechanics in Mandena, Madagascar: A quantitative approach to understanding normal and pathological gait patterns.** T.P. TRENTADUE, C.L. NUNN, D. SCHMITT.

18 **The relationship between social status, body size, and salivary hormone levels among Garisakang forager-horticulturalist men of lowland Papua New Guinea.** S.S. URLACHER, M. KONEČNÁ.

19 **Bone mineral density is associated with waist circumference and blood pressure but not lipid profile among the Amazonian Shuar of Ecuador.** F.C. MADIMENOS, M.A. LIEBERT, S.S. URLACHER, T.J. CEPON-ROBINS, T.E. GILDNER, C.J. HARRINGTON, J. SNODGRASS, L.S. SUGIYAMA.

20 **The Effect of Trisomy 21 on Facial Morphology and Variation.** J.M. STARBUCK, T.M. COLE III, R.H. REEVES, J.T. RICHTSMEIER.

21 **A comparative analysis of evolutionary changes in human physiological traits.** A.Q. VINING, C.L. NUNN.

22 **Analysis of Humeral Trochlear Angles As Possible Biological Sex Characteristic.** A.M. PENNAVARIA, G. THOMAS.

23 **Post-Marital Residence and Patterns of Cranial Morphological Diversity.** O. CHERONET, R. PINHASI.

24 **Quantifying Phenotypic Differences in Human Scalp Hair Morphology Associated with Ancestry and Sex.** E. BRAMEL, S. KOCH, N. JABLONSKI, M.D. SHRIVER.

25 **Geographic and temporal variation in morphological sexing traits of the pelvis.** S.R. RENNIE, M. CLEGG, S. GONZALEZ.

26 **Secular Change in Pelvic Morphological Age Indicators.** D.V. CHAPMAN, A.M. SHADE, S.D. OUSLEY.

27 **Geometric morphometrics of sexual dimorphism and pulmonary kinematics in** *Homo sapiens***.** S. TORRES-TAMAYO, D. GARCÍA-MARTÍNEZ, C. UTRILLA, I. TORRES, F. GARCÍA-RÍO, M. BASTIR.

28 **The differential role of cranial modules in the diversification of the human skull.** D.V. BERNARDO, T.F. ALMEIDA, C.D. SILVA, W.A. NEVES.

29 **The Jiri Dental Study: Uncovering Genetic Influences on Orofacial Morphology.** R.J. SHERWOOD, D.L. DUREN, J. SUBEDI, S. WILLIAMS-BLANGERO.

30 **Intrapopulation Variation in Craniometric Ancestry Proportions of a Modern Cuban Sample.** M.L. TISE.

31 **Reconstruction of Cranial Surfaces from 3D Point Data.** B.J. POMIDOR, D.E. SLICE, B.D. CORNER, J.A. HUDSON.

32 **Cranial Bone Mineral Density as a Possible Age Indicator.** A.K. PASCHALL, A.H. ROSS.

33 **Scapula morphology variation at Point Hope, Alaska.** A.M. SHARPLIN, W.E. HARCOURT-SMITH, M.E. MACIAS.

34 **The influence of speed and foot shape on lateral midfoot loading in an ontogenetic and adult human sample.** A.N. HEARD-BOOTH, R.E. WUNDERLICH.

35 **Subadult Age-at-Death and Mortuary Practice during the Neolithic Transition at Niah Cave, Sarawak, Malaysia.** A. SCHRENK.

36 **Height trends in early childhood: Easter Island and Chile from a global perspective.** R. RETAMAL, C. MASCIE-TAYLOR.

37 **Visualization and Materialization for High-dimensional Morphometric Data.** D.E. SLICE, B.J. POMIDOR, B.D. CORNER, F.J. ROHLF.

38 **Exploring the ultrastructure of human hair: Preliminary results and prospects for correlation with genetic variation.** S. KOCH, N. JABLONSKI, M.D. SHRIVER.

39 **Comparing narrow-band to full-spectrum based methods for measuring human skin pigmentation.** J.D. WHITE, R.T. LAI, A.A. ZAIDI, B.C. MATTERN, M.D. SHRIVER.

40 **Diurnal testosterone variation among indigenous Shuar men from Amazonian Ecuador.** T.E. GILDNER, M.A. LIEBERT, R.G. BRIBIESCAS, L.S. SUGIYAMA, S.S. URLACHER, T.J. CEPON-ROBINS, F.C. MADIMENOS, J. SNODGRASS.

41 **Validation of field methods for freezing whole blood for later analysis with flow cytometry.** A.D. BLACKWELL, A. GARCIA, N. KEIVANFAR, S. BAY.

Session 47 **Primate ecology and behaviour**

Contributed Poster Presentations. Chair: Timothy D. Smith.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Baboons (***Papio anubis***) in Kibale National Park, Uganda, disperse seeds into diverse habitats: preliminary results from spatial analysis and seed fate experiments.** J. BONAVIA, C.A. JOHNSON, J.M. ROTHMAN, G. VAN DER HEIDE, J.E. LAMBERT.

2 **How primates move seeds: movement ecology and dispersal kernels in a Cercopithecoid community.** G. VAN DER HEIDE, J. BONAVIA, J.E. LAMBERT.

3 **A primate and a bird, sitting in a tree, c-o-m-p-e-t-i-n-g: Co-occurrence patterns of primates and their potential dietary competitors.** I.E. SMAIL, J.M. KAMILAR.

4 **An organism-focused view of heterogeneity: the effect of landscape spatial pattern at multiple scales on the habitat use, behavior, and movement patterns of five diurnal lemurs in Betampona Natural Reserve, Madagascar.** E. MERTZ.

5 **Nocturnal leopard (***Panthera pardus***) predation risk for olive baboons (***Papio anubis***) in Kenya.** L.R. BIDNER, L.A. ISBELL, A. MATSUMOTO-ODA.

6 **Food patch characteristics and dynamics of patch use and sharing in two sympatric lemur species at Tsinjoarivo, Madagascar.** M.A. KEELEY, M.T. IRWIN, J. RAHARISON.

7 **Determinants of terrestrial feeding in an arboreal primate: the case of** *Hapalemur meridionalis***.** T.M. EPPLEY, G. DONATI, J.U. GANZHORN.

8 **Dynamics of human-chimpanzee encounters at Fongoli, Senegal, 2006-2014.** K. BOYER ONTL, J.D. PRUETZ.

9 **Dietary correlates of gut microbe composition in white-faced capuchins (***Cebus capucinus***).** E.K. MALLOTT, P.A. GARBER, R.S. MALHI.

10 **Plastic digestive response to variation in dietary nutrient density and energetic status.** J.E. LAMBERT, J.M. ROTHMAN.

11 **The effect of dental impairment on food digestion in wild ring-tailed lemurs (***Lemur catta***) using fecal nutritional content.** J.B. MILLETTE, M.L. SAUTHER, C.P. FRANK.

12 **Dietary chemical and energetic values differ in** *Lemur catta* **sexes.** N. YAMASHITA, M. LAFLEUR, R. HOOD.

13 **Nutritional composition of plant foods consumed by the chimpanzees of Gombe National Park, Tanzania.** R.C. O'MALLEY, C.M. MURRAY, R.S. NOCKERTS, M.L. POWER.

14 **Relative tooth size at birth in primates: Life history and dietary correlates.** T.D. SMITH, M.N. MUCHLINSKI, C.J. BONAR, S. EVANS, L. WILLIAMS, C.J. VINYARD, V.B. DELEON.

15 **Longitudinal body mass variation in wild primate populations: are individuals or populations more variable?** E.C. LAUB, G.S. YAPUNCICH, K.E. GLANDER, A.E. PUSEY.

16 **Lemurs are not Special, but Aye-Ayes are: Primate Basal Metabolic Rates in Phylogenetic Context.** M. LAUTERBUR.

17 **Dietary Survey of Captive Housed Chimpanzees (***Pan troglodytes sp.***) .** B. SMITH.

18 **Low Mortality Rates among Ngogo Chimpanzees: Ecological Influences and Evolutionary Implications.** B.M. WOOD, D.P. WATTS, J.C. MITANI, K.E. LANGERGRABER.

19 **Somatic senescence in female chimpanzees (***Pan troglodytes***) occurs earlier and more rapidly than in women.** C.T. CLOUTIER, K. HAWKES.

20 **Habitat quality and maternal rank predict intraspecific variation in development among olive baboons.** S.K. PATTERSON, E.K. ROBERTS, J.B. SILK, S.C. STRUM.

21 **Comparative growth and static allometry in the genus** *Chlorocebus***.** C.A. SCHMITT, T.R. TURNER, J. DANZY CRAMER, J. LORENZ, J. GROBLER, N.B. FREIMER.

22 **Infant weight growth and weaning age in free-ranging rhesus macaques (***Macaca mulatta***).** D. LEE, C. DUBUC, T. MANDALAYWALA, D. MAESTRIPIERI, A. WIDDIG, J.P. HIGHAM.

23 **Maternal body composition predicts prepubertal fat mass accrual in female offspring.** A. MUMMERT, K.F. ETHUN, M.E. WILSON, A. MUIR.

24 **Energy expenditure and physical activity levels in captive tufted capuchins (***Cebus apella***).** W. EDWARDS, H. PONTZER, E. LONSDORF.

25 **Low body temperature among primates and implications for energy expenditure.** C.M. MCCABE, R.W. WRANGHAM.

26 **Effect of habitat type and sex on morphometrics and body mass of the silvery-brown tamarin (***Saguinus leucopus***).** L.M. VALENCIA, A. DI FIORE.

27 **Life History Variation in Strepsirrhine Primates from the Duke Lemur Center.** J.K. SCHAFER.

28 **Male reproductive skew in multimale social groups of Verreaux's sifaka (***Propithecus verreauxi***) at Kirindy Mitea National Park, Madagascar.** L. ABONDANO, A. DI FIORE, R. LEWIS.

29 **The Monkeybar Project: Population Density of Long-Tailed Macaques (***Macaca fascicularis***) in Two Different Forest Types in Kudat District, Sabah, Malaysia.** L. GILHOOLY, A. MCINTYRE, M. GRIGG, K. FORNACE, J. COX, C. DRAKELEY, M. SALGADO LYNN, D. STARK.

30 **Phenotypic and genetic ontogenetic integration of squirrel monkey (***Saimiri boliviensis***) age-specific body mass.** G.E. BLOMQUIST, L.E. WILLIAMS.

31 **Validation of Urine Test Strips to Measure Relative Ketone Body Levels in Wild Bornean Orangutans,** *Pongo pygmaeus wurmbii***.** D.J. NAUMENKO, M. WATFORD, W.M. ERB, E.R. VOGEL.

32 **Heterochrony of nasal turbinal development in Primates.** M.C. MARTELL, T.D. SMITH, J.B. ROSSIE, V.B. DELEON.

33 **A preliminary examination of genetic diversity in mantled howler monkeys (***Alouatta palliata)* **in a fragmented forest in Costa Rica.** A.L. SCHREIER, M. FRANCO, M. BARTON, N.P. PRYOR, N.L. BARRICKMAN.

34 **Detection of** *Entamoeba* **spp. and** *Entamoeba histolytica* **in seven lemur species in Ranomafana, Madagascar.** L. RAGAZZO, S. ZOHDY, P.C. WRIGHT, T.R. GILLESPIE.

35 **Three-dimensional photogrammetry of wild primates.** J.T. KERBY, V.V. VENKATARAMAN, N. NGUYEN, P.J. FASHING.

36 **Have You Seen a Pet Lemur? Using Online Surveys for Data Collection.** M.S. SCHAEFER, K.E. REUTER.

37 **Acoustic monitoring: transforming primate conservation strategies in African tropical forest protected areas.** J.M. LINDER, C. ASTARAS, P.H. WREGE, D.M. MACDONALD.

38 **Are Roads a Dispersal Barrier for** *Microcebus***?** M.S. RAMSAY, A. RAZAFINDRAKOTO, S.M. LEHMAN.

39 **Predicting the climatic niche breadth of African catarrhines.** E.M. LOCKE, J.M. KAMILAR.

40 **Beauty, brains, and brawn: phylogenetic and ecological interpretations of new virtual endocasts of large-bodied subfossil lemurs.** K.L. ALLEN, T. CLARKE.

Session 48 **Human Genetic Variation: Population Studies and Adaptation**

Contributed Poster Presentations. Chair: Kara C. Hoover.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Human structural variants shared with Neandertal and Denisovan genomes.** Y. LIN, P. PAVLIDIS, E. KARAKOC, J. AJAY, O. GOKCUMEN.

2 **Neanderthal Introgression to Western Asian Human Populations.** R.O. TASKENT, D. XU, D. ALIOGLU, H.M. DONERTAS, E. FER, M. SOMEL, O. GOKCUMEN.

3 **Neanderthal ancestry in Yemeni populations.** D.N. VYAS, A. AL-MEERI, C.J. MULLIGAN.

4 **Ancient dental calculus as a reservoir of whole human mitogenomes.** A.T. OZGA, M. NIEVES COLÓN, T. HONAP, K. SANKARANARAYANAN, C. HOFMAN, G. MILNER, C. LEWIS, JR., A. STONE, C. WARINNER.

5 **Genetic diversity of Sanggan River Valley population provides evidence of Neolithic introgression from people of two farming centers in North China.** H. ZHOU, Y. ZHANG, J. LI.

6 **Ancient Mitochondrial Genome Reveals Trace of Prehistoric Migration in the East Pamir by Pastoralists.** Y. CUI, H. ZHOU, C. NING.

7 **The distribution of the C677T allele of the MTHFR human gene in Eurasia: evidence of two distinct clines.** K. TRAZMONTE, D. GODFREY, L. MADRIGAL.

8 **Building ancient noses: a functional approach to paleogenomic data.** K.C. HOOVER.

9 **No role for strong purifying selection on *MC1R* in populations from Northern Island Melanesia.** H.L. NORTON, E.A. WERREN, J.S. FRIEDLAENDER.

10 **Holocene Gene Flow Patterns between New Guinea and Australia.** S. RAGSDALE, H. MARSH.

11 **Simulating the effects of migration rates on Neolithic range expansion.** N.J. ANGAL, C.R. TILLQUIST.

12 **A search of human beta-globin polymorphisms in ancient DNA of European populations.** C. VIGANÒ, G. AKGÜL, F.J. RÜHLI, A. BOUWMAN.

13 **Tracing the geographic origin of the Indian Ocean slave trade: Genomic ancient DNA data from the historical cemetery of Le Morne (Mauritius).** R. FREGEL, M. SANDOVAL, M. SIKORA, M. AVILA, M. CARPENTER, D. POZNIK, C.R. GIGNOUX, K. SEETAH, S. CAVAL, D. CALAON, C. BUSTAMANTE.

14 **Migration Waves and Genetic Drift in the Peopling of Fuego-Patagonia.** M.P. ALFONSO-DURRUTY, M.G. VILAR, F. MORELLO.

15 **Sub-Regional Population Structure within South America Using MtDNA.** B.C. HERRERA, M. HUBBE.

16 **Genes determining Andean high-altitude adaptive phenotypes.** A.W. BIGHAM, M. KIYAMU, G. ELIAS, F. LEON-VALERDE, M. RIVERA-CHIRA, T.D. BRUTSAERT.

17 **Genomic identification of recent positive selection in populations from Andean highlands and south-central Chile.** P.S. CONTRERAS, A.E. BLANCO, A. MORENO-ESTRADA, K. SANDOVAL, C. ENG, S. HUNTSMAN, E.G. BURCHARD, C. GIGNOUX, C. BUSTAMANTE, E. LLOP, M. MORAGA, R. VERDUGO.

18 **Investigating patterns of admixture in rural Mesoamerica due to Spanish colonialism: genome-wide evidence from Xaltocan, Mexico.** J. MATA-MIGUEZ, A.T. MIRÓ-HERRANS, D.A. BOLNICK.

19 **Investigating possible signals of natural selection due to historic epidemics in Mesoamerica using ancient DNA.** A.W. REYNOLDS, O.A. GARCIA, J. MATA-MÍGUEZ, A.W. BIGHAM, D.A. BOLNICK.

20 **Genetic analysis of a British colonial cemetery in Belize.** L.C. SPRINGS, J.F. GARBER, D.A. BOLNICK.

21 **The third root of Mexico: Genetic structure of Mexicans of African descent.** M.C. ÁVILA-ARCOS, A. MORENO-ESTRADA, K. SANDOVAL-MENDOZA, M.W. FELDMAN, C.D. BUSTAMANTE.

22 **Basal pigmentation is a poor predictor of tanning response in Mexican Americans.** E.E. QUILLEN, J. TURNER, A. SHELDRAKE, M.D. SHRIVER.

23 **Genetic diversity of A2 and C1 haplotypes in Puerto Rico: Implications for initial migration and settlement patterns of the Caribbean.** R.E. FLESKES, M.G. VILAR, C. MELENDEZ, T.G. SCHURR.

24 **Examining Mitochondrial Haplotype Diversity in Ancient and Modern Indigenous Caribbean Populations.** F. SAAVEDRA, J.P. BENN TORRES.

25 **Heritable traits and their impacts on child health in a Caribbean village.** M.H. AHSAN, M.V. FLINN, J.C. BAIN.

26 **Ancient DNA Analysis of the Prehistoric Inhabitants of the Lower Pecos Region of Texas and Northern Mexico.** J.A. RAFF, J. MATA-MÍGUEZ, C.R. KU, D.A. BOLNICK.

27 **Isotopic and Genetic Analyses of a Mass Grave in Central California: Implications for Precontact Hunter-Gatherer Warfare.** H. LI, J.W. EERKENS, R.S. MALHI.

28 **Ancient DNA Analysis of San Nicolas Island, California.** A.B. POTTER, S. KERR.

29 **Improved mitochondrial aDNA sequence quality and recovery rates using Next-Generation Sequencing (NGS): A case study using highly degraded material from Cahokia Mound 72.** J.L. HARRISON, F.A. KAESTLE.

30 **Additional IGG haplotype data supporting two founding populations of Native Americans.** M.S. SCHANFIELD, B.J. ARAUJO JATOBA, B.C. DIAS DE OLIVEIRA, S. PACHECO ALBANO.

31 **Serum leptin, anthropometric phenotypes and epigenetic programming across 7 Leptin (LEP) core promoter CpG sites in two diverse populations: The Western Buryat of Siberia and the Mennonites of Central Kansas.** M. MOSHER, P.E. MELTON, P. STAPLETON, M.H. CRAWFORD.

32 **An Initial Investigation of the Biological Affinity of the Arikara and Caddo Using Dental Metrics.** K.E. KULHAVY.

33 **Drift and selection in material culture on the High Plains: A quantitative analysis of inter-tribe parfleche characteristics.** S.J. LYCETT.

34 ~~**Exploring the limits of approximate Bayesian computation as a method for human demographic analysis.**~~ ~~F.A. VILLANEA~~. *Withdrawn*

35 **Copying error, artifactual mutation, and phylogenetic signal in cultural evolution: Experimental approaches to "model artifacts".** K. SCHILLINGER, A. MESOUDI, S.J. LYCETT.

36 **Patterns of mutations in exome sequencing seen as an effect of sampled genes.** T.F. ALMEIDA, D.V. BERNARDO, M.S. PASSOS-BUENO.

37 **Evolution of *MUC7*: Insights into human salivary adaptation.** D. XU, P. PAVLIDIS, C. FLANAGAN, S. THAMADILOK, E. REDWOOD, S. FOX, R. BLEKHMAN, S. RUHL, O. GOKCUMEN.

38 **Optimisation of metagenomic next generation sequencing shotgun techniques for the study of ancient anthropogenic sediments.** T.C. COLLIN, R. PINHASI, R.N. FEENEY.

39 **Phylogeographic signals in an immune gene family reflect linkage disequilibrium.** R.K. LEITER, C.R. TILLQUIST.

40 **Genetic factors influencing the phenotypic variation leading to clinical complaints in sickle cell trait athletes.** C.M. BALENTINE, R.W. GRIEGER, J. LUND, M. CIAMBELLA, C. FLANSBURG, L. MADRIGAL, A.C. STONE.

41 **Differences in DNA yield among buccal swab types: Medical-grade vs. standard cotton swabs.** C.A. RUIZ, M.E. CHANEY, A.J. TOSI.

42 **Evaluating minimally invasive methods of telomere length measurement: A sub-study of the WHO Study on Global AGEing and Adult Health (SAGE) .** E.A. GOLDMAN, G. EICK, D. COMPTON, P. KOWAL, J. SNODGRASS, D.T. EISENBERG, K.N. STERNER.

43 **Simplified access to human genomic evidence for clinical variants with new NCBI services.** S. SHERRY, C. XIAO, D. SLOTTA, K. RODARMER, M. FEOLO, M. KIMELMAN, G. GODYNSKIY, C. O'SULLIVAN, E. YASCHENKO.

44 **Association of *ACE*, *TPA*, and *WNK1 Alu* polymorphisms, perceptions of unfair treatment, and personal networks with hypertension in African Americans.** K.C. FULLER, C. MCCARTY, R. VACCA, C.C. GRAVLEE, A.C. BOULTER, C.J. MULLIGAN.

Session 49 **Dental Anthropology**

Contributed Poster Presentations. Chair: Christopher W. Schmidt.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Enamel defects in *Paranthropus robustus* relative to other South African hominins.** I.E. TOWLE, J.D. IRISH, I. DE GROOTE.

2 **Elliptical best fits as shape descriptors: a case study on Neanderthal and modern human teeth.** C.C. BAUER, P.D. BONS, S. BENAZZI, K. HARVATI.

3 **Dental microwear texture differences between permanent and deciduous enamel.** K.L. KRUEGER.

4 **Putting the X in Expression: Tooth Crown Morphology and Chromosome Number.** C. MAIER, J. DUMANČIĆ, H. BRKIĆ, Z. KAIC, G. SCOTT.

5 **Seeing RED: A new statistical solution to an old categorical data problem.** C. WILLERMET, J. DANIELS, H.J. EDGAR.

6 **Measurement Strategies in Dental Metrics: Caliper Measurements versus Computer Measurements Taken from Photographic Images .** J.D. SYKES.

7 **Covariation and modularity in the human dentition.** A. NESBITT.

8 **Investigating the Effects of Dental Wear on the Scoring of Morphological Traits.** D.E. EHRLICH, S.E. BAILEY.

9 **Energetic costs of eating raw foods in humans.** J.B. HANNA, C.E. WALL.

10 **Experiencing Childhood at Roonka: An Analysis of Enamel Hypoplasia in the Permanent Dentition of Australian Aboriginal Hunter-Gatherers.** C.B. SMITH, J. LITTLETON.

11 **Environment, culture and society as reflected in the dental wear and pathology of the inhabitants of the 4th cataract, Sudan.** R. WHITING, S. HILLSON, D. ANTOINE.

12 **Dietary Nuances of Late Prehistoric Agriculturists Determined Via Dental Microwear Texture Analysis.** C.W. SCHMIDT, A.J. REMY.

13 **Tooth Tales from Lima: Dental Health and Socio-Political Change Along the Pre-Columbian Central Coast of Peru.** J. DEFRANCQ, K. GERDAU RADONIC.

14 **An assessment of correlation between linear enamel hypoplasias and Wilson bands in a cemetery from the Bronze Age Levant.** T.V. WILSON.

15 **Ancient Celts: Myth, invention or reality? Dental affinities between continental and non-continental Celtic groups.** M.J. FISHER.

16 **Diet and Weaning in Late Iron Age Dorset.** M.A. CLARK, J. BEAUMONT, R. REDFERN.

17 **On the cusp of a great discovery: Dental morphology in medieval England.** J.H. KUOSA, J.D. IRISH, I. DE GROOTE.

18 **Biological affinities of Manasota Period populations in Southwestern Florida as derived from dental nonmetric traits.** A.A. ELGART.

19 **Co-occurring extreme torus mandibularis, palatine torus, and oral exotoses: a case study.** L.R. LEASE, C. BOUCHIE, J.S. OHR, JR..

20 **Evidence for intense migration influx into the Greek colony of Metaponto: A study of dental nonmetric variation.** H. RATHMANN, G. SALTINI SEMERARI, K. HARVATI.

21 **Concerning Dental Wear: an examination of macro-wear in the Erie County Poorhouse Cemetery (1851-1913).** K.C. KNOWLES, J.E. SIRIANNI.

22 **Dental characteristics of clinically diagnosed cases of congenital syphilis in the United States of America prior to 1910.** S. IOANNOU, M. HENNEBERG.

23 **The reconstruction and analysis of oral microbiome composition using dental calculus from the Mississippi State Asylum (1855-1935), Jackson, MS.** J.R. BELANICH, M.K. ZUCKERMAN, H.R. JORDAN, N.P. HERRMANN, J.W. ROSCH.

Session 50 **Genetics of Non-human primates**

Contributed Poster Presentations. Chair: Lisa Nevell.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **A simple, economical protocol for DNA extraction and amplification where there is no lab.** E.E. GUEVARA, J. RANAIVONASY, A.F. RICHARD, J. RATSIRARSON, R.R. LAWLER, B.J. BRADLEY.

2 **Glucocorticoid mediated responses to calorie restriction, sleep deprivation and wheel running in the mouse brain and its evolution among placental mammals.** L. NEVELL.

3 **Parentage complexity in socially monogamous wild lemurs (*Eulemur rubriventer*).** D.C. FRANKEL, R.L. JACOBS, R.J. RICE, B.J. BRADLEY.

4 **Phylogenetic history of tarsiers: Uncovering the history of a deeply rooted family.** R.A. MUNDS, M.H. AHSAN.

5 **A comparative study of human and howler monkey Toll-Like Receptor 7 under the selective pressure of yellow fever virus.** N. TOROSIN, K. FISCHER, J. ROUND, L.A. KNAPP.

6 **Mitochondrial relationships of red colobus monkeys from the TL2 region (Tshuapa, Lomami, Lualaba River Basins), Democratic Republic of Congo, relative to other central African populations.** M.E. CHANEY, C.A. RUIZ, J.A. HART, K.M. DETWILER, A.J. TOSI.

7 **Associations between skeletal DNA methylation and baboon femur morphology.** G.A. HOUSMAN, L.M. HAVILL, E. QUILLEN, A.C. STONE.

8 **Spatial analysis of mitochondrial genetic diversity across the genus *Pan*.** M.A. NIEVES-COLON, C.E. TILL, A.C. STONE.

9 **A genetic survey of the bonobos (*Pan paniscus*) at the Iyema field site, DRC.** C.M. BRAND, F.J. WHITE, M. RUIZ-LOPEZ, M.T. WALLER, M.L. WAKEFIELD, N. TING.

10 **Genetic evidence for the prehistoric expansion of *Enterobius vermicularis* parasites and their human hosts in the greater American Southwest.** A. ROLLINS, F. KAESTLE, K. REINHARD.

Session 51 **Human Biology: Demography**

Contributed Poster Presentations. Chair: Luseadra McKerracher.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **Human males have low reproductive skew compared to other mammals: An analysis of new data from small-scale human societies.** P.L. HOOPER, C. ROSS, S. GAVRILETS, M. BORGERHOFF MULDER.

2 **Historical Demography of Todos Santos, California Baja Sur, Mexico: population growth and environmental constraints.** J.L. BURNS, S. MACFARLAN.

3 **Reproductive history of three generations of women from the municipality Plaza de la Revolución, Havana, Cuba.** V. VAZQUEZ, A. DAUDINOT, J. GONZALEZ.

4 **Breastfeeding and ovulatory status affect $\delta^{15}N$ values: Evidence from living Maya women from Guatemala.** L.J. MCKERRACHER, M. COLLARD, P. NEPOMNASCHY, M.P. RICHARDS.

5 **Differences in circadian electrolyte excretion between women with and without a family history of hypertension: reproducibility over the menstrual cycle.** G.D. JAMES.

6 **Pellagra in the Mississippi State Asylum: An examination of differential survivorship.** M.L. DAVENPORT, N.P. HERRMANN, M.K. ZUCKERMAN, M. MURPHY.

Session 52 **Education and Outreach**

Contributed Poster Presentations. Chair: J. Lynn Funkhouser.

Atrium Ballroom A/B.

7:30 - 8:00 Poster set-up. 5:30 - 6:00 Poster take-down. Even numbered poster authors present for discussion 10:30-11:00 and 4:45-5:30- Odd numbered poster authors present for discussion 9:30-10:00 and 4:00-4:45

1 **The 'Paleo' diet in the United States: Why, how, and what now?** M. PATIÑO.

2 **The effect of context on visitor responses to the question "What does it mean to be human?".** J.N. OBENDA, B. POBINER, R. POTTS.

3 **Classroom optional: Service learning and community engagement in anthropology.** C.A. BRADBURY, S.H. BLATT, P. YU.

4 **The need for revising and modernizing postcranial measurement definitions: New standards.** K.A. CARPENTER, S.D. OUSLEY, N.R. LANGLEY.

5 **Open access to Fayum primate fossils through the digital data archive MorphoSource.** E.R. SEIFFERT, G.F. GUNNELL, S.W. HERITAGE, H.M. SALLAM, D.M. BOYER.

6 **Forensics in the Classroom: Anthropology as a Tool in K-12 Education.** A. CASADO, M. CLARK.

7 **Digitizing "Roger": Creating a Recommended Osteology Guide for eReaders [ROGeR].** M.E. ZECHINI, M.R. VOAS, J.E. HOLMSTROM, K. KILLGROVE.

8 **The Forensic Anthropology Center at Texas State and Associated Texas State University Donated Skeletal Collection.** S.R. MAVROUDAS.

9 **GriffinVC: Video Coding Software for Microanalysis of Complex Behavior.** S.V. SINGH, S. RAGIR.

10 **Anthropology is Elemental: Observations from the first four years of an outreach initiative.** J. FUNKHOUSER, M. CARR, J. FRIEL, C. LYNN.

11 **Flipping Anthropology: an assessment of student knowledge and evaluation in a flipped introductory anthropology course.** J. WIECZKOWSKI, L. ANSELMI, S.E. MAGUIRE, M.M. MAYBERRY.

12 **The Mesoamerican Corpus of Formative Period Art and Writing.** C.J. BERKLEY, M.D. CARRASCO, J. ENGLEHARDT, D.E. SLICE.

Saturday, Afternoon sessions.

Session 53

Early-life stress in the past: bioarchaeological approaches to the evolution, ecology, and cultural contingencies of human life history

Invited Podium Symposium. Chair: Daniel H. Temple.

Imperial Ballroom A.

The human dentition and skeleton are two of the most data-rich sources for evaluating individual life histories. Specifically, mineralized hard tissues detail evidence of stressors experienced early in the life course and the consequences of these experiences on future developmental pathways. The goal of this symposium is to unlock the potential of the human skeleton and dentition to elucidate early-life stress events and to evaluate how these experiences place physiological constraints on energetic investments in future growth, maintenance, and reproduction. Here, plasticity is found in the human capacity to survive stressful events early in life, and these events are recorded on bones and teeth. Skeletal and dental evidence for physiological constraints are also possible to observe, particularly disease, growth faltering, and mortality. Together, these represent a broader series of trade-offs where the human body may survive early-life stress events, but reduces energetic investments into future physiological functions. Because bioarchaeological research examines the human skeleton within the broader context of culture, many of these presentations will also provide evidence for the cultural and environmental contingencies acting to ameliorate or exacerbate the impact of early-life stress on individual life histories.

2:00 **Bioarchaeological approaches to the study of early-life stress: the potential of human skeletal and dental remains to studies of life history theory.** D.H. TEMPLE.

2:15 **The effect of multiple stress events on risk of mortality during the medieval Black Death.** S.N. DEWITTE.

2:30 **A stressful legacy: Childhood stress and longevity.** G. MCFARLANE, J.H. LITTLETON.

2:45 **Developmental variation in perikymata expression in co-interred child foragers.** L. HARRINGTON, S. PFEIFFER.

3:00 **Short bones, short life: Subadult selective mortality in Tirup Cemetery.** B.M. USHER.

3:15 **Stressful childhoods, (un)healed lesions, and lifelong impacts: A view of life history and frailty in West-Central Illinois.** J.J. WILSON, J.M. BAUDER.

3:30 **Growth disruption and adult mortality: the deferred consequences of early-life stress in industrializing London.** G.M. HUGHES-MOREY.

3:45 **Ill-health or the burial environment: differentiating developmental defects from postmortem stained enamel in deciduous dentition, prehistoric Tonga, Polynesia.** S.E. HALCROW, R.A. FARAH, L. PAINUTHARA, J.M. BROADBENT, H.R. BUCKLEY, A. BARKER.

4:00 **Famine, feast, and frailty: early-life histories from dentine.** J. BEAUMONT, J. MONTGOMERY.

4:15 **Exploring stress thresholds through dental enamel defects and skeletal evidence for life history trade-offs in adults.** J.A. GAMBLE.

4:30 **An examination of early stress, longevity, growth and childhood socioeconomic circumstances in a modern juvenile skeletal sample from Portugal.** H. CARDOSO.

4:45 **Discussion: Sabrina Agarwal.**

5:00 **Break.**

Session 54 **Genetics and Evolution: Non-human Primates**
Contributed Podium Presentations. Chair: Joseph Orkin.
A 602.

2:00 **Building heads: Morphological and genetic variation in facial length, cranial base angle, and endocranial volume in baboons.** J.L. JOGANIC, K.E. WILLMORE, J.T. RICHTSMEIER, K.M. WEISS, L.A. COX, J.L. VANDEBERG, M.C. MAHANEY, J. ROGERS, J.M. CHEVERUD.

2:15 **The embryonic origins of primate encephalization: allometric and growth analyses.** A.C. HALLEY, T.W. DEACON.

2:30 **Tales from the teeth: Investigating the potential of dental microstructure for phylogeny reconstruction.** C. KUFELDT, W. DIRKS, B. WOOD.

2:45 **Big primate, small primate: possible evidence for convergent dwarfism within nocturnal galagids.** L. POZZI.

3:00 ~~**Genetic variability of two colobine primates in Vietnam.**~~ ~~A. ANG, Q. LE KHAC, B. LUU TUONG, B. TRAN VAN, L. VU, R. MEIER, D. HOANG MINH, H. COVERT~~. *Withdrawn*

3:15 **Longitudinal Variation in the Gut Microbiota of Free-ranging Capuchin Monkeys (***Cebus capucinus***).** J.D. ORKIN, A.D. MELIN.

3:30 **Comparison of the vaginal, fecal, and rectal microbiome in captive Pigtailed Macaques (***Macaca nemestrina***).** N.D. NGUYEN, S. YILDIRIM, A.J. RIVERA, Y.C. SWEENY, D.L. PATTON, B.A. WILSON, R.M. STUMPF.

3:45 **Dietary adaptations in digestive enzymes of New World primates.** M.C. JANIAK.

4:00 **Disease-associated genetic variation drives differential expression of** *MHC-DQA1 in vitro***: A role for** *cis***-regulatory variation in disease susceptibility in wild primates.** N.D. SIMONS, G.N. EICK, M.J. RUIZ-LOPEZ, C.A. CHAPMAN, T.L. GOLDBERG, N. TING, K.N. STERNER.

4:15 **Genetic analyses of pre- and post-contact North American** *Mycobacterium tuberculosis* **complex strains.** T.P. HONAP, Å. VÅGENE, A. HERBIG, M.S. ROSENBERG, J.E. BUIKSTRA, K.I. BOS, J. KRAUSE, A.C. STONE.

4:30 **Ring-tailed lemurs use olfactory signals to differentiate the MHC quality of potential mates.** K.E. GROGAN, M. BOULET, C.M. DREA.

4:45 **Accelerated evolution of marmoset genes implicate potential candidates for reproductive suppression.** M.J. MONTAGUE, W.C. WARREN.

5:00 **Break**

Session 55 **Primatology: Life History**
Contributed Podium Presentations. Chair: Julienne Rutherford.
A 703/704.

2:00 **Hormonal Correlates of Sexual Swellings During Pregnancy in Wild Chimpanzees (***Pan troglodytes schweinfurthii***) of Kanyawara and Gombe.** E.E. BOEHM, A.E. PUSEY, Z. MACHANDA, M. MULLER, E. OTALI, R. WRANGHAM, M. EMERY THOMPSON.

2:15 **New data on female maturation milestones indicate longer development in wild chimpanzees.** K.K. WALKER, J. GOODALL, A.E. PUSEY.

2:30 **Testosterone, musculature, and development in Kanyawara chimpanzees and Tsimane forager-horticulturalists.** M.N. MULLER, M. EMERY THOMPSON, B.A. BEHEIM, D.K. ENIGK, M. GURVEN, K. SABBI, B.C. TRUMBLE, R.W. WRANGHAM, H.S. KAPLAN.

2:45 **Expensive tissues and gestation length in primates.** C.S. MONGLE, A. KOENIG, J.B. SMAERS, C. BORRIES.

3:00 **Fecal stable isotopes ($\delta^{13}C$:$\delta^{15}N$, %N) used to track infant nutritional development and reveal average weaning age in wild chimpanzees.** I. BADESCU, M.A. KATZENBERG, D.P. WATTS, D.W. SELLEN.

3:15 **Offspring survivorship in wild geladas (***Theropithecus gelada***).** A. LU, T.J. BERGMAN, J.C. BEEHNER.

3:30 **In the Thick of Things: Menstrual Bleeding Reflects Placental Development in Non-Human Primates.** E. ROWE.

3:45 **Metabolic hormone dynamics across marmoset monkey pregnancy: sources of variation and implications for birth outcomes.** J. RUTHERFORD, S. TARDIF, C. ROSS, A. SILLS, D. LAYNE COLON, L. RIESCHE, T. ZIEGLER.

4:00 **Comparison of maternal investment in two troops of wild olive baboons (***P. anubis***) at ecologically different sites in the Laikipia Plateau, Kenya.** C.A. MOST, S.C. STRUM.

4:15 **Development of female-dominance in lemurs coincides with androgenic development.** S.L. MEREDITH, M. O'MARA.

4:30 **Evidence that male face shape in rhesus macaques (***Macaca mulatta***) is subject to inter-sexual selection.** K.A. ROSENFIELD, C. DUBUC, A.V. GEORGIEV, D. MAESTRIPIERI, S. SEMPLE.

4:45 **Cease and De-Cyst: Female geladas are more likely than males to fight off cyst-inducing tapeworms.** I.A. SCHNEIDER-CREASE, J.C. NOH, T.J. BERGMAN, J.C. BEEHNER.

5:00 **Break.**

Session 56 **Paleoanthropology: Late Homo**
Contributed Podium Presentations. Chair: Juliet K. Brophy.
A 706/707.

2:00 **Niche expansion and the process of becoming human: using the Extended Evolutionary Synthesis to model the origins of modern human behavior.** M. KISSEL, A. FUENTES.

2:15 **Energetics and Economics of Foraging in Humans and other Apes.** H. PONTZER, D.A. RAICHLEN, J.A. HARRIS, B.M. WOOD.

2:30 **Seasonal foraging in Early Pleistocene Olduvai Gorge, Tanzania.** A.N. GURTOV.

2:45 **Analyses of Morphological Variation among Hominin Proximal Femora.** L.H. EASON.

3:00 **How Linguistic Instruction Reorganizes the Neural Networks Involved in Stone Tool Knapping.** S.S. PUTT, S. WIJEAKUMAR, R.G. FRANCISCUS, J.P. SPENCER.

3:15 **Lineage-specific patterns of brain expansion and dental reduction in hominins.** A. GÓMEZ-ROBLES, J.B. SMAERS, P. POLLY, B. WOOD.

3:30 **Cranial dimensions as predictors of phenotypic integration in the primate basicranium: implications for hominin evolution.** C.I. VILLAMIL.

3:45 **Diploic vessels and computed tomography: segmentation and comparison in modern humans and fossil hominids.** G. RANGEL DE LÁZARO, J. DE LA CUÉTARA, H. PÍŠOVÁ, C. LORENZO, E. BRUNER.

4:00 *Homo erectus* **paleoecology and behavior based on 1.5 million year old footprints from northwestern Kenya.** N.T. ROACH, K.G. HATALA, K.R. OSTROFSKY, B. VILLMOARE, J.S. REEVES, A. DU, D.R. BRAUN, J.W. HARRIS, A.K. BEHRENSMEYER, B.G. RICHMOND.

4:15 **A morphometric examination of** *Homo naledi* **teeth from Dinaledi Chamber, Rising Star cave system, South Africa.** J.K. BROPHY, L.K. DELEZENE, A.N. GURTOV, J. HAWKS, J.D. IRISH, D.J. DE RUITER.

4:30 **"By the skin of their teeth": Instrumental striations on Neandertal and early modern human anterior teeth challenge the assertion of differential visuospatial integration and extended cognition.** J.C. WILLMAN.

4:45 **Dental development and life history in** *Homo naledi.* Z. COFRAN, M.M. SKINNER, C.S. WALKER.

5:00 **Break.**

Session 57 **Human Biology and Skeletal Studies**
Contributed Podium Presentations. Chair: Chelsey A. Juarez.
Atrium Ballroom C.

2:00 **Energetics and Muscle Use of Human Climbing.** E.E. KOZMA, D.A. RAICHLEN, B.M. WOOD, H. PONTZER.

2:15 **Investigating variation in age at menarche: relationships between gene methylation and reproductive traits in rural Polish women.** M.P. ROGERS, K.M. LEE, A. GALBARCZYK, G. JASIENSKA, R.S. MALHI, K.B. CLANCY.

2:30 **Cyclical Nursing Patterns in Wild Orangutans Recorded in Teeth.** T.M. SMITH, C. AUSTIN, K. HINDE, M. ARORA.

2:45 **Human pelvis shape, stature, and head size covary in a way that alleviates the obstetric dilemma.** B. FISCHER, P. MITTEROECKER.

3:00 **Analyzing the biological relatedness of individuals from a late 1800s Missouri cemetery.** C.E. SKIPPER, D.J. WESCOTT.

3:15 **Identifying Region of origin in a 18th Century Charleston Slave Cemetery.** C.A. JUAREZ, S. ABEL.

3:30 **Regional and extra-regional dental affinities of populations between the Late Neolithic and Copper Age in the Portuguese Estremadura.** K.T. LILLIOS, J.D. IRISH, A.J. WATERMAN, A.M. SILVA.

3:45 ~~**Comparing Methodologies for Documenting Commingled and Fragmentary Human Remains.** E. SUSSMAN, M. PERRY~~ *Withdrawn*

Session 58 **Injury Recidivism and Violence: Perspectives from Bioarchaeology and Forensic Anthropology**
Invited Poster Symposium. Chair: Caryn E. Tegtmeyer.
Co-organizers: Debra Martin.
A 701.

The idea of injury recidivism has been a part of the forensic, clinical and medical literature for some time as have the concerns surrounding it. The goals of this session are to examine a wide range of case studies where injury recidivism has been interpreted to be part of a cultural pattern of violence targeting specific individuals or subgroups. For example, we are interested in addressing the possible long term effects of blunt force trauma on the cranium and other areas of the body among at-risk subgroups. Injury recidivism is often defined as the reoccurrence or accumulation of injuries and trauma (and their sequelae) over time as a result of beatings, altercations or provocations. In the clinical literature, injury recidivism is sometimes correlated with mild to moderate traumatic brain injury (TBI) which initially results from blunt force trauma to the head, leading to (often unrecognized)

neurological and behavioral problems (short or longer term) with anger management and decision making. Consistently, worldwide studies have shown that individuals who are beaten early in life continue to sustain non-lethal injuries throughout their lifetime. In terms of overall health and well-being, nonlethal violence contributes to what epidemiologists call "allostatic load", referring to the accumulation of physiological stress and insults to the body over the course of a lifetime and can contribute to the overall deterioration of the body. Injury recidivism is particularly high in correctional facility populations, the homeless, victims of domestic abuse and minority populations. This session will help develop **methodological rigor and the application of standards** to the analysis of injury recidivism. Hopefully what will emerge is a "best practices" set of recommendations for how to identify, diagnose and predict for repeated trauma on skeletonized human remains and the ways that related (but often hidden) injuries can be better contextualized and understood.

Poster set-up 12:45 – 1:00; Poster take-down 4:45 – 5:00
Even numbered poster authors present 2:30 – 3:30; odd numbered poster authors present 3:30 – 4:30.

4:30 **Discussion: Debra Martin.**

1 **Just what the doctor ordered: Socioeconomic status and subsequent injury in Pre-Industrial and Industrial London.** D.A. BOYD, C.F. MILLIGAN.

2 **Witnessing Exploited Bodies: The Bioarchaeology of Violence Recidivism and Labor Abuse in 19th-Century Chinese America.** J.J. CRANDALL, R.P. HARROD.

3 **Patterns of trauma, recidivism, and violence in urban and institutionalized 19th-century-born African Americans and Euro-Americans.** C.M. DE LA COVA.

4 **Polytrauma or Injury Recidivism? A bioarchaeological analysis of individuals with multiple injuries.** R.P. HARROD, A.Y. WILLETT, M.A. KINCAID, A.R. WOODS.

5 **Disability, disease, trauma, and stigma: did chronic infection with syphilis influence experiences of trauma and recidivistic trauma in post-medieval London?** M.K. ZUCKERMAN, M.L. DAVENPORT.

6 **Trauma Recidivists at Neolithic Catalhöyük (Turkey): Social Context and Implications.** C.J. KNÜSEL, B.A. GLENCROSS.

7 **Cranial Trauma and Victimization among Ancestral Pueblo Farmers of the Northern San Juan Region .** K.A. KUCKELMAN.

8 ~~**A Life History of Skeletal Trauma: Cases from a Medical Examiner's Office.**~~ ~~J.C. LOVE, S.M. DERRICK~~ *Withdrawn*.

9 **Injury recidivism and early mortality in the Danish West Indies: a case study from the Holy Trinity Lutheran Church.** S.A. MATHENA, M.K. ZUCKERMAN, V.R. PÉREZ.

10 **An Exploration of Skeletal Evidence of Injury Recidivism in Cases of Transients from Northern California.** J.R. PRINCE, H.L. MACINNES, C.F. MILLIGAN, E.J. BARTELINK.

11 **Do people with multiple injuries also have poor health?** R. REDFERN, S. DEWITTE, M. JUDD.

12 **Socializing Violence: Interpersonal Violence Recidivism at Abu Fatima (Sudan).** S. SCHRADER.

13 **Recidivism of Traumatic Injury in the Bass Donated Skeletal Collection.** D. STEADMAN, H. MAIJANEN.

14 **Patterns of Violent Crime and Injury Recidivism in Southern Nevada.** C.E. TEGTMEYER, D.L. MARTIN.

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Male reproductive skew in multimale social groups of Verreaux's sifaka (*Propithecus verreauxi*) at Kirindy Mitea National Park, Madagascar

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In many non-human primates living in multimale groups, male reproductive success is usually skewed towards dominant individuals. Models of reproductive skew predict that female monopolization by males depends on the number of receptive females that can be monitored by the dominant male and the number of males in the group that might constitute competitors for access to females. However, female reproductive strategies might hinder dominant males' monopolization of matings by providing reproductive opportunities to non-dominant and extra-group males. We explored male reproductive skew in a population of Verreaux's sifaka (*Propithecus verreauxi*) living in Kirindy Mitea National Park, Madagascar. Using an array of 14 microsatellite markers, we analyzed maternity and paternity for 32 individuals born in five social groups between 2007 and 2012. Out of 27 offspring whose paternity was successfully assigned, 85% were born to either the sole resident male in single-male groups or to the dominant resident male in multimale groups. Dominant males in multimale groups sired 71% of offspring, however, this result was not significantly different from an even distribution of paternities among dominant and subordinates. Male reproductive skew was also not significantly biased towards males with longer tenure. Although dominant males in multimale groups were unable to completely monopolize female matings, subordinates' reproductive success did not increase when more females were present in the group. Our study suggests that in this female-dominant species, female choice may play an important role in paternity distribution because intersexual dominance relationships may prevent males from monopolizing female reproduction entirely.

Supported by the L.S.B. Leakey Foundation and the University of Texas at Austin

Hybridization in human evolution

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Hybridization occurs in almost all sexually reproducing groups of organisms, resulting in the transfer of genes from one lineage to another. Hominins are no exception. A number of studies of both fossils and DNA have pointed to a complex picture of lineage divergence and remerger, resulting in the diverse phenotypes and genotypes we see among living people. Although the emphasis of these studies has been on the contact between lineages in Eurasia in the late Pleistocene, studies of African diversity, ancient DNA from earlier time periods, and evidence from other comparative studies suggest that gene exchange was widespread both in time and space and may be responsible for a considerable amount of diversity we see across the fossil record. Lingering resistance to hybridization as an important driver in human evolution persists in part because it involves a paradigmatic change on the question of modern human origins. It also necessitates rethinking the adaptationist mindset to considering diversity, and questioning the applicability of our species concepts. This provides a conceptual challenge, but also an opportunity for fresh exploration into how, when and why human complexity emerged. Gene flow can be a powerful evolutionary force, creating variation and novelty. Because sample sizes of fossils and especially ancient DNA are small, and humans represent an unusual case given our migration to myriad environmentally and climatically diverse regions, model organisms drawn from a wide range of contexts can provide some of the most important insights into understanding the likely dynamics and outcomes of this process.

Research supported by grants from the University of Cape Town, the National Research Foundation of South Africa and the DST/NRF Centre of Excellence in Palaeosciences (COE-Pal).

Foiled again!: Playback experimental evidence that saki and titi monkey alarm calls deter ambush predators

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The primary function of alarm calls is thought to be intraspecific communication – to warn group members or to cause changes in conspecific behavior that reduce risk to callers. An alternative, albeit not mutually exclusive, hypothesis is that alarm calls act as 'deterrent' signals, informing a predator its presence has been detected and a successful attack is unlikely. This is especially important when encountering ambush-style predators like felids that rely on surprise attacks. Although intriguing, almost no studies have tested this by focusing on predator response to prey vocalizations. We conducted playback experiments (n=40) on two radio-collared ocelots (*Leopardus pardalis*) at Peru's Estación Biológica Los Amigos using audio of saki (*Pithecia irrorata*) and titi monkey (*Callicebus brunneus*) alarm calls. Loud calls emitted outside of predator contexts were used as control stimuli. For 15 minutes following each trial, we triangulated the felid's position and mapped movements in ArcGIS. If alarm calls function as deterrent signals, then we expect ocelots to depart the area after exposure to alarm calls but not control playbacks. Preliminary results indicate a significantly different pattern between trials (Fisher's exact, $p = 0.001$); ocelots moved away or departed the area (>50m) in 73.7% of alarm call and 15.8% of control playbacks, whereas subjects had no change in location or approached the playback source in 84.2% of control but only 26.3% of alarm call playbacks. We conclude that these alarm calls may have evolved (at least in part) as deterrent signals to ambush predators.

This research was supported by The Ohio State University (Columbus and Mansfield), Animal Behavior Society, Society of Integrative and Comparative Biology, Tinker Foundation, and National Science Foundation (BCS-1341174).

Impact of population-specific dental development on age estimation

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Dental age estimation techniques are commonly utilized in forensic and archaeological contexts. Two methods commonly used are from Ubelaker and AlQahtani *et al*. The age ranges outlined by Ubelaker are based on dental eruption of a Native American population. Whereas, the method of AlQahtani *et al.* focuses on dental development as observed in a sample of British White individuals. The applicability of either method to modern forensic samples has yet to be adequately demonstrated. The present study is a test of these methods on a diverse set of modern individuals with known ages and ancestry with consideration of developmental differences between populations.

Data were collected from 379 individuals from the James K. Economides Orthodontic Collection at the University of New Mexico. The sample consisted of 46 African Americans, 31 Asian Americans, 101 European Americans, 100 Native Americans, and 101 New Mexico Hispanics. Individuals were scored blind to chronological age, ancestry, and sex. Ubelaker performed with an accuracy rate of 84.6%. The London Atlas produced an accuracy rate of 45.4% with an average error of 2.29 years. Developmental differences were identified between ancestral groups. African American and Native American samples exhibited earlier development than the European American and New Mexico Hispanic samples. According to these results, practitioners should use Ubelaker as it accounts for a greater range of intra- and inter-population variation. However, it is suggested that an updated atlas with inclusion of more ancestral groups and consideration of secular change should be developed.

Macromammalian faunas and biostratigraphy of the Drimolen Main Quarry deposits, South Africa

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The Drimolen palaeocave Main Quarry deposits have been excavated intermittently over two decades and has yielded a rich record of fossil hominins (*Paranthropus robustus*, *Homo* sp.) and associated mammals. To date, publication on the non-hominin mammals has consisted solely of a preliminary faunal listing and primary description of the Carnivora. Here we present the first accounting of the non-hominin macromammals recovered from the Main Quarry to date, and the impact of this data on deposit biochronology, from a comprehensive revision of all 1,357 taxonomically identifiable specimens (NISP) derived from at least 132 individuals (MNI).

Two primate species (*Papio hamadryas robinsoni*, *Cercopithecoides williamsi*) comprise nearly half (NISP: 554, MNI: 56) of the remains from the Main Quarry. The second-largest group are antelopes (NISP: 672, MNI: 51) that contrast with nearby site samples in the dominance of extinct springbok (*Antidorcas recki*). Also in contrast to other nearby assemblages is the limited incorporation of hyrax (*Procavia*), porcupine (*Hystrix*), equid (*Equus quagga* ssp.) and suid (?*Metridiochoerus*); yet single specimens of rarely species - an indeterminate elephantid and aardvark (*Orycteropus* cf. *afer*) - occur in the sample. Our revision and expansion of the Carnivora (NISP: 90, MNI: 16) has resulted in the first identification of the hyaenid *Lycyaenops silberbergi* and felids *Dinofelis* cf. *barlowi* and *Megantereon whitei* in the deposit sample.

Our revised and expanded interpretation of the Main Quarry faunas indicates deposition of at least some (or most) of the sample ~2.0 Ma; contrasting prior suggestions of faunal deposition as late as ~1.4 Ma.

This research into the Drimolen faunas has been funded through Monash University.

Comparison of molar metric variation and dental microwear among three species of *Parapapio* from the Pliocene cave site of Sterkfontein Member 4, South Africa

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Sterkfontein Member 4 has yielded three species of *Parapapio*: *Pp. broomi*, *Pp. jonesi*, and *Pp. whitei*. Prior analyses of dental metric variation indicated that *Pp. whitei* exhibits the largest molars and *Pp. jonesi* the smallest. However, craniofacial morphometrics and isotopic values have shown a lack of clustering of individuals with respect to taxon, while dental microwear analyses have suggested that all *Parapapio* from Sterkfontein exhibit evidence of hard-object consumption, particularly *Pp. broomi*. Using digital images from dental casts, measurements were taken of the molar dimensions of *Parapapio* (n=30), including *Pp. broomi* (n=10), *Pp. jonesi* (n=10), and *Pp. whitei* (n=10). A subsample of the same casts were examined using low-magnification stereomicroscopy to detect differences in use-wear scars. A comparative sample of *P. ursinus* (n=10) was included in the use-wear analysis to provide paleoecological inferences. A bivariate relationship between mesiodistal and buccolingual dimensions of the first molar with 95% confidence ellipses suggests that *Pp. whitei* is largely distinct from *Pp. jonesi* but that *Pp. broomi* partially overlaps both these taxa. Analysis of variance indicates that *Pp. whitei* is significantly larger than both *Pp. jonesi* and *Pp. broomi* in molar dimensions. For dental microwear features, *Pp. broomi* has significantly more coarse scratches compared to *Pp. jonesi* and *Pp. whitei*, whereas *Pp. jonesi* has a significantly greater number of hypercoarse scratches than *Pp. whitei*. A discriminant function analysis of all dental microwear features largely separates the taxa, indicating potential dietary differences that are reflected in the molar metric variation.

Funding for this research was received from the Office of the Vice President for Research at Georgia State University.

Exploring the relationship between radiographic and osteologic measurements of the human talus

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Plain radiographs of the foot are a common form of examination when medical evaluation is indicated, providing information on bone morphology and angular relationships. Since plain radiographs are commonly performed, their availability makes them useful for studying human variation where large sample sizes are crucial. Talar morphology is critical to understanding human foot form and function, but few studies have examined the accuracy of talar measurements taken from plain radiographs. If these radiographs are to be used in quantitative analysis of the talus, their accuracy must first be demonstrated.

For this study, fifty feet from amputated human limbs were collected, imaged in standard radiographic views, and skeletonized. Measurements that represented overall talar length, talar body length and height, talar head-neck length, and talar head and neck width, were performed on each skeletonized talus and radiograph. The accuracy of the radiographic measurements was evaluated using paired Student's t-test and correlation analysis. All measurements are different (all $p \geq 0.05$), but the overall talar skeletal measurements are correlated (all $r > 0.79$, $p < 0.001$) with the radiographic measurements. The talar head width measurement is also correlated ($r = 0.88$, $p < 0.001$), but the neck width ($r = 0.37$, $p < 0.001$) and head-neck length measurements ($r = 0.17$, $p < 0.001$) are less so.

Measurements taken from radiographs provide useful information about the talus, suggesting that radiographs of living individuals can be evaluated quantitatively, compared to osteology collections of modern humans, and used in the interpretation of the hominin fossil record.

Developmental shift or postnatal plasticity? Manual and pedal variation in two populations of *Microcebus griseorufus* at Bezà Mahafaly

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Under the "Narrow Niche Hypothesis" (NNH), long posterior digits are adaptive in arboreal environments to facilitate grasping thin, unstable branches. *Microcebus griseorufus* is an arboreal primate residing in forests in southern and southwestern Madagascar. We compare neighboring *M. griseorufus* populations to investigate whether autopod proportions conform to NNH expectations: one from a gallery forest with denser canopy and numerous small branches, the other from a spiny forest with more vertically-oriented, large supports and less ground cover. Previous research indicates these populations are phenotypically variable but genetically similar.

Data were collected on the hand, foot and head of adults and juveniles from the Bezà Mahafaly Special Reserve (BMSR). T-tests show significant differences in standardized manual and pedal digit lengths in both adults and juveniles (*p-value* < 0.001). A cross-validated discriminant function shows 98.7% correct classification for adults and 100% for juveniles when using digit length — a rate higher than for head variables (87.3% and 56.7%, respectively). Unbiased QSTs indicate divergent morphologies, especially in the foot (0.43). All tests indicate significant autopod differentiation in a pattern consistent with NNH expectations. Gallery forest individuals possess a shorter hallux/pollex and longer posterior digits.

We present two proximate pathways by which these contrasting patterns could arise: [1] postnatal plasticity stimulated by differing locomotor strategies and [2] heterochronic shifts during development regulated by currently

unknown genetic or epigenetic factors. While plasticity cannot be ruled out, our results are better explained by a heterochonic shift in BMP-signaling that acts during the chondrification stage of digit development.

Heritable traits and their impacts on child health in a Caribbean village

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Ancestry, individual genetic variation, and the environment work together to influence health and susceptibility to conditions such as metabolic syndrome. While many clinical studies have identified genes associated with disease phenotypes, and anthropologists have analyzed variation as it relates to ancestry, rarely have these been combined to assess their overall impacts on health. More research is needed in admixed populations to address specific influences of ancestry, selection pressures, and individual genetic variation on a variety of health conditions.

Longitudinal data from a Caribbean village document the high prevalence of metabolic syndrome in an admixed population that has experienced a recent shift to more sedentary lifestyles, and a detailed genealogy allows us to assess additive genetic trait variances. We quantify repeatabilities and heritabilities of height, weight, and BMI for children aged five through nineteen in the village of Bwa Mawego, Dominica using variance component estimation. Analyses of longitudinal data show strong repeatabilities for these traits throughout childhood, indicating that early measures of child health often predict long-term conditions such as obesity. Moderate heritabilities from this admixed population reveal a genetic signal for these traits, explaining the variation observed between families in this village regarding metabolic syndrome. These results demonstrate the value of longitudinal data with regards to child health outcomes as well as the importance of exploring genetic variation in admixed populations.

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Factors associated with generalised and abdominal obesity among Bangladeshi migrants in UK

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South Asians face challenges of general obesity and central adiposity with increased risks for diabetes and cardiovascular diseases (CVD). This is compounded among migrant communities by financial and acculturation pressures. We assess the prevalence of obesity and central adiposity among 562 first- and second-generation, British-Bangladeshis in north and south England as part of a larger study on acculturation and health. We hypothesized that Bangladeshis in the economically-deprived north, as well as females and less affluent first-generation migrants would be more obese with a higher waist circumference (WC).

Several studies have shown that, for an equivalent risk of diabetes and CVD, a lowered body mass index (BMI) and WC is appropriate for Asian populations. We use the World Health Organization suggested cut-off point of BMI $\geq$27.5 kg/m^2 for Asians for generalized obesity. For abdominal obesity, $\geq$80cm and $\geq$90 cm WC is used as cut-off among men and women, respectively. Logistic regression was performed to determine factors associated with generalized and abdominal obesity.

Only some of our hypotheses were supported. About 27% male and 35% female Bangladeshis had generalized obesity, whereas prevalence of abdominal obesity was higher (male= 39%, female =62%). While generalized obesity was significantly higher for females and better-educated Bangladeshis, abdominal obesity was significantly higher among females, second generation migrants, those with financial difficulties, and those who did not walk on a regular basis. Poverty reduction strategies, health education and behavioral changes may help in tackling the high prevalence of obesity among Bangladeshis living in England.

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Biological and cultural approaches to the study of population affinity among contemporary Pre-Columbian Cuban burial populations, through the analysis of cultural dental modifications and dental non-metric trait analysis

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Canímar Abajo, a multi-component shell midden necropolis dated from 1380 BC to 950 AD with two distinct overlying cemeteries separated by a midden layer representing a roughly 1000 year burial hiatus, raises questions regarding the cultural continuity and biological affiliations of the populations utilising Canímar Abajo and their interactions with other early Cuban populations. Biological and cultural traits recorded in the human dentition were examined to identify the relatedness between the two distinct cemetery populations at Canímar Abajo. The sample examined includes the dentition of 88 adult individuals from Canímar Abajo, from both cemeteries, and 20 individuals from three other 'Archaic' Cuban sites housed in the University of Havana. The biological affiliation of these two Canímar Abajo burial populations was determined through the use of biological distance statistics based on frequencies of dental morphological traits between the two cemetery populations and contemporary Cuban burial populations. Additionally, these dental samples were examined for evidence of dental modifications, which are culturally specific traits. Preliminary analysis indicates that both cemetery populations at Canímar Abajo share a common biological and cultural connection, despite a 1000 year hiatus in burial activity.

The human brain evolving : a diachronic study of endocranial variation

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Although human brain anatomy is well-known, its variations throughout the recent evolution of our species are poorly documented. However, studying brain shape variability through time is essential in order to gain a better understanding of cerebral evolutionary mechanisms.

The present study analyses, compares and visualises the variations in morphology between Upper Palaeolithic specimens from the Cro-Magnon and Pataud shelters (France), Epipalaeolithic specimens from Afalou (Algeria) and Taforalt (Morocco), and a sample of extant humans.The size, shape and some vascular and convolutional details of the endocrania (casts of the inside of the neurocranium) of these prehistoric and extant *Homo sapiens* are studied and compared in the form of 3D models.

We used the Deformetrica software to run landmark-free morphological analyses and to create visualisations of a range of differences among the endocasts of these groups of humans, which represent different chrono-cultural contexts, for scientific and didactical purposes.

Our results support evidence that the reduction in brain size over the past 20000 years is associated with a compression of the brain in the antero-posterior axis and with changes in the relative size of cerebral areas. The frontal and occipital lobes become relatively smaller while the parietal lobes and cerebellum, although smaller in size, become larger in relative terms. This high plasticity of the human brain makes functional interpretations from the size and

shape of fossil brains problematic. Our ongoing work improves our understanding of current endocranial variability, which will allow more useful comparisons between extant humans and non-human *Homo* species.

Neurodevelopmental disorders as models for developmental interactions between brain and skull in human evolution

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The brain and skull develop and function as a tightly integrated system. This integration allows us the use of endocasts as proxies for the brain in extant and fossil specimens, affording the only direct evidence of brain evolution. As evolution occurs via changes in development, differences in endocast morphology among taxa result from divergent developmental patterns. However, it is unclear whether this affects the interdependence of brain and skull, and therefore the associated endocasts. One strategy for addressing this question is through study of distinct craniofacial morphologies within a species. For example, a number of developmental disorders have characteristic brain and skull features, such as Down Syndrome, Fetal Alcohol Syndrome, and Autism Spectrum Disorders.

In this study, premature cranial suture fusion, craniosynostosis, serves as an example for studying brain/skull interaction in differing craniofacial shapes. Size and shape of the brains and endocasts as measured from magnetic resonance images (MRIs) are statistically compared among four groups of infants with morphologically distinct head shapes following approved IRB protocols: infants with unilateral coronal, metopic, or sagittal craniosynostosis, and typically-developing infants. Results demonstrate no significant differences in brain or endocasts volumes among groups. However, volume of subarachnoid space (between brain and endocranium) differs significantly, with the location of increased/decreased space differing among groups. Surprisingly, the range of variation in all measures was greater within groups than among them. These results demonstrate additional study of both intra- and inter-specific variation in brain/skull interaction is needed to accurately interpret the fossil record.

Work supported in part by NIDCR R01 DE018500 and the MU Departments of Pathology & Anatomical Sciences and Surgery.

Migration Waves and Genetic Drift in the Peopling of Fuego-Patagonia

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The human colonization of Fuego-Patagonia is plagued with questions regarding the origin, timing and routes followed by its first colonizers (inland hunter gatherers), as well as the origin of later, highly specialized, marine populations. This study presents results obtained based on the analysis of mtDNA extracted from 20 prehistoric teeth, dated between 7,200 and ~700 cal yrs BP, and 38 modern individuals (Kawesqar, Mapuche-Huilliche and Yagan). The analysis shows that prehistoric settlers carry three distinct Native American founding haplogroups (C1, D1 and D4h3a), whereas modern groups correspond to the C1b, C1b13, D1, D4h3a, and B2i2 haplogroups among others. The prevalence of D1 and C1 haplogroups among modern Mapuche-Huilliches in the region (38.5% and 53.8% respectively) likely respond to a later migration, during historic or protohistoric times, that reflects the influence of populations from central Chile and Argentina that introduced lineages C1b13 and B2i2, while they mixed with local, long-time, resident groups. Haplogroups D1 and C1 account for most of the variation among the Yagan (40% each) which likely reflects processes of genetic drift characteristic of groups of small size, and the population decimation that resulted from the introduction of new diseases associated with European and Criollo colonization. Among modern Kawesqar 60% of those sampled present the D4h3a haplogroup, which is also found in prehistoric marine settlements in the archipelagos of Patagonia? This later haplogroup may reflect a second migration wave composed by individuals adapted to marine life that were moving along the Pacific coast, as early as 6,500BP.

This research was funded by the Genographic Program, National Geographic Foundation. Grant #: 14-01.

Beauty, brains, and brawn: phylogenetic and ecological interpretations of new virtual endocasts of large-bodied subfossil lemurs

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Extant primate suborders Strepsirrhini and Haplorhini display distinct endocranial shape differences that are correlated with suborder differences in encephalization and brain proportions. However, endocranial shape possesses a strong allometric component that may confound suborder differences, as modern anthropoids occupy a greater body size range than do extant strepsirrhines. Large-bodied subfossil lemurs expand the range of strepsirrhine body size and ecological diversity to greater overlap with haplorhines, allowing us to more fully evaluate the relationship between phylogenetic, allometric, and ecological correlates of endocranial diversity within and between primate suborders.

Virtual endocasts were reconstructed from micro-CT scans of subfossil lemur crania from the Duke Lemur Center (*Mesopropithecus*, *Archaeolemur*, *Babakotia,* and *Hapalemur*). A 3D morphometric analysis was conducted including a comparative sample of 54 extant primate species. Principal Component (PC) scores from Procrustes-aligned landmark sets were tested for correlation to endocast volume (ECV), body size (reconstructed from craniodental dimensions), and diet category (estimated from upper molar shear quotients).

Despite their large bodies and—in the case of *Archaeolemur*—relatively large brains for lemuroids, the subfossils are distinctly strepsirrhine-like in endocast shape. PC1 separates strepsirrhines and haplorhines, and is correlated with residual ECV (RSquare=0.33, $p<0.001$). PC2 weakly correlates with body mass (RSquare=0.12, $p=0.04$), indicating that strepsirrhine and haplorhine endocasts "get big" in somewhat the same fashion, while retaining key characteristics that are diagnostic of their suborder and related to brain proportions rather than overall size. Finally, residual ECV estimates for subfossil lemurs are not consistent with a strict relationship between diet and encephalization among strepsirrhines.

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On the edge of the empire: A craniometric analysis of group affinities from an Ottoman garrison in western Romania

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Recently, 160 human skeletal remains were excavated from the city center of Timişoara, Romania. This cemetery dates to the 15th and 16th centuries, a brief but dynamic time period when the Ottoman Empire expanded into Central Europe and utilized Timişoara as an important defense center. The inhumations are a representative sample of the population relocated into the fortified center during the ~150 years of Ottoman occupation. Here, we present a comparative study of craniometric variability that aims to better understand the population history of this group.

An inter-observer analysis of eight skulls from Howell's craniometric database was conducted to ensure comparability of data. Thereafter, 38 measurements were obtained from 28 crania in the Timişoaran sample. Two geographically-proximate populations from the

Howell's database – Berg and Zalavar – were employed as comparative data. Principal Component Analyses of size-adjusted data show broadly overlapping similarities among the three populations. However, MANOVA found all three groups to differ significantly, suggestive of different among-group shape patterns. Moreover, statistical analyses comparing males and females from the three groups indicate a substantial difference in average shape between the Timişoara males and females not found in the other two groups. These results might indicate inflated sexual dimorphism compared to the other European populations, or a different migration history for the Ottoman males and females buried in Timişoara. This study illustrates how biological data and historical information can be combined to better understand the effects of migration and military expansion in the past.

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Patterns of mutations in exome sequencing seen as an effect of sampled genes

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Human mutations are generally studied as individual or genome-wide approaches, and rarely the patterns of variations are studied for samples of genes for a group of individuals. This study shows the patterns of human variation for a group of genes, in order to assess the effects of gene sampling on the quantity of variations.

We performed whole-exome sequencing in 36 individuals and sampled 1000 lists of 143 random genes, from 16000 genes and performed a counting of variants found in each list. Each variant was separated by their impact on the protein in ten categories, frameshift, splicing, stopgain/stoploss, nonframeshift indels, missense (separated by in silico prediction of pathogenecity from zero to five), and synonymous. After the separation each individual had their variants counted as benign (population frequency above 0.05), polimorfism (frequency between 0.05 and 0.01), rare (frequency below 0.01), and private (exclusive of the individual). The quantity of variantions were normalized by the total of mutations in each category of mutations in each list.

We found that for mutations predicted to be loss-of-function there is not a clear separation of ratios between the frequencies groups, but for synonymous and missense mutations predicted as benign there is a clear separation and the quantitiy of benign mutations is not smaller than 0.1 for missense and 0.05 for synonymous. The ratio of private frameshift mutations is not superior to 0.25, and nonframeshift indel mutations have more benign variants than missense variants with pathogenicity three.

Mosaic and homoplastic evolution of the hominoid skeleton precludes 'overall' ancestral reconstructions based on single-taxon models

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For more than a century, models of human evolution have been guided by competing hypotheses of phylogenetic relationships. The 'molecular revolution' resolved the *Gorilla-Pan-Homo* trichotomy and, in combination with later paleontological discoveries and molecular clock advances, they confirm that *Pan* and *Homo* are sister taxa sharing an African last common ancestor (LCA) approximately 7-6 Ma. This finding is the primary basis of the 'chimp-like LCA paradigm,' which posits that *Pan* is a 'living fossil' reflecting the behavior, anatomy, and overall biology of the LCA.

The current fossil record is rich with partial skeletons of extinct apes and hominins that form part of the project presented here that analyzes the evolution of selected postcranial regions from a morphometric and phylogenetically informed viewpoint. Our results reveal stepwise mosaic evolution of the skeleton (i.e., fossil hominoids have no extant analogues) and pervasive homoplastic evolution of traits related to specialized antipronograde behaviors. Extinct and extant primate taxa can provide good LCA models for *specific* regions, but not for the whole organism –implying that Cuvier's principle of correlation of parts does not apply to hominoid evolution. Our results highlight that phylogenetic proximity does not necessarily predict phenotypic evolution. This inference agrees with modern genomics: humans and *Pan* share ~98% of their genes, but they exhibit remarkable phenotypic differences (resulting from changes in gene regulation rather than in the genes *per se*). Collectively, these results preclude using chimpanzees and bonobos as 'time machines' and indicate that fossils are critical in reconstructing the LCA's mosaic anatomy.

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Men's reproductive ecology and diminished hormonal regulation of skeletal muscle phenotype: An analysis of between- and within-individual variation among rural Polish men

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Human life history is characterized by several distinctive features—sexual division of labor, prolonged care of altricial young, multiple dependents of different ages, and male provisioning. Testosterone has been suggested to mediate a trade-off between men's reproduction and survival, through the regulation of sexually dimorphic musculature. This hypothesis predicts a relationship between testosterone and musculature in which mating effort, elevated testosterone, and dimorphic musculature covary positively. Testosterone is also posited to mediate a trade-off between mating and parenting effort, and accordingly, investing fathers show decreased testosterone production. Because men use their musculature not only in mating competition but also to support work demands, an important component of parenting effort, a relatively fixed relationship between testosterone and muscularity would seem maladaptive. We hypothesize that men's parenting effort, specifically provisioning and subsistence activities, becomes a primary determinant of muscularity. Life history, anthropometric, and hormonal data were collected from 122 rural Polish men (at the Mogielica Human Ecology Study Site) during the summer harvest and for 103 of these participants in the winter. We found that fatherhood jointly predicted heavier workload and decreased testosterone, but positively predicted muscle mass and strength measures. Furthermore, within-individuals, men experienced intensified workload and suppressed testosterone during summer, along with a concomitant increase in muscularity and strength. These findings provide preliminary support for our model, termed the 'Paternal Provisioning Hypothesis'. Between and within individuals, men's provisioning and subsistence activities were robust predictors of muscular development and performance, whereas their testosterone levels had no appreciable effect on skeletal muscle phenotype.

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The impact of kinship and social contact on the gut microbiota of wild, black howler monkeys (*Alouatta pigra*)

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While research has overwhelmingly demonstrated the effect of diet on the mammalian gut microbiota, contributions of other factors such as host genotype and social interactions are less clear. Studies of baboons and chimpanzees, highly social, terrestrial primates, suggest that individuals that spend more time in physical contact possess more similar gut microbial communities. Nevertheless, in contrast to results from human studies, related individuals do not always have more similar gut microbial communities. These patterns suggest that differences in host ecology and behavior impact the mechanisms by which gut microbes are transferred between individuals, but additional data from other primate species with distinct behavioral patterns are necessary. Here, we explore the effect of host kinship and time spent in social contact on the gut microbiota of wild, black howler monkeys (*Alouatta pigra*). In contrast to chimpanzees and baboons, black howler monkeys are arboreal, live in small social groups, and spent less than 10% of their daily activity budget engaged in social activities. Our results indicate that, as found in other hosts, kinship leads to more similar gut microbial communities among individuals. However, time spent in close proximity leads to more dissimilar gut microbial communities. These disassortative affiliation patterns may allow howler monkeys to maintain high gut microbial diversity within populations, but further research is necessary to confirm this hypothesis. Understanding the mechanisms that determine inter-individual variation in the gut microbiota of a variety of wild primates will allow us to examine ecological and evolutionary questions regarding acquisition of specific microbial communities.

Early hominid habitat preferences in the Middle Awash Valley, Ethiopia, from 5.6 to 0.08 Ma: paleosol stable isotope evidence

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The Middle Awash Valley area of the Ethiopian northern Rift Valley contains hominid fossil occurrences ranging in age from 5.8 to 0.08 Ma. Environmental reconstruction with fossil soil (paleosol) and tooth enamel carbon and oxygen isotopes has been used to investigate early hominid habitat preferences for some assemblages. Mio-Pliocene localities yielding *Ardipithecus kadabba* (5.8-5.3 Ma) have slightly lower average δ^{13}Cvalues than those with *Ar. ramidus* (4.4 Ma) in the western lower Aramis Member of the Sagantole Formation, reflecting predominantly grassy woodland in both areas. Eastern Aramis Member paleosols have higher δ^{13}Cand δ^{18}O values, reflecting drier wooded grassland. Lower average δ^{13}C and δ^{18}O values in the Adgantole Member of the Sagantole Formation (4.1-4.2 Ma) reflect a more closed and humid woodland to grassy woodland setting for *Australopithecus anamensis*. Paleosols associated stratigraphically with *Au. garhi* in the Hata Member of the Bouri Formation (2.5 Ma) have higher, more variable δ^{13}C values, reflecting dry wooded grassland to grassland. *Homo erectus* in the overlying Pleistocene Daka Member (1.0 Ma) is associated with even higher values, reflecting more open conditions. Acheulean and MSA sites in the upper Bouri (~0.3 Ma) and Ardu C (<80 ka) beds have even higher δ^{13}C values, reflecting open semi-arid grassland. Average paleosol oxygen isotope ratios increase substantially through time, from an average of -5.8‰ in the early Pliocene to +6.3‰ in the Middle Pleistocene. The large magnitude of this shift may reflect increasing global ice volume through time, combined with progressive subsidence of the Afar Rift region.

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Parasite risk influences the water preferences of lemurs

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Across cultures, humans avoid substances that transmit parasites. This universal repugnance for materials such as feces and vomit is hypothesized to prevent exposure to parasites and the subsequent cost of infection. Despite growing evidence for culturally and biologically based parasite avoidance strategies in humans, behavioral strategies for avoiding parasites have received little attention in other primates. We tested whether lemurs avoid consuming water that presents a potential parasite transmission risk. We studied captive lemurs (*Eulemur coronatus*, *Eulemur mongoz, Lemur catta, Varecia rubra,* and *Varecia variegata*) at the Duke Lemur Center in Durham, NC. We presented subjects with a choice between two sources of water – a clean source and one that was tainted with feces – and recorded how frequently the lemurs drank from each water source. Under the null hypothesis that individuals were indifferent to their choices, we found that the lemurs significantly preferred clean water ($p<0.001$, n=50 drinking events, one-sided binomial test), even when the contaminated water was dilute and more similar to the clean water ($p=0.008$, n=40 events). Preference for clean water was not simply a byproduct of habituation, because it was maintained when both the clean and tainted choices were made to appear novel by adding blue dye. Results of additional experiments support the importance of olfaction in discerning tainted water. These findings suggest that lemurs possess parasite avoidance strategies and point to the importance of underlying psychological mechanisms, including possibly disgust, in motivating the avoidance of contaminated water in nonhuman primates.

The Use of Physical and Cultural Anthropology in Resolving Medicolegal Cases: Forensic Anthropology at the PCOME

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The Pima County Office of the Medical Examiner (PCOME) has investigated the deaths of over 1600 known foreign national "undocumented border crossers" (UBCs) and 800 more unidentified individuals suspected to be UBCs since 2000. Ten years ago, the PCOME started partnering with a cultural anthropologist to better and more thoroughly describe these UBC cases. Today, PCOME forensic anthropologists, both physical and cultural, are actively involved in obtaining missing person reports and comparing postmortem data in an effort at identification. These descriptions, both of the dead and for the missing, are more thorough because of this collaborative effort. The purpose of this poster presentation is to discuss the results of this decade-long collaboration between physical and cultural anthropologists in the investigation and resolution of UBC cases, and to suggest a model for future such collaborations. Although cultural anthropologists have been utilized in international human rights investigations for decades, such expertise is rarely sought out in the domestic context. In the latter, medicolegal cases are generally investigated on a single-case basis, rather than with the collective and social

approach taken internationally. This standard approach is challenged along the U.S.-Mexico border, where a mass-fatality event has been occurring over decades, involving individuals from diverse cultural backgrounds throughout the Americas. The deaths on the border represent a significant social problem, with both causes and effects felt on the collective level. From investigation to notification to research, integrating a social science approach strengthens the work of forensic anthropology in this setting, and likely in others.

Blood in the Villages: Situating Massacres within Broader Social Processes

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Massacres are a unique form of violence that have been documented in both ancient and modern societies. Massacres should not be viewed as events occurring at specific moments in time but rather should be seen as non-random processes. The purpose of the perpetrators of a massacre can vary but often include a desire to eradicate a group of people perceived as the other. In order to gain a broader understating of the history of massacres we examined published data from 15 massacre archaeological human skeletal samples. These cases ranged in time from approximately 12000 BCE to 1300 CE and were from a wide variety of locations including North America, North Africa, Southwest Asia, and Central Europe. Variables used included time period, archaeological context, demography and the interpretation provided by the authors of the study. While patterns were difficult to identify some interesting data resulted from the analysis. For example, 11/15 (73%) of the cases had evidence of torture and/or mutilation of the victims. This included 2 cases (13%) with skeletal evidence suggestive of torture of the feet or legs and 7 sites (46%) with "extreme processing" that was sometimes interpreted as evidence for cannibalism. Demographic profiles published in these cases were often consistent with a typical population profile but abduction of some females was suggested in one study and is possible in at least 2 others based on male to female ratios. Overall, this supports the idea that massacres often target entire communities, including even the youngest members of society.

Pedal Functional Morphology of *Paracolobus chemeroni*

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Paracolobus chemeroni is a large fossil colobine from the Pliocene of Africa. Birchette described its morphology as intermediate between that of terrestrial and arboreal extant cercopithecids based largely on the forelimb. Delson however, suggested that it was relatively arboreal based largely on the foot. Morphological differences among metatarsals and pedal phalanges are driven by a combination of phylogenetic and functional factors often tightly correlated to differences in substrate preference and locomotor pattern. This study compares the morphology of associated *P. chemeroni* metatarsals and pedal phalanges to those of extant Cercopithecidae to explore any patterns that may have functional significance for understanding its locomotor behavior.

A total of 7 measurements were taken on 140 metatarsal and 859 pedal phalanges from both extant and fossil cercopithecid taxa were used to analyze shape along with 7 functional indices and body mass estimates. A comparison of estimated body mass and metatarsal length shows that *P. chemeroni* has a relatively long metatarsus. It also has a large third digit to metatarsal ratio similar to extant arboreal colobines. *P. chemeroni* also has relatively robust metatarsals and proximal phalanges more similar to terrestrial cercopithecines, although significantly less so than *Theropithecus oswaldi*. Further analyses are necessary, but metatarsal and pedal phalangeal morphology suggest that *P. chemeroni* is more robust that extant arboreal colobines, perhaps related to its large size, its digital and metatarsal lengths suggest significant use of arboreal substrates.

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Normal variation in osteocyte lacunar parameters between human skeletal elements in cortical and cancellous bone from adult males - a synchrotron micro-CT approach

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Osteocytes, the most abundant bone cells, together with their lacunar-canalicular network are believed to form an interconnected complex for the regulation and maintenance of healthy bone. High-resolution 3D imaging modalities including synchrotron radiation (SR) micro-CT have recently increased our understanding of osteocyte lacunar parameters in human bone tissue. Previous studies, however, have not focused extensively on inter-element variation in osteocyte lacunar parameters. As such, the objectives of this research are to describe osteocyte lacunar density, spatial distribution and morphology among skeletal elements and bone tissue types (cortical and cancellous bone) from adult males. The sample (n=36) includes bones that are representative of all types from three human males with no known bone-affecting conditions at the time of death. Ages at death range from 40-70 years. Bone blocks (2 mm x 2 mm x 10 mm) were procured from each element and imaged using SR micro-CT at the Canadian Light Source, SK, Canada. Average lacunar densities differ substantially between skeletal elements, with a higher density in those with a greater proportion of cancellous to cortical bone tissue. Shape differences were also evident between cortical and cancellous bone, with elongated lacunae being more prevalent in cancellous bone. Differences in lacunar parameters among bone tissue types may be attributed to higher turnover in cancellous bone. The observed high variation in osteocyte lacunar parameters among skeletal elements signifies that conclusions regarding pathological conditions and aging drawn from osteocyte lacunar data should be situated in a broader context of normal variation.

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Balancing selection and adaptive introgression as sources of advantageous genetic diversity in populations

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The maintenance of advantageous genetic diversity in certain genomic loci is key for the survival of populations, as shown by the extreme levels of diversity in the Major Histocompatibility (MHC) loci. This genetic and phenotypic diversity can be maintained by long-term balancing selection, as in the case of the MHC and many additional loci in the genomes of humans and other primates. Advantageous genetic diversity can also be due to introgression from sister species –in humans, from archaic human forms. This is because introgression can efficiently introduce, in human populations, alleles that were viable (and possibly advantageous) in archaic human forms, potentially increasing diversity in loci where it is beneficial. We analyzed the genomes of Neandertal, Denisova and modern humans to investigate this phenomenon and to identify candidate loci. One such case is the cluster of immune genes TLR1, TLR6 and TLR10. In non-Africans this locus contains not one, but three different introgressed haplotypes; two are most similar to the sequenced Neandertal genome, while the third is most similar to the Denisovan genome. We show evidence of positive selection of the introgressed haplotypes, suggesting that the archaic alleles were likely advantageous shortly after introgression. Interestingly, genetic variation in this locus is associated with changes in gene expression and with differential susceptibility to disease. Thus, both long-term balancing selection and adaptive introgression contribute to the presence of phenotypically relevant diversity in humans.

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Dental anthropology in the Eocene: Using modern approaches to answer long-standing questions in the study of fossil primates

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Since fossil primates are typically represented by dental remains, dental anthropologists have always played a leading role in their analysis. The rich North American record of primate evolution during the Eocene epoch provides many opportunities for modern analytical approaches from dental anthropology. Phylogeny, tempo and mode of evolutionary change, and life history are some of the areas of evolutionary inquiry where the tools and techniques of dental anthropology can contribute to the study of primate evolution in the Eocene. Our micro-CT work explores dental development and correlated aspects of life history on fossil primate teeth, many from our paleontological fieldwork in the Great Divide Basin of SW Wyoming, in order to answer some long-standing evolutionary questions. Imaging of the enamel-dentine junction of a series of upper molars of European (adapine) and N. American (notharctine) Eocene primates reveals the existence of a true dentine horn underlying the distolingual cusps in both groups. This suggests that the proposed distinction between a true hypocone in the former and "pseudohypocone" in the latter group, first proposed in 1916, is invalid. Micro-CT imaging has also allowed us to better understand developmental sequences of the dentition in the poorly known archontans *Plesiadapis*, *Galeopterus* and *Ptilocercus*. In all three, molars erupt before the replacement dentition, following Schultz' rule for animals with a rapid life history. All three taxa also share specialized (i.e., large, procumbent, and/or comb-like) lower incisors, which we suggest influence the development and eruption of the premolars independently of life history characteristics.

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Genetic variability of two colobine primates in Vietnam

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The primates of Vietnam are one of the top global priorities for primate conservation. Nearly 90% of Vietnamese primate taxa are threatened. All 12 colobine species are either critically endangered or endangered. It is important to examine the genetic variability of small and isolated populations in order to assess viability and conservation status of threatened species. The Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) is endemic to northeastern Vietnam, with only 200-250 individuals left in two provinces. The black-shanked douc (*Pygathrix nigripes*) is endangered with a restricted range in southern Vietnam and northeastern Cambodia. Here we assess the genetic variability at mitochondrial HV-I of d-*loop* of one population of Tonkin snub-nosed monkeys and two populations of black-shanked doucs in Vietnam based on 239 fecal samples. Using Next-Generation Sequencing (NGS) and traditional Sanger sequencing, we find zero variability in the Tonkin snub-nosed monkey population, and relatively high variability in black-shanked doucs at Cat Tien National Park and Ta Kou Nature Reserve. We compare these results with published data on colobines and discuss conservation implications for the recovery of endangered populations. While protected habitats are important sanctuaries for the long-term survival of threatened species, genetic bottlenecks may require translocations in order to restore genetic diversity.

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Simulating the effects of migration rates on Neolithic range expansion

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There are two major hypotheses for the spread of agriculture into Europe: cultural diffusion, which states that farming spread through trade and other forms of cultural contact and that any clinal signals observed were established by Paleolithic peoples; and demic diffusion, which states that high–density farming populations migrating from the Near East spread agriculture into Europe replacing hunter gatherer populations. In this latter scenario, the majority of clinal patterns observed in European populations are signals of past range expansions by high density farming populations. We investigated how migration rates may have influenced the development of clines during colonization in Europe by high density farming populations moving out of the Near East after the advent of agriculture. We expected to find that a moderate migration rate would enhance the development of stronger, more patent, diversity clines more so than a high migration rate.

Using simuPOP, an open source collection of python libraries, we simulated range expansions, which typically generate a diversity cline. Migration occurred as a 2D–stepping–stone model with migration rates of 0.2, 0.25, and 0.3. Modeling one locus with two alleles, we tracked heterozygosity for 1000 demes, sampling in the final generation. Our data show that these migration rates do not impact the development of a cline. These results, that clinal signals of range expansion are not visible when the founding populations were of high density, better support the hypothesis that clinal signals in Europe are rather the result of Paleolithic expansions or selection.

Using the periodicity of enamel incremental structures to provide new insights into the initiation, development and timing of crown formation

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Incremental growth layers are visible both within enamel and on the crown surface. These structures reflect periodic variations in matrix secretion by the ameloblasts and, owing to rhythms that are inherent in their formation, provide an independent way of establishing the chronology of crown formation. Over the past 30 years, these structures have increasingly been used to investigate dental development in great detail, allowing researchers to compare ancient and modern hominids without relying on modern developmental standards. Prior to such work, our understanding of the timing of crown formation was mostly based on radiographic studies and anatomical collections of known-age children. Enamel histology is now refining our understanding of dental development and has, for example, added to our knowledge of the crown initiation. The initial mineralization times for permanent teeth are seldom reported, due in part due to the difficulty of x-raying or dissecting the early stages of dental development. The histological analysis of developed teeth has the advantage that the early crown formation is recorded in the enamel below the cusps, and can be studied in unworn or developing teeth. Here, using the developing dentition of Post-Medieval known-age children, we show how histological studies of this kind are refining our understanding of dental development and can provide new data on crown initiation and formation. Further work is required to contextualize some of the observed - earlier than expected - initiation times, and the impact

this may have on our interpretation of cusp and crown formation times.

An integrated perspective on the origin and evolution of *Homo*

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The origin and early evolution of the genus *Homo*, often tacitly linked to the interplay between brain evolution and tools, has long been envisioned as a response to heightened aridity and more open habitats in Africa. Scenarios have attempted to explain a 'package' of bio-cultural features associated with living humans, including our large, linear bodies and elongated hind limbs, large energy-expensive brains, reduced sexual dimorphism, increased carnivory, unique life history traits and increased cooperation particularly as related to reduced interbirth intervals. Yet recent fossil, archeological, and environmental data indicate that the morphological traits did *not* arise as a single package near the origin of the genus nor in stable environments. We analyze the data from ~2.5 -1.5 Ma that suggest at least three lineages of early *Homo* evolved in a context of habitat instability and fragmentation that significantly influenced their populations on seasonal, inter-generational, and evolutionary time scales. Using data from extant human and nonhuman primate populations and 16 fossil 'populations', we test hypotheses arising from this integrated framework that suggest the success of these early taxa, and especially *H. erectus,* was linked to dietary flexibility and increased developmental (phenotypic) plasticity. In this investigation we consider the implications of variation in later species, such as the recently discovered *H. naledi* and *H. floresiensis,* as well as the significance of inter-population level variation in *H. erectus.* And we propose a series of programmatic questions of the extant record that form the necessary framework for understanding future fossil finds.

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The impact of food insecurity and food-based coping on serum folate status: A case study among breastfeeding Ariaal women in northern Kenya

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Prioritizing dietary quantity over quality is reported as one of the coping strategies to ameliorate the effects of food insecurity. This strategy may help maintain energy status but diminish micronutrient health. We hypothesized that folate status would be negatively impacted by this type of strategy when sacrificing folate-rich foods. We tested this hypothesis using data from breastfeeding Ariaal women of Kenya collected during a 2006 drought. A food insecurity index was created from interviews on access to key foods. Women were classified into more (n=74) and less food insecure (n=52) groups using the median as the cutoff. 24-hr dietary recall data with volume estimates provided gram intake of milk and beans, folate-rich foods. Serum samples were assayed for FOLR1, a reverse marker of folate status where high FOLR1 indicates low status. Multiple-sample structural equation modeling was performed to compare the effects of milk/bean intake on folate status between groups, using -ln(FOLR1) as the outcome and controlling for BMI and postpartum time. The groups were equivalent in age, postpartum time, BMI, and folate status, while the more food insecure group consumed less beans/milk ($p<.01$) indicating diminished folate intake. Model comparisons suggest that beans had no impact on folate status in either group while the effect of milk was similarly positive for both groups ($p<.05$). Results suggest that coping with food insecurity by sacrificing beans/milk may not necessarily jeopardize folate status short term. The highly bioavailable folate in dairy products may help food insecure women maintain folate status despite diminished dietary quality.

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Constructions: From Hands and Tools to the Evolution of Language

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This talk reports on a series of computational models integrating data from macaque neurophysiology, primate gesture, and human data (eye movements and brain imaging) on the linkage of language and vision. This report shifts the focus from tools *per se* to the use of tools in constructing assemblages (whether buildings or other tools) and the relation between the external process of construction and the internal processes of envisaging a construct, planning the process of construction, as well as recognizing and imitating acts of construction by others. The notions of complex action recognition, complex imitation, and duality of action (theory of tweaks) provide a bridge between the analysis of praxic action and an action-oriented account of the evolution of the human language-ready brain.

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Morphological assessment of a putative hybrid species, *Trachypithecus pileatus*, based on a 3D geometric morphometric analysis of cranial morpholgy

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The langurs (subfamily: Colobinae) of Southeast Asia have undergone many taxonomic revisions. Incongruent results from recent genetic work suggest the *pileatus*-group langurs (*Trachypithecus pileatus* and *T. geei*) are the result of ancient hybridization between *Semnopithecus* and *Trachypithecus* species. Geographically, these species are distributed between *Semnopithecus* to the west and *Trachypithecus* to the east. The phylogenetic position of the *pileatus*-group langurs is thus uncertain, and in order to resolve their evolutionary history, more data are needed on these poorly-known species.

Forty-five 3D cranial landmarks were collected using a Microscribe-3DX on a sample of 144 adult crania from wild populations of *Semnopithecus* and *Trachypithecus* species, and 28 adult crania of *Trachypithecus pileatus*. Procrustes distance was used to quantify shape differences and pairwise permutation tests with 1000 replications were performed for statistical significance. All subgroups differed from each other in shape (*Semnopithecus* and *Trachypithecus* p=0.00, Procrustes distance=0.05254; *Semnopithecus* and *T. pileatus* p=0.00, Procrustes distance=0.06604; *Trachypithecus* and *T. pileatus* p=0.00, Procrustes distance=0.04550). The mean Procrustes distance between *Semnopithecus* and *T. pileatus* was most comparable to interspecific differences within colobine genera, while the mean Procrustes distance between *Trachypithecus* and *T. pileatus* was most comparable to differences within colobine species. The data suggest the *pileatus*-group langurs are most similar to other *Trachypithecus* species in shape but are also similar to *Semnopithecus* species. The morphology of the putative hybrid *pileatus*-group langurs is thus intermediate to the parent genera rather than extreme, which has implications for understanding the morphological signatures of hybrid speciation.

Divergence With Genetic Exchange

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Darwin included only one figure in the *Origin of Species*, which depicted an "evolutionary tree". This metaphor of evolutionary change is now being challenged. Instead of a tree-like structure, the so-called "web-of-life" metaphor – possessing strands interconnected by genetic exchange – has been supported by a growing number of data sets. The processes underlying this new metaphor have been given various names with one of the most recent being "divergence-with-gene-flow." Examples of genetic exchange-mediated evolution include organisms from all domains of life. Though the mechanisms by which such divergent forms of life exchange genomic material differ widely, the outcomes of interest – i.e. adaptive evolution and the formation of new "hybrid" lineages – do not. This talk will delve into the evidence supporting the new metaphor, with much of the discussion centering on our own species, and those species with which we daily interact.

A Review of the Yale Peabody Museum Osteological Collection of *Pan troglodytes*: Behavioral and spatiotemporal markers of ecology, disease, injury and death

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Museum collections are critical for examination of comparative anatomy, developmental biology and life history hypotheses. For endangered species such as primates, these collections provide spatiotemporal data that are now nearly impossible to replicate. Evaluation of skeletal collections provides insight into species-, population- and individual-level variation associated with environmental, social and epidemiological history.

Here, we provide the first in a series of papers reviewing the great ape collection of the Yale Peabody Museum (YPM). Our paper describes the *Pan troglodytes* skeletal collection. Multiple age and sex classes are represented. All cranial and postcranial elements were assessed regarding developmental, disease, trauma, and socioecological indicators. The majority of the collection is from West Africa, with multiple indicators of metabolic stress present. These are likely associated with nutritional and/or epidemiological factors. Instances of trauma and injury, ranging from antemortem to perimortem events, are described. For some individuals, these injuries are likely associated with intraspecific and intrasexual competition and violence, while others are suggestive of infanticide attempts. Other injuries are associated with interspecific violence, and are of value for forensic examination. Subspecific variation is also observable in the collection. Our initial evaluation provides both a baseline for future research and testable hypotheses using alternate techniques, such as isotopic analyses of calculus and noninvasive genetic testing. Museum collections continue to provide new insights into taxonomic and individual variation and environmental cues, and ultimately allow for comparisons between modern and historic environmental and behavioral variables.

This work was supported by the Yale University Department of Anthropology and the YPM Division of Vertebrate Zoology.

Comparative study of metabolic disease risk factors during nutritional transitions among traditional populations

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The change in subsistence mode from foraging to urban lifestyle has a resulted in a nutritional transition in many populations. Nutritional transitions are often part of the globalization process accompanied by demographic and epidemiological transitions. In general they are characterized by a shift from diets high in fiber and carbohydrates to diets composed of more saturated fat and processed foods. How this nutritional transition affects metabolic health may depend on the current and evolutionary ecology of the population. We looked at health markers such as blood pressure, body mass index, glucose and cholesterol levels to assess metabolic disease risk in adults (n=372) of three ethnic groups in the Gran Chaco of Argentina currently experiencing a nutritional transition. We found high risk for metabolic syndrome based on clinical standards of hypertension (38.4%), high blood glucose (31.7%), high waist circumference (49.1%), and overweight and obesity (77.1%). We compared these risk factors to other traditional populations in different ecologies also undergoing nutritional change. Results suggest that most populations experience increases in body mass during the nutritional transition; however, the metabolic responses accompanying increases in body mass differ among groups.

Effects of age on sexual dimorphism in the adult modern human skull

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The influence of age on levels of sexual dimorphism (SD) in the human skull between subadults and adults is well-accepted, but fewer studies have investigated whether SD levels change throughout adulthood. Some studies suggest that as old age progresses, skull growth continues – especially in the frontal bone and facial region – resulting in more robust old females (and sometimes males); other studies find no relationship between age and skull SD. This study tested whether levels of SD in the human skull significantly differed between sub-equal samples of documented young adults (21-56 yr) and old adults (≥ 56 yr) for 28 standard linear measurements in four 19-20th c populations (South African, European, US African ancestry, US European ancestry) (n = 380). Significant differences between sex and age groups within each population were tested for each variable via two-tailed t-tests and two-way ANOVA (family-wise $\alpha = 0.05$). In South African and European populations, young adults exhibit significant SD for more variables than old adults, suggesting that levels of SD decrease with age in these groups. The two US populations, while exhibiting higher SD levels overall, do not show age-related differences in SD. The contribution of facial variables to total significant SD variables for each age group differs among populations, exceeding half of the total contribution only in South Africans. This suggests that the effects of age on SD in the adult human skull differ among populations, and facial variables are not necessarily more affected by age-related change than other skull variables.

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Rethinking Environmental Effects on Diachronic Change in Adult Human Stature

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Perhaps due to the great range of studies examining diachronic change in adult human stature, bioarchaeologists ascribe myriad environmental effects as causing reductions or increases in mean stature among groups over time. An apparent lack of consensus has emerged about the importance that shifts in environmental factors have in changing stature. For example, ascertaining whether mean stature decreased with the introduction of agriculture depends on the location and time period used for the comparison.

Despite this causal uncertainty, bioarchaeological studies take the position that stature dissimilarities indicate changes in population health. Yet, midparental stature is still the best predictor of offspring stature, even in light of genome wide association studies identifying dozens of pleiotropic effects; stature is a highly heritable trait. Thus, we expect that little of the variance in stature remains to be explained by environmental factors.

This study explores this argument by using archaeological skeletal samples from North American pre- and post-agricultural subsistence

groups with evidence for ancestor-descendant relationships. The fit of variance in stature between temporal groups—treating earlier groups as the parent and later groups as the offspring—was compared to models allowing stature to have narrow-sense heritability values ranging between 0.5 and 0.9, encompassing the range reported in studies of living humans. Models with higher heritability values fit the data better. This indicates that, while the environment contributes to some variance in stature, bioarchaeologists should first account for population structure (using quantitative evolutionary models) in explaining trait variance between groups before assessing potential environmental effects.

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Embodying the Goddess: Tattooing and Identity Formation in Bioarchaeology

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While tattooing is increasingly popular in anthropological research, it is rarely discussed in bioarchaeology owing to the infrequent identification of tattoos in human remains. This is now changing, as computed tomography and infrared reflectography have made it easier to identify tattoos on preserved skin tissues. Like other forms of body modification, tattoos can aid bioarchaeologists in studying social identity formation. However, existing scholarship on tattoos remains mostly descriptive, making it necessary to develop a conceptual framework to better understand how tattooing can advance bioarchaeological research on identity.

In this paper, I present such a framework using ancient Egypt as a case study. I propose indicators for seven rationales for tattooing that can be assessed through combining bioarchaeological data with the systematic analysis of the placement, orientation, order, and symbolism of tattoos.

During the 2014-2015 mission of the Institut Français d'Archéologie Orientale at Deir el-Medina, I identified over 23 figural tattoos. Radiographic data together with analysis of the tattoos demonstrates that tattooing in Egypt was used to permanently and publicly display female religious identities. The presence of multiple instances of tattooing in a single individual further demonstrates that one's religious identity could evolve and grow throughout adulthood. The purposeful placement of divine imagery along the arms and neck enabled the tattoos to be ritually active during religious cult activities, thereby embodying the divine.

This research is further contextualized with broader evidence for ancient tattooing in order to exemplify how the applied conceptual framework aids in bioarchaeological studies of identity formation.

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Nutrition and proportionality: A study of undocumented migrants from the Texas-Mexico border

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Many studies have demonstrated that populations living in favorable socioeconomic environments in the early years of life attain a greater adult stature than populations that do not. However, leg length in proportion to stature is considered a better proxy for childhood nutrition and health status as it remains the same with age. Thus, this study evaluates the health and socioeconomic status (SES) of 34 migrant remains found along the Texas-Mexico border by using relative leg length (LL). The presence of stress indicators such as enamel hypoplasias, porotic hyperostosis and untreated caries lesions is utilized as supportive evidence for poor health and low SES.

Skeletal remains of migrants and 39 documented White Americans with low SES were measured using the revised Fully technique by Raxter et al. (2006), and leg length included femur length, tibia length, and height of the calcaneus and talus. Descriptive statistics show mean differences in relative leg length (leg length/stature*100) by sex; White American males having the highest LL to height ratio (53.84cm) and migrant females having the least (52.53cm). T-tests indicate that relative leg length is statistically significant among the male and female groups. Although both groups are from a low SES, the results indicate a relatively lower SES during growth and development for the migrants. This finding allows us to better understand the migrant group as they consist of unidentified individuals and will assist forensic anthropologists in the development of the biological profile.

Fecal stable isotopes ($\delta^{13}C$:$\delta^{15}N$, %N) used to track infant nutritional development and reveal average weaning age in wild chimpanzees

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The lengths of time between complete and partial dependence on maternal milk and independent feeding are key biomarkers of infant nutritional development and include life history parameters used to distinguish evolutionary changes. Identifying the timing and duration of nutritional development in nonhuman primates is difficult from observations; infants may appear weaned during the day but may continue to nurse at night, or weaned individuals can be classified inaccurately as nursing infants when they make nipple contact for comfort only. To assess observational limitations, we used fecal stable isotopes ($\delta^{13}C$:$\delta^{15}N$, %N) to physiologically track the diets of infant chimpanzees at Ngogo, Uganda, as they transitioned from reliance on maternal milk to adult foods. We analyzed 614 fecal samples from 48 infants varying in age from two months to one year after birth of a sibling, each matched to samples collected from their mothers on the same day. Due to trophic level effects, infants ≤1 year old had average $\delta^{15}N$, $\delta^{13}C$ and %N that were 2.0‰, 0.8‰ and 1.3% greater than their mothers, respectively. These differences decreased gradually with increasing infant age. Isotopic evidence revealed that infants were weaned by 4 years old – more than a year earlier than nipple contacts ceased, which suggests comfort nursing occurred. Juvenile siblings had 0.3% greater %N than mothers, and 0.1‰ greater $\delta^{15}N$, which indicates no nursing overlap between siblings. Our results contribute to a model of chimpanzee nutritional development that is required to ultimately understand human infant feeding, development, and early life history patterns.

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Relationship of molar root and mandibular size in extant great apes

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The mandible and its dentition are inevitably linked in that the mandible is the supporting and embedding structure for the lower teeth; both act together as one functionally integrated module. In primates, a tight positive correlation between dental and mandibular size has been argued previously. Tooth size is mostly referred to as crown size (with differing parameters), and not root size. The term "mandibular size" also varies in its definition from overall mandibular size, to mandibular corpus length, height, breadth and shape, or symphyseal size. Studies investigating the relationship of root (length) and mandibular (symphyseal) size did not find a correlation.

Here is demonstrated that the relationship of molar root and mandibular size is highly complex and only significant in specific aspects. Whether root/mandibular size relationship is significant, depends on the investigated taxon, molar and molar/mandibular parameters applied. The number of correlations is highest in Pan and lowest in Pongo. Relationships of root size measurements and overall mandibular size, as

well as mandibular cross-sectional area are overall significant, whereas mandibular height, width and robusticity only show sporadic correlations.

The results prove that general statements about dental and mandibular size relationships cannot reflect the complexity of the subject, and maybe lead to misinterpretation. Whether dental (root) and mandibular size correlate is highly dependent on the chosen structural parameters and molar position chosen. These facts may influence interpretations of comparative size studies, awaiting further investigation to model the complex relationship between dental and mandibular size in hominids.

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A probable case of rheumatoid arthritis from medieval Transylvania

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Paleopathologists have contributed to enriching what is known about the global history of rheumatoid arthritis; however, little is understood about the occurrence of the condition in the Carpathian Basin of Eastern Europe. This presentation describes a 12th -13th century burial of a young adult woman recovered from the Reform Church in the village of Bögöz, located in eastern Transylvania. This woman suffered from a pathological condition presenting bone abnormalities in the preserved joint areas of both knees, left elbow, metapodials, as well as hand and foot phalanges. These lesions presented as porous, lytic surfaces and have been documented both macroscopically and radiographically. The progression and location of the condition provided differential diagnosis possibilities of rheumatoid arthritis, gout, spondyloarthropathy, or psoriatic arthritis, with rheumatoid arthritis suggested as the most likely condition. The severity of the disease process, demonstrated by the marked lytic destruction of the left elbow joint, suggests that the woman would have had significant loss of movement of her left forearm. Moreover, the lytic destruction of the joint spaces of her lower limb and foot elements would have also impaired or prohibited movement altogether. We use this data, along with contextual information from the burial environment, to interpret the social climate of her daily experience and suggest that this case study is best understood through the recently proposed bioarchaeology of care.

A morphometric approach to Butler's field concept: the deciduous and permanent molars

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The primitive placental mammalian molar field consists of seven postcanine teeth, only four of which are replaced by permanent counterparts. The human permanent molars, often considered separately from the deciduous 'molars', are derived from an extension of the same dental lamina. As such, they are actually part of the primary molar row that does not get replaced. Thus, the deciduous second molar (dm2) and permanent first molar (M1) are meristic elements. Here we present analyses of the crown shapes of upper and lower dm2s and M1s and apply the results to Butler's field concept. Our samples include 104 recent *Homo sapiens,* 39 Upper Paleolithic *H. sapiens,* 18 early *H. sapiens,* 42 Neandertal and 2 *H. erectus* specimens. Of these, 156 represent dm2/M1 pairs from the same individuals. Crown shapes were obtained from occlusal photographs. Principal components analyses were used to explore the patterns of morphological variation across the dm2 and M1 samples. We found that the dm2 of *H. sapiens* preserves a more primitive shape than does the M1. Previous studies have found that the dm2 is also more stable than the M1. These results suggest that the dm2 is more conserved than the M1. Similar studies of non-human primates will establish whether this is true across primate taxa. In terms of Butler's field concept, these findings support the hypothesis that dm2 may be the key tooth of the molar field. This conclusion has implications for studies of evolutionary dental development in the genus *Homo*, primates and mammals in general.

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Human Migration Across the US/Mexico Border

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There are approximately 11.4 million undocumented immigrants residing in the U.S. In 2014 alone, more than 479,000 individuals were apprehended migrating into the United States without proper authorization. The majority of unauthorized migrants are from Mexico, Honduras, Guatemala and El Salvador. Cultural and biological diversity in the U.S. is increasing at rates similar to a century ago and have a significant impact in the field of forensic anthropology. Since 1998, over 6,300 people have died on the U.S. southern border. The Reuniting Families Project (RFP) founded in 2003, aids in the identification and repatriation deceased undocumented border crossers. This presentation includes mtDNA, elemental and skeletal analyses of RFP cases in order to develop our understanding of the biological diversity of these recent migrants.

Mitochondrial HVRI&II were sequenced for 278 deceased border crossers. Ninety-four percent of the cases could be classified into Native American haplogroups. There is little European (4%) or African (2%) maternal genetic contribution despite high admixture rates that vary throughout Latin American. Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) was used to obtain concentrations of 31 elements and Pb isotope ratios from bone samples of 22 positively identified deceased border crossers and 38 documented individuals from the northeastern U.S. Al and Mn discriminated between the two groups and reflect real environmental differences that may aid in provenience. Tin and Gadolinium were virtually nonexistent in the immigrant population and abundant in the U.S. group. Most interestingly, discriminate function analysis gave a cross-validated correct classification rate of 96%.

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Genetic factors influencing the phenotypic variation leading to clinical complaints in sickle cell trait athletes

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Recent reports have cited sickle cell trait (SCT) as the cause of death in several NCAA athletes. The purpose of this study is to identify single nucleotide polymorphisms (SNPs) that may influence the probability of suffering from SCT-related clinical complaints in SCT individuals who participate in strenuous exercise, such as college athletes. Previous research in our laboratory has studied five SNPs related to fetal hemoglobin (HbF) levels, which have been shown to be negatively correlated with disease severity in sickle cell anemia patients. In addition to genotyping these five SNPs in seven new DNA samples, this study looks at SNPs in the *G6PD* gene that cause

G6PD deficiency. The *G6PD* gene encodes the G6PD enzyme that plays a key role in glucose metabolism within red blood cells (RBCs), protecting them from oxidative stress which may cause sickling in SCT RBCs. Two SNPs—rs1050829 and rs1050828—that cause G6PD A-deficiency were genotyped in 29 DNA samples; this form of the deficiency was chosen as it is found commonly in African Americans, who are likely the main subjects of this study. Minor allele frequencies match closely with other African populations (rs1050829=0.333 & rs1050828=0.233). These data will be compared with medical records with the ultimate goal of determining the genetic factors contributing to the SCT-related clinical complaints observed in SCT college athletes.

No evidence for genomic convergence between true echolocating mammals and the aye-aye (*Daubentonia madagascariensis*), a primate percussive foraging and auditory specialist

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Several taxonomically distinct groups of mammals – certain microbats, megabats, and cetaceans (e.g. dolphins) – share morphological adaptations related to echolocation behavior and strong signatures of convergent evolution at the amino acid level across seven genes related to auditory processing. Aye-ayes are nocturnal lemurs with a derived auditory processing system relative to other primates. Aye-ayes tap rapidly along the surfaces of dead and decaying trees, listening to reverberations to identify the mines of wood-boring insect larvae; this behavior has been hypothesized to functionally mimic echolocation. Here we investigated whether there were signals of genomic convergence between aye-ayes and echolocating bats or dolphins. We developed a computational pipeline (BEAT: Basic Exon Assembly Tool) that produces consensus sequences for regions of interest from shotgun genomic sequencing data for non-model organisms without requiring de novo assembly. We reconstructed complete coding region sequences for the seven convergent echolocating bat-dolphin genes for aye-ayes and another lemur, the diademed sifaka (*Propithecus diadema*). Sequences were compared in a phylogenetic framework to those of bat and dolphin echolocators and their appropriate non-echolocating outgroup species. While our analysis reaffirms the existence of well-supported amino acid convergence at these loci among echolocating bats and dolphins, we observed no significant signal of amino acid convergence between aye-ayes and non-primate echolocators. Our results suggest that aye-aye tap-foraging auditory adaptations represent distinct evolutionary innovations compared to echolocating bats and dolphins. These results are also consistent with a developing consensus that convergent behavioral ecology is not necessarily a reliable guide to convergent molecular evolution.

Trabecular orientation in the 3rd metacarpal head of humans and chimps reveals their difference in locomotion behavior

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If Wolff's law is valid, then quantifying the three-dimensional architecture of trabecular bone, specifically principal trabecular orientation (PTO), can reveal locomotor behavioral differences among different taxa. This study measured the architecture of trabecular bone in the 3rd metacarpal head of humans and chimps, and then tested their correlation with their locomotion behavior. We postulate that since chimps, unlike humans, directly load their metacarpal bones during knuckle-walking, trabecular structure in the chimps' 3rd metacarpal head dorsal aspect will be significantly more organized and robust. To test our hypothesis we microCT scanned the 3rd metacarpal from 11 chimps and 12 humans. Three 6mm volume of interest (VOI; palmar, central and dorsal) were selected and trabecular bone properties and PTO were measured. The results revealed unexpected similarities between humans and chimps. In both taxa the dorsal VOI demonstrated the lowest bone volume fraction, the most rod-like trabecular structure, the fewest and thinnest trabeculae, and low organization of the trabecular architecture (degree of anisotropy). Nevertheless, PTO in the dorsal VOI revealed significant differences between humans and chimps. While PTO in humans was clustered together and aligned nearly along the bone's long axis, in chimps PTO was divided into two distinct groups and aligned with an angle toward either the medial or lateral orientations. Our results demonstrate that while trabecular bone properties are probably derived mostly from a shared genetic blueprint, PTO is affected by loading and can serve as a tool to infer locomotion behavior among extant and extinct taxa.

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Stable isotopic evidence for diet and nutritional stress in a potentially cannibalized human skeletal sample from Ana Manuku, Mangaia, Cook Islands

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Ana Manuku, a prehistoric rockshelter on Mangaia (Cook Islands), has been interpreted as a ritualistic site that potentially shows evidence for cannibalistic practices. Two excavated earthen ovens at the site contained over 1800 NISP of human bone representing 26% of the faunal assemblage. Of these, 39 NISP yielded cutmarks. Previously reported dietary isotopic evidence from human skeletal material recovered from the earthen ovens (n=23 adults) was initially interpreted to represent a potentially cannibalistic diet through isotopic modeling (IsoSource). This interpretation was bolstered by archaeological evidence for dietary resource depletion. Here we significantly enlarged the isotopic datasets from the zooarchaeological assemblage (n= 65) and increased the human skeletal sample to include subadults (n= 10) and additional adults (n = 32, total 55). We compared our data to those of all published contemporaneous samples from Pacific Islands and modeled diet with IsoSource and a concentration-dependent isotopic model (IsoConc). Individuals from Ana Manuku show significantly higher $\delta^{15}N$ values relative to other Pacific Islanders and low $\delta^{13}C$ values. We found that subadult samples show systematic variation in $\delta^{15}N$ values indicating breastfeeding and weaning. The IsoConc models indicate dietary contributions from pelagic fishes and terrestrial endemic species, not cannibalism per se. We also assert that the elevated $\delta^{15}N$ values may be a consequence of nutritional stress. We cannot rule out that these potentially cannibalized individuals also practiced nutritive cannibalism during life. All three of these factors-endemic dietary resources, nutritional stress and cannibalism-may have acted in concert to produce the dietary isotopic results.

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Vitamin D Intake and Serum Leptin Levels in Central Kansas Mennonite: The Kansas Nutrition Project

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The obesity pandemic exerts immense biomedical and socioeconomic burdens within

developed and developing countries with global prevalence doubling since 1980. The pathological accumulation of adipose tissue characterizing obesity phenotypes continues to be the leading risk factor to many chronic and metabolic diseases while epidemiological research has established clear genetic and environmental etiologies. Of the multifactorial causes, nutrition, dyslipidemias, and adiopokines including leptin, are implicated in obesity pathogenesis. Recent research suggests vitamin D affects both serum leptin and obesity phenotypes. However, established associations between vitamin D intake and serum leptin levels remain largely ambiguous.

We analyze samples from 2003-2005, collected from a population of central Kansas Mennonites (n= 160: 76 males, 84 females) in order to assess the correlation between vitamin D intake and serum leptin levels. Three nonconsecutive day dietary diaries were previously analyzed for nutrient content through NutriBase Professional software and serum leptin levels analyzed at SFBR per their 2003 protocols. Both factors natural log transformed for normality. Linear regression was used to account for differential effects of body fat distribution on leptin levels, using anthropometric measures of both central and peripheral deposits. Applying univariate ANOVA on standardized leptin residuals, vitamin D intake was significantly associated with leptin levels in both combined (p=0.02) and sex-stratified samples (p=0.04 both sexes). Despite observed sexual dimorphism of leptin in this population, vitamin D intake influences serum leptin levels in both sexes. Research examining metabolic systems underlying this role is needed.

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The interrelationship of cytomegalovirus and Epstein-Barr virus antibodies among Shuar of Amazonian Ecuador

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Latent cytomegalovirus (CMV) infection contributes to immunosenescence, while CMV and Epstein-Barr virus (EBV) co-infection contributes to chronic inflammation in older adults. CMV and EBV antibodies are also key biomarkers of psychosocial stress; however, much about the frequency of co-occurrence and interrelationship of these two herpesviruses is unknown. Elucidating this relationship is integral to understanding associations among stress, immune function, and aging. The current study tests for a relationship between antibodies to CMV and EBV among the Shuar, an indigenous forager-horticulturalist population in Amazonian Ecuador. CMV and EBV antibody concentrations were measured in dried blood spots collected from 167 Shuar (64 men, 103 women) between 15 and 86 years old. By study design, all individuals included in the sample were EBV seropositive, and of those infected with EBV 65% were also infected with CMV. Additional analyses were conducted among EBV/CMV seropositive individuals (n = 102). Pearson correlations were performed to test for a relationship between CMV and EBV antibody concentrations in the sample overall, as well as by sex and age group (younger vs. older). CMV and EBV antibody concentrations showed a significant positive correlation in the pooled analysis (r = 0.205; p = 0.038), but there was no significant relationship between titers of CMV and EBV antibodies among men, women, younger Shuar (<40 years old), or older Shuar (≥ 40 years old) when analyzed separately. These findings indicate that the incorporation of multiple measures of immune function might provide deeper insight into population-level associations among stress, immune function, and aging.

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Elliptical best fits as shape descriptors: a case study on Neanderthal and modern human teeth

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Fossil dental material is more prone to be preserved at archaeological sites, owing to their relatively robust material properties compared to other fossil material. Therefore, the application of a variety of approaches has been developed for dental shape characterization in human evolutionary studies. Here we present a new approach using elliptical best fits to dental tissue outlines below the occlusal plane, which also enables the inclusion of abraded teeth in the sample. In this study we examined several shape descriptors of the elliptical best fits of 3D-µCT-scans of upper second deciduous molars (dM^2) and upper third permanent molars (M^3). In some previous approaches, the accurate orientation of every dental specimen was a crucial step during analyses. The shape descriptors used in this study are size and orientation-free and therefore facilitate the analysis of dental outline shape. In addition, especially when it comes to 3D-geometric morphometric analyses, data collection is very time-consuming and cumbersome. Our approach only uses two cross-sectional planes of each specimen and thus data collection is far less labor intensive. Furthermore, only few analyses of M^3 outline shapes have been undertaken so far due to their high variability. Our study showed that the parameters measured can be used for taxonomic purposes to distinguish between Neanderthal and recent modern dM^2 and M^3 teeth and therefore provides a useful additional approach to existing methods.

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A comparison of high-throughput genomic and proteomic techniques in quantitative molecular analyses of primate brain

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Neurons in the brain contain the same DNA as all other cells in our bodies (gametes excluded), and their specialized morphologies and functions are dictated by the way the genetic code is expressed as gene transcripts and proteins. Quantitative analysis of gene transcript expression by RNA-Seq is the current standard for molecular expression analyses. However, analysis of transcript expression alone may neglect important biological signals that would be accessible by proteins.

I performed high-throughput genomic (RNA-Seq) and proteomic (liquid chromatography coupled with tandem mass spectrometry [LC/MS/MS]) analyses on the anterior cingulate cortex and caudate nucleus in 3 humans and 3 chimpanzees (*Pan troglodytes*) to assess the differences in biological signals produced by transcripts and proteins. Using these methods, the molecular expression of 12,443 transcripts and 1,337 proteins were quantified. In categorical enrichment analyses, the transcripts revealed species differences in neuronal communication, developmental processes, and cellular differentiation (≥ 10 genes per category, $q \leq 0.05$), while proteins reflected biological differences in metabolic processes, biosynthesis, and intracellular signaling (≥ 3 proteins per category, $q \leq 0.05$). Regulatory mechanisms

affecting transcript and protein half-lives and rates of translation likely caused discordance between the expression levels of these molecules, making their biological signals distinct. Despite the broader molecular coverage of RNA-Seq, certain research questions – like inquiries into the expression of molecules supporting metabolism – may be better answered by analysis of protein expression, and it is important to understand the benefits and limitations of both approaches when planning comparative studies of the brain.

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A Metric Approach to Sex Estimation Using Fragmented Os Coxae

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Many sex estimation methods rely on complete skeletal elements. However, in bioarchaeological, paleoathropological, and forensic contexts remains are often fragmented or incomplete. Therefore, there is a need for estimation methods that can be applied to fragmentary remains, while still providing high accuracy rates and maintaining low intra- and inter-observer error rates.

This study utilized a total of 11 measurements of the os coxa, from which six discriminant functions were extracted, based on common scenarios of fragmentation. The study sample consisted of 200 os coxae of known sex from the Hamann-Todd collection, housed in the Museum of Natural History in Cleveland, Ohio. Cross-validated classification accuracies for all equations were above 90%, with very low levels of sex bias. A second sample of 150 os coxae was collected from 3D CT scans to validate the six equations. The validated classifications displayed high levels of accuracy, with four of the equations reaching over 94% correct classification, and over 83% for the remaining two equations. The validation sample provides a modern comparison to the more historic Hamann-Todd sample, demonstrating the efficacy of these equations on both historic and modern samples. The measurements utilized in the study have also been shown to display very low inter- and intra-observer error rates, often under 10%. These results suggest that the new equations represent a reliable alternative to the traditional sex estimation methods when whole skeletal elements are not available.

***A priori* postulates, immanent properties, diluted inferential confidence and unexplainable residues: a consideration of the scientific basis of taphonomic theory**

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Taphonomists, like all historical scientists, are faced with the well-known problems of inferring events in the past based on their similarity to events in the present. This reliance on inductive reasoning, in association with issues of equifinality, has led some to question the scientific nature of taphonomy and its application in forensic and physical anthropology.

Although the philosophical problems of inductive inference have been discussed and debated for centuries, the fact that inductive reasoning provides probable, rather than guaranteed, conclusions means that the debates will not likely abate any time soon. The uniformity of nature has been used as a warrant for inductive reasoning; however, some philosophers question its necessity based on the notion that inductive reasoning can be justified on the grounds of its asymptotic nature of producing more accurate results with continued scientific research.

Nevertheless, methodological uniformitarianism remains central in historical science given its association with actualism and, therefore, analogical reasoning. The use of analogy in the historical sciences has received considerable attention over recent decades; however, questions regarding the potential shortcomings of relational analogies to answer increasingly complex questions related to ecological and behavioral systems have been raised.

Thus, it remains critically important that we continue to focus on the validity, relevance and strength of the analogies that we draw via our actualistic studies. In doing so, we affirm the scientific basis of taphonomy and begin to set the foundation for a general theory of taphonomy.

Seasonal variation in rainfall at Allia Bay, Kenya 3.97 Ma

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Paleoenvironmental reconstructions in East Africa often rely on surface-collected fossil fauna even though such collections traditionally combine multiple temporal and geographically dispersed components. This project will reconstruct aridity and rainfall patterns 3.97±0.03 Ma at Allia Bay, Kenya, one of the few sites with material recovered *in situ*, to refine the definition of the mosaic paleoenvironment of *Australopithecus anamensis*. These patterns are reconstructed using a secondary ion mass spectrometer (SIMS) to generate high-resolution serial spot analyses (13 µm spots) of oxygen isotope ratios in fossil faunal tooth enamel ($\delta^{18}O_{en}$) from a well-characterized excavation.

This presentation will highlight variation recorded during enamel development for browsers (giraffidae, elephantidae, and deinotheriidae) and grazers (hippopotamidae, suidae and bovidae). For mid-sized herbivores such as gazelle, enamel deposition occurs at an approximate daily rate of 10 µm and records a single season. Modern gazelle teeth from individuals previously analyzed indicated that the seasonal rainfall at Lake Turkana has an inter-seasonal (i.e., intra-annual) variation of approximately $\Delta^{18}O_{en}$ = 2.5‰. The fossil samples show variation in the mean intra-annual variation (i.e., amplitude difference) within the enamel region analyzed: browsers = 3.4‰; grazers (suidae and bovidae) = 2.4‰; hippopotamidae = 1.4‰. This difference in variation is either animals being differentially influenced by seasonal conditions and/or the enamel capturing different periods of time. This snapshot of seasonal rainfall at Allia Bay suggests that rainfall amounts were higher and more variable in the past, which would impact the available biomass and other ecological variables during the period *Au. anamensis* occupied the site.

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Investigating migrant deaths: Viewing a humanitarian crisis through individual life histories

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Undocumented border crossers (UBCs) who migrate to the United States from Mexico and Central America, though far from a homogenous group, represent a community of individuals who are disproportionately affected by structural factors such as poverty, marginalization, and violence. Forensic anthropologists who investigate migrant deaths are unique in their ability to document these structural factors through careful examination of individual lives. Whereas bioarchaeologists often combine skeletal analysis with details from burial contexts to construct personal narratives of past lived experiences, forensic anthropologists can use an osteobiographical approach to validate the experiences of migrants who become victims of the humanitarian crisis along our southern border.

We present osteobiographies of two undocumented migrants who died while attempting to cross the US/Mexico border into Arizona. Data was collected at the Pima County Office of the Medical Examiner and biographical narratives were constructed using the biological profile, skeletal indicators of non-specific stress and infections, aspects of the recovery context, and personal effects associated with the decedents. Skeletal evidence for enamel defects, porotic cranial lesions, untreated infections, and poor oral health chronicle socioeconomic marginalization embodied throughout the life

course and experienced as nutritional stress and limited access to medical resources. The circumstances of death—preventable, occurring in remote areas, and characterized by significant physical suffering—speak to the structural forces that both compel individuals to cross the border and influence migration routes. Detailed life histories humanize the effects of structural violence in the UBC community and may assist in identification and informing human rights initiatives.

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Examining childhood stress through vertebral neural canal size: implications for the Developmental Origins of Health and Disease hypothesis

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There has been a recent emphasis in bioarchaeology on the relationship between early-life stress and risk for early mortality. Increasingly, this research is framed within the Developmental Origins of Health and Disease (DOHaD) hypothesis. Multiple skeletal indicators, including vertebral neural canal size, have been used to assess the link between stresses in childhood with risk of earlier mortality. Recent study of vertebral neural canal (VNC) size in archaeological samples has renewed some of the earlier promises of the method and is worth further study to better understand how childhood stress impacts health throughout the life course. In this poster we present vertebral neural canal data from the late medieval rural population of Villamagna (n = 72) of central Italy. Vertebral neural canals were measured following standard protocols, with thoracic elements considered separately from lumbar ones as they complete growth at different stages in the life course. Statistical analyses demonstrate that smaller transverse canals in both thoracic and lumbar vertebrae are associated with earlier age-at-death, while anterior-posterior canal measures are not. An important implication of these findings is that stress likely occurred later in childhood and into early adolescence, instead of in infancy and early childhood. These data are also discussed in relation to other indicators of early life stress to explore some of the potential uses of the Developmental Origins of Health and Disease hypothesis in bioarchaeological research.

Reconstructing early hominin brain evolution from South African *Australopithecus* endocasts

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Tracking the early appearance in the hominin fossil record of the derived *Homo*-like neuroanatomical pattern should contribute to the understanding of the inter-taxic evolutionary relationships within the human lineage. Paleoneurology has recently enlarged its traditional investigative toolkit by integrating methods of high-resolution imaging and 3D modeling granting a remarkable degree of reliability of the qualitative and quantitative estimates. In this perspective, we engaged in the computer-assisted assessment of the endocranial structural organization of some South African hominin endocasts.

The fossil specimens investigated so far are from three *A. africanus* representatives: the Taung child and the adult (or subadult) specimens Sts 5 and Sts 60 from Sterkfontein Member 4. We combined a semi-automatic technique for extracting the sulcal pattern together with a landmark-free registration method based on smooth and invertible surface deformation. Both local and global information provided by our morphometric approach are used to perform statistical classification and topological mapping of inter-specific variation. In order to highlight the nature and extent of the differences distinguishing *A. africanus* from the extant hominids, we investigated three samples representing *Homo* (n>10), *P. troglodytes* (n=10), and *P. paniscus* (n=10).

While the analysis of the prefrontal sulcal organization confirms the presence of some *Homo*-like features in *A. africanus*, the deformation-based models reveal substantial differences with respect to the extant human condition, notably at the level of the frontal and parietal regions. Based on the deformations computed from the extant groups to the fossil specimens, statistical analyses indicate that *A. africanus* closely approximates the *Pan* condition.

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Famine, feast, and frailty: early-life histories from dentine

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Introduction: the stable isotope ratios of carbon and nitrogen in human tissues have been shown to reflect both the diet and physiological changes due to undernutrition of an individual. We have established using micro-CT scans of known-age modern deciduous teeth that the first 0.5mm of dentine forms before birth. Early-life experiences have effects on the long-term health of an individual.

Methods: Novel techniques now allow the analysis of tiny samples of dentine collagen, which means that for the first time we can reliably sample dentine formed in utero. Samples taken from archaeological populations with known stress are compared to a small number of modern cases with known medical histories to test the hypothesis that new data from stable isotope analysis of human deciduous dentine collagen shows potential to investigate the diet and physiology of the mother during pregnancy.

Results: the high variability of values from dentine formed in utero suggests that these may be recording a variation from the usual maternal diet, or stress levels in mothers during pregnancy. Values from dentine formed during periods of early life also allow more accurate assessment of breastfeeding/weaning and undernutrition.

Conclusion: the analysis of exfoliated deciduous teeth may give a guide to in utero and early life experience and hence the lifetime effects and need for health interventions. These can be applied to modern children, but also applied to archaeological populations to estimate the health of mothers in the past.

Bodies in motion: Isotopic analyses of mobility and diet at Marroquíes Bajos, Spain

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At 113 hectares in size, Marroquíes Bajos represents one of the largest early villages in Iberia. This third millennium Copper Age

settlement is located in the Upper Guadalquivir river basin in Jaén, Spain. Its spatial organization is demarcated by five concentric ditches and a 2km long adobe wall surrounding the fourth ditch. The available radiocarbon chronology suggests an initial foundation in the first half of the third millennium, extensive investments of communal labor in a ditch and wall system starting circa 2450 BC, and a dramatic decrease in human activity at around 2000 BC. As at other matrix villages, life at Marroquíes was characterized by increasing archaeological evidence for managerial hierarchies, and brought with it difficult new demands like navigating complex interpersonal relationships, establishing property ownership, and organizing labor. Previous analyses of the dynamics of such sites have largely relied on archaeological proxies such as shifts in settlement patterns or internal organization and architecture. In contrast, our project takes a bioarchaeological approach and evaluates human mobility and diet at this early mega-village through isotopic analyses of human skeleton remains. We examine one of the largest prehistoric populations in Iberia, sampling 120 human and faunal individuals using strontium ($^{87}Sr/^{86}Sr$) oxygen ($\delta^{18}O$), carbon ($\delta^{13}C$), and nitrogen ($\delta^{15}N$) isotopic analysis. Preliminary ANOVA and Kruskal-Wallis test results show significant inter-individual and inter-necropolis differences in mobility and diet, providing important information about variability in lived experience in the first complex societies in Iberia.

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Did Potters Urn? Potential Skeletal Evidence of Ceramic Production from the Ch'iji Jawira Site in Tiwanaku, Bolivia

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The city of Tiwanaku (AD 500-1100) in the Bolivian *altiplano* was comprised of multiethnic neighborhoods, with some of these *barrios* being home to "guild-like" specialists laboring at differing jobs. Ch'iji Jawira, one site within this community, is often described in the archaeological record as containing both a manufacturing center for pottery and a residential area that was home to these ceramic manufacturers. Prior bioarchaeological research has also shown that the people who were buried at the Ch'iji Jawira site show statistically significant differences in labor and activity from others who lived in the Tiwanaku capital. This study further explores the idea that Ch'iji Jawira was home to ceramic specialists using a life-history approach and describing one individual from this community, a 30-39 year old female (CJ-35250). This person has evidence of osteoarthritis in the joint surfaces of her shoulder, elbow, wrist, metacarpals, hand phalanges, and lumbar spine. Furthermore, the bones of her wrists, hands, and fingers show extensive skeletal changes at tendon and muscle attachment areas. For example, the hands show extensive rugosity changes in the palmar and dorsal interosseous muscles of the metacarpals as well as the medial and lateral sides of the proximal hand phalanges. While it cannot be definitely determined that she was a potter, her bones do suggest she worked at tasks different from other Tiwanaku citizens involving repetitive joint movement as well as heavy arm and hand musculature.

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Mathematical model of spinal curvature: implications to human evolution

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During human evolution, different hominin groups present different lumbar lordosis angles. H. sapiens present high lordosis angles while Neandertals present smaller angles. Recently, Wagner et al. demonstrated that lordosis reduces the local joint torques necessary for an equilibrium of the vertebral column. They found that the ventrodorsal position of the spine has a crucial impact on the amount of lordosis needed to maintain efficient upright posture: When the spine is located far from the line of gravity, a high lordosis is needed for efficient upright posture. When the spine is located closer to the line of gravity, less lordosis is needed.

The purpose of this study is to explore the ventrodorsal position of the spine in relation to the pelvis and thorax in modern humans and Neandertals and compare it with their lordosis angle. We hypothesize that hominins with high lordosis will show a dorsal position of their spine while hominins with smaller lordosis will show more ventral position of their spines.

The ventro-dorsal position of the spine in relation to the pelvis and thorax was measured in modern humans (n=88) and Neandertals (n=3). The results indicate that the sacrum and thoracic vertebra of modern humans are more dorsal while those of Neandertals are more ventral. The sacrum of Neandertals is situated much closer to the acetabula and their thoracic vertebrae are more invaginated into the thorax. These results suggest that while both Neandertals and modern humans present an efficient upright posture, they do so in two different ways.

Is the chimpanzee a living fossil?

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Hypotheses of hominin origins that emphasize similarities between chimpanzees and early hominins are often met with rhetoric: chimps are not living fossils; they have evolved as much as humans; they are not appropriate models for understanding human origins. The analysis of *Ardipithecus ramidus* suggests to some that hominins evolved from a palmigrade arboreal quadruped, more like *Ekembo* (*Proconsul*) than *Pan*. Alternatively, analysis of late Miocene apes and hominoid comparative anatomy suggests to others that hominins evolved from a suspensory ape. The results of the ongoing analysis of late Miocene Eurasian ape fossils reveals numerous characters throughout the skeleton of functional and phylogenetic affinity with African (knuckle-walking) apes.

Whether or not one accepts the idea that the LCA was a knuckle-walker, it is hard to maintain that chimp morphological evolution has proceeded at the same rate and magnitude as in humans. This may be the most interesting result of our quest for the LCA. Focus has been on the dramatic changes in human morphology. Is there something about chimp adaptation, genetics or population dynamics that has constrained the rate and extent of its evolution? A combination of all three may signal that the "primitive" look of modern chimps compared with humans is a real and important aspect of chimp evolution not to be summarily ignored. While chimps are not living fossils they are for some reason less changed than are we from our last common ancestor and probably do represent a good model for many aspects of early hominin biology.

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Network Position and Human Presence in Barbary Macaques of Gibraltar

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The Barbary macaques of Gibraltar experience high levels of tourism. The steep terrain of the Upper Rock Nature Reserve allows individual macaques to choose whether to be near tourists or avoid them altogether (e.g. going down the cliffs). To examine how the anthropogenic environment may relate to social dynamics, we observed two groups of free-ranging Barbary macaques, Apes Den and Prince Phillips Arch. We examined whether individuals that chose to be near humans more often had different positions within their social networks. From activity scans (spanning the home range) we tallied the frequency each individual was present and the number of these scans with humans present. Grooming and aggression networks were constructed from focal sampling data across all adults. Poisson regression analyses showed that macaques that were more frequently near humans tended to be high ranking ($b=0.017$; $p<0.001$) and more peripheral in the grooming network ($b=0.014$; $p<0.001$) than those less often in the presence of humans. The rank effect may stem from high-ranking animals gaining priority access to food from tourists, though high-ranking individuals did not spend more time eating provisioned food than lower-ranking individuals. Further, the effect of groom network position may arise if individuals that are drawn toward humans have less inclination or time available to groom others. In fact, peripheral individuals in the groom network did spend less time grooming in their activity budgets ($b=0.004$, $p<0.001$). These results suggest that interaction with humans may impact macaque social dynamics in highly commensal groups of primates.

The reconstruction and analysis of oral microbiome composition using dental calculus from the Mississippi State Asylum (1855-1935), Jackson, MS

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In recent years, the human oral microbiome has become an emerging foci for anthropological and molecular biological research, especially given its relevance to human health, immunity, and disease. The microbial composition of the oral microbiome can affect both the oral and systemic health of the host, making detection of microbiome composition an important avenue of research for examining past patterns of health and disease. Uniquely, through the analysis of dental calculus and genomic sequencing, it is possible to reconstruct and examine the oral microbiomes of past individuals.

Here, dental calculus was sampled from (N=4) 20th century skeletons recovered from the cemetery of the mid 19th, to early 20th, century Mississippi State Asylum (MSA), a mental asylum in Jackson, MS. From this calculus, bacterial DNA was isolated and sequenced using16S rRNA sequencing through Illuminia BaseSpace, which generated high-resolution taxonomic charts of bacteria that were extant in the oral cavity during the lifetimes of the individuals. Preliminary results from the sequencing reveal that the samples yielded an average of 95.5 bacterial species, with an average Shannon diversity index of 0.00725 ± 0.0033. The negative control sample that was processed using the same kits and methods, revealed only one bacterial species.

This project represents one of the first to reconstruct the oral microbiomes of a subsample of an historical institutionalized population. Final results, which will incorporate data on oral pathologies, will grant additional insight into relationships between living conditions, overall health, oral pathologies and microbiome composition in an historical asylum population.

Canine sexual dimorphism in "*Micropithecus*" *leakeyorum* from Maboko Island, Kenya and other African Miocene small-bodied non-cercopithecoid catarrhines

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Excavations at 15 ma deposits on Maboko Island by Benefit and McCrossin between 1987 and 1997 resulted in the discovery of 39 new canines (27 upper and 12 lower) of "*Micropithecus*" *leakeyorum*. Only one complete upper female canine was previously known for the species. The new canines add significantly to our understanding of its paleobiology.

"*M.*" *leakeyorum* is currently the smallest of the African small-bodied non-cercopithecoid catarrhines. Its upper canine mesiodistal lengths (mean=7.1 mm for males and 5.3 for females) and buccolingual widths (mean=5.5 mm for males and 4.2 mm for females) are most similar to *Procolobus verus* which, according to Plavcan and Ruff, has a body mass of 4.2 kg for females and 4.7 kg for males. *P. verus* has significantly taller male upper canines (mean 14.9 mm) than "*M.*" *leakeyorum* (10.9 mm maximum unworn).

Canine sexual dimorphism is high in "*M.*" *leakeyorum* with non-overlapping ranges of male and female crown area and cusp height for upper and lower teeth. However, male and female cusp height is strongly correlated to crown area in "*M.*" *leakeyorum* and in other African Miocene small "apes", including six females of *Dendropithecus macinnesi.* Only one female upper canine of *D. macinnesi (*KNM-RU 1850) exhibits exceptionally tall canines relative to crown area, falling with hylobatid females on a bivariate plot. High levels of canine sexual dimorphism in "*M.*" *leakeyorum* indicates that its social groups experienced higher male than female intra-sexual competition. The contradictory pattern within *D. macinnesi* warrants further examination.

Excavations at Maboko and study of fossils were funded by the National Science Foundation, National Geographic Society, LSB Leakey Foundation, and Wenner-Gren Foundation.

On the Trail of the First Caribbean Islanders: Genomic data from indigenous Trinidadians and St. Vincentians

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Human history within the Lesser Antilles is at least 5000 years old. While fragmented archeological and ethnographic records provide some understanding of migrations and cultures that developed within the region, little is known about the biological histories of indigenous Caribbean peoples.

To further our knowledge of this history, we considered 150,000 autosomal and high-resolution unipartenal genetic markers, part of the Genographic Project's GenoChip, from 59 people in two indigenous Caribbean communities, the First People's Community of Arima in Trinidad (FPC) and the Garifuna of St. Vincent. These data were used to estimate their biogeographic ancestry, evaluate different migration models into the Caribbean Basin, and consider the genetic impacts of European and African colonization.

Complementary to local histories and our previous work with these communities, we found strong evidence of indigenous genetic ancestry. As previously reported, in FPC and in the Garifuna respectively, about 58% and 37% belonged to an indigenous American mitochondrial haplogroup while 20% and 17% belonged to an indigenous American Y chromosome haplogroup. However, regardless of the uniparental haplogroup status, about 23% and 12% average autosomal indigenous American ancestry was estimated in the FPC and the Garifuna, respectively. African, European, and Asian genetic ancestries were also prominent in both communities. Given that the genetic variation between the two island communities varied, we suggest that these communities are the product of different migration events, thus supporting archeological models that posit multiple migrations into the Caribbean Basin. Our genomic analysis provides a fuller understanding of Caribbean biohistories.

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Down through the generations: the role of developmental programming in the intergenerational inheritance of cardiometabolic disease risk among high-prevalence populations

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Over the last twenty-five years, a great deal of experimental animal research, in addition to human epidemiological and clinical studies, has revealed the important role phenotypic plasticity (i.e., developmental programming) plays in the global cardiometabolic health crisis. Identification of these features of early life growth and development extend our understanding of the origins of the cardiometabolic disease that move beyond etiological explanations pointing solely to genetic predisposition and nutrition and lifestyle risk factors. Developmental origins of health and disease (DOHaD) and epigenetics research has also revealed how environmental stressors (e.g., maternal malnutrition during pregnancy) trigger the developmental programming of cardiometabolic traits (e.g., insulin resistance) that are transmissible to subsequent generations. At the familial/household level, food insecurity and the nutritional 'dual burden' of over- and under-nutrition exacerbate the problem, and help ensure that developmentally programmed traits associated with cardiometabolic disease will be transmitted to subsequent generations. The conceptualization and implementation of future public health initiatives aimed at stemming this global health crisis, especially in the highest prevalence populations, must account for the role of developmental programming in cardiometabolic disease – including its intergenerational transmissibility – if they are to be effective.

Dental health and dietary indicators in the Bronze Age Hexi Corridor of Western China

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This project tests the paradigm that climate change in Bronze Age Eurasia caused a deterioration or collapse of human-environment systems. It traces changes in human health and subsistence in the second and first millennia BCE in Northwest China, which were characterized by a drying climate and the spread of steppe vegetation. Two Bronze Age populations from the Hexi Corridor (Gansu Province) are discussed: the Siba Culture cemetery of Huoshaogou (1700-1400 BCE) and the Shajing Culture cemeteries of Hamadun and Xigang, associated with the Sanjiaocheng site (900-400 BCE). Skeletal remains of 125 individuals were examined for osteological and dental indicators of diet and stress. From the Siba to the Shajing Culture populations, caries rate declined (Chi-sq $p<0.0001$); sex differences in caries rate reversed; dental attrition increased ($p<0.0001$); linear enamel hypoplasias declined ($p=0.024$); and birth rate, rate of periostitis, and stature did not change significantly. Archaeological evidence supports the conclusion that during this period, inhabitants of the Hexi Corridor developed more specialized animal husbandry practices adapted to the arid environment, but continued to practice agriculture. This suggests that some changes in subsistence practices were precipitated by climate change, but that the existing human subsistence system did not collapse in the face of climate change and reorganize into a new system, as is often posited in the literature. Rather, archaeological and bioarchaeological evidence suggest that agropastoralism in the second millennium BCE represented a complex adaptive system, which was highly resilient and persisted into the first millennium BCE.

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Sexual Dimorphism of the Oval Window

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Minimal levels of sexually dimorphic expression prevent the accurate and reliable estimation of sex in subadult skeletal remains, but a more nuanced understanding of hormone production during the fetal and neonatal periods challenges this assumption. Certain skeletal elements that develop during early sex hormone surges, such as the oval window, may yield evidence of sexual dimorphism in subadults.

The stapediovestibular joint, comprised of the stapes and oval window, achieves adult form by 35 gestational weeks. Although the oval window preserves well archaeologically, very little is known about the fenestration. The purpose of the present study was to assess oval window variation and evidence of sexual dimorphism. Both metric and geometric morphometric methods were applied to data derived from 2D landmarks and semilandmarks acquired from images of 204 adult oval windows collected from the UCL Institute of Archaeology's Chichester assemblage. The size (inter-landmark distances) and shape (first 5-6 PCs of the Procrustes coordinates) of each oval window were calculated. Oval window variation and sex estimation accuracy were assessed, and the results indicate an absence of sexual dimorphism. Sex differences accounted for a mere 3-8.7% of the sample variance, and sex classification accuracy ranged from 53.9-62.4%. The present study proves that the oval window form is unsuitable for sex estimation; however, the length and PC5 shape variables were identified as near significance ($p= 0.05$-0.15), and these indications of real biological differences should be examined further.

Neurophysiological differences between hamadryas and anubis baboons are maintained by natural selection

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Comparisons of closely related species that differ in behavior and social system can reveal the genetic and proximate factors underlying these differences. Two baboon species, *Papio hamadryas* and *P. anubis*, display distinct behavioral ontogenies and previous research has shown such differences to be reflected in relative and absolute levels of metabolites in cerebrospinal fluid (CSF) that serve as proxies for overall level of dopaminergic and serotoninergic activity in the CNS. In the present study, we identify genes affected by adaptive divergence via genome-wide scans for differentiation and analyses of the distribution of high impact variants in and near coding regions. Among the candidates for adaptive divergence, we find several that in other taxa are known to show functional connections to neurophysiological and behavioral differences, and are thus potential proximate causes of species-specific behaviors and divergent social organization in baboons. For example, the dopamine mediated signalling pathway is significantly enriched for regions of high differentiation and several of its components contain high impact variants that may explain some of the behavioral differences between the two species.

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The Mesoamerican Corpus of Formative Period Art and Writing

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The Mesoamerican Corpus of Formative Period Art and Writing is a digital resource that will facilitate and robustly support research on the emergence of writing in the New World, and provide a suite of tools aimed to facilitate research on trends in anthropology. The goal of the project is to reveal the artistic and scribal traditions of the Olmec culture, Mesoamerica's first civilization and the originator of an ancestral sign system from which all later Mesoamerican writing developed. The Corpus assembles a database of Formative period (ca. 1500-400 BCE) Mesoamerican iconography and writing in a digital catalog accessible via intuitive and interactive web and mobile applications. This new suite of digital research tools, including an innovative visual-input search tool, is targeted to a broad range of users, from academic researchers to K-12 teachers and students. These tools allow users to compare, analyze, and visualize relationships among a broad corpus of visual data, archaeological materials, and conceptual information, and could be adapted for general access to complex data types such as 3D scans and landmark coordinates on bones. We envision the educational reach of The Mesoamerican Corpus of Formative Period Art and Writing surpassing the presentation of essays and static visual data to allow for the dynamic search, visualization, and investigation of a corpus of material currently only partially available in scattered sources with restricted access, such as small, regional Mexican museums.

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The differential role of cranial modules in the diversification of the human skull

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In the last decades several studies are showing that morphological integration and modularity are important points of intersection between the evolution and the development of organisms. These studies are particularly abundant on debate about the evolutionary nature of the morphological integration and modularity of skull. Some of these studies have shown how this morphological pattern can be seen in modern human populations and if it had some role during the cranial morphological human diversification. In a general way, the same modules are shared in a similar way by the different populations, what can be explained by the recently evolutionary history of *Homo sapiens*. Here, we attempt to explore how different modules can reflect particularities of cranial morphologies of 18 human populations dispersed along six great geographic regions of the world. To investigate the effect of the modules, we performed a series of General Discriminant Analysis (GDA) using linear measurements of human skull divided in different sets of variables, representing the whole skull and four cranial modules. Our results shown that the best prediction, inferred by the wright classification by GDA, is reached when whole skull is used, although some modules can present differential results to particular populations. These results suggests that in despite of the patterns of variance/covariance remained relatively constant along the recent human evolutionary history, some amounts of diversification were due to the differential evolutionary forces specific to each population of the world.

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Sexual dimorphism in masticatory cranial deformations in Bornean Orangutans (*Pongo pygmaeus*): a finite element analysis and geometric morphometrics study

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Relative to other extant apes, orangutans exhibit a high level of cranial sexual dimorphism. These large differences in size and shape could lead to sexual differences in biomechanical performance during mastication, despite having identical diet. Here, we investigate sexual dimorphism in cranial biomechanical performance during hard object feeding in Bornean orangutans using finite element analysis (FEA) and geometric morphometrics (GM). Three male and two female orangutan crania were constructed into FE models and assigned homogeneous, isotropic mechanical properties, and scaled muscle forces. 270 simulations were run per bite point (P3, M2) where muscle activation patterns and bone mechanical properties were varied within published ranges to capture all possible modes of deformation the crania could have undergone during feeding. GM was run on all deformed crania (540 per individual) to examine modes of deformation (e.g. bending, twisting). Modes of deformation were most affected by changes in bite point (premolar biting caused the premaxilla to bend upwards vs downwards during molar biting) and masseter muscle activation pattern. While changes in mechanical properties only slightly affect mode of deformation, they rather affected degree of deformation, with more compliant skulls deforming more. Overall, these factors masked any sexual dimorphic signature in skull deformation. However, when bite point was held constant, a slight sexual dimorphic signature was present during premolar, but not molar biting, suggesting the larger, more robust male crania may deform differently than the more gracile female crania.

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A geometric morphometric comparison of within-individual levels of pelvic and cranial sexual dimorphism

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The os coxae and the cranium are often mentioned as the most sexually dimorphic regions of the human skeleton. Sexual differences in these regions have been attributed to differential hormonal expression, functional or biomechanical constraints, and sexual selection. However, the relative influence of each of these variables remains relatively unexplored. The aim of this study was comparing intra-individual levels of cranial and pelvic sexual expression. If some factors influence both the cranium and pelvis, it should result in correlations between the levels of expression of some sex markers from both areas.

Forty-two cranial landmarks and 12 os coxae landmarks were digitized from 113 African-American adults. Following generalized Procrustes superimposition, principal component analysis, and discriminant function analysis (DFA), the cranial and os coxae DF scores were compared through Spearman's rank correlation. Partial least squares regression served to explore the overall relationship between the two structures, and correlations with centroid size to assess allometric factors. We found no significant relationship between cranial and pelvic sexual dimorphism, regardless of whether shape, form, or size is examined. Overall, the os coxae was much more sexually dimorphic than the cranium, producing much higher correct classification rates. These results suggest that cranial and pelvic sexual dimorphism are influenced by different factors.

Coming of age as a discipline: eighty-five years of forensic anthropology in the AAPA

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The 2016 annual meeting of the American Association of Physical Anthropologists (AAPA) is a milestone event and marks the 85th anniversary of the annual conference. Since the meeting's humble beginnings in 1930 in Charlottesville, Virginia, the AAPA has become one of the world's premier scientific societies responsible for the professionalization of biological anthropology. Over its history the AAPA has cultivated the development of numerous specialties within the discipline, including forensic anthropology and imminent biological anthropologists have played an instrumental role in shaping the specialization in both academic and applied contexts.

This presentation examines the history of the AAPA in developing forensic anthropology by examining contributions of specific scholars, documenting presentations at the AAPA Annual Meeting over its history, and examining publication trends in the American Journal of Physical Anthropology (*AJPA*) and the Yearbook of Physical Anthropology (*YPA*). The Academic Phylogeny of Physical Anthropology was utilized to trace doctoral level training in forensic anthropology and demonstrated that the discipline is the 8th most popular specialization with 4.8% (n=97) of all included anthropologists. A bibliometric survey of *AJPA*, *YPA*, and previous conference programs suggests that forensic anthropologists have been involved in some capacity with the AAPA for nearly the entire duration of the association. Moreover, an example from publication trends suggests a robust influence with two papers combining for 1,284 citations [Todd (1920) and Phenice (1969)]. Indeed, the AAPA has helped shape the discipline of forensic anthropology throughout its history and continues to influence the specialty through the present day.

Babies, Culture, and Identity: An Analysis of Perinatal Mortuary Patterns

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Perinatal remains (6 months *in utero*–1 month postnatal) are often excluded from bioarchaeological analyses. However, these remains may provide insight into identity as reflected in mortuary treatment. Comparison of funerary treatment of perinates with that of post-neonates (1 month–1 year) and young children (1-4 years) provides insight regarding societal views of and relationships to perinates and how these may have changed throughout infancy. If perinates are excluded from or segregated in a cemetery or given distinct burial treatment, it may reflect separate identity. Several Late Mississippian (AD 1300-1600) sites in eastern Tennessee have preserved perinatal burials, providing an opportunity to compare how different populations treated and viewed perinates. The purpose of this study is to compare burial contexts of perinates, infants, and young children between two temporal components, the Dallas phase (AD 1300-1550) and the Mouse Creek phase (AD 1400-1600), to determine whether treatment and, therefore, identity of perinates changed over time.

A sample of 445 subadult remains (n=303 Dallas, n=142 Mouse Creek) was assessed for several aspects of mortuary treatment (location, funerary objects). Results indicate that at all sites from both phases, perinatal remains received similar burial treatment to that of infants and young children, indicating a comparable identity for the youngest individuals over time. However, there is a temporal change in the funerary treatment of all subadult groups. Significantly more Dallas subadults have funerary objects than Mouse Creek subadults, and burial location differs based on time period, which may reflect an overall shift in mortuary treatments.

Reconstruction of Late Pleistocene Paleoenvironments using Stable and Clumped Isotopes from the Lake Victoria Region

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Climate-driven environmental change is a commonly proposed mechanism for the dispersals of humans within and out of Africa, but few data are available in East Africa prior to the Last Glacial Maximum. Here we present new conventional and "clumped" stable isotope data from four sites near Karungu, Kenya dated to between ~94 and >33 ka. Fossils and Middle Stone Age artifacts are preserved within a sequence of tuffaceous fluvial sediments and paleosols. The isotopic data complements existing paleoenvironmental reconstructions using micromorphology and bulk geochemistry to reconstruct mean annual precipitation (MAP) and other soil properties. The average clumped isotope soil temperature is ~33°C with no statistical change in temperature up section, which is notably warmer than modern soil temperatures of 24°C. The high temperatures suggest that either air surface temperatures in the region were considerably warmer during the Late Pleistocene (≥5°C) or that vegetation cover was considerably different allowing for warmer soil temperatures. The stable isotope values of soil organic matter indicate that C_4 plants dominated the landscape during the Late Pleistocene, but the percentage of C_3 plants increases up section at all sites. There is no change in MAP throughout the section, so this increase in the percentage of C_3 plants is probably due to a lithologic change between the upper and lower paleosols that changed plant communities and/or proximity to a local fluvial system. The faunal, geologic, and isotopic evidence indicate a seasonally dry, open grassland environment that is very different from the closed bushland habitat present today.

Examining the fundamental niche parameters of Neanderthals and Modern Humans in Iberia

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Models of Neanderthal extinction and modern human expansion, such as the Ebro Frontier, hypothesize the presence of ecological frontiers on the landscape and are testable with Ecological Niche Modeling (ENM) methods. However, previous research has relied on archaeological datasets to stand as proxies for Neanderthal and early modern human (EMH) presence and has failed to address whether or not one can use much more theoretically conservative samples and still produce statistically reliable results. To investigate this question, this project uses the ENM algorithm GARP (Genetic Algorithm for Rule-set Prediction) to produce predictive maps of Neanderthal and EMH fundamental niche parameters. Their respective geographic distributions were predicted using presence-only location data with increasingly conservative samples: 1) Middle Paleolithic sites, generally considered indicative of Neanderthal presence, 2) Upper Paleolithic sites, generally considered indicative of EMH presence, 3) Neanderthal sites with diagnostic skeletal remains, and 4) EMH sites with diagnostic skeletal remains. Predictive maps of the fundamental niche parameters were projected for the time prior-to, during, and after Heinrich Event 4 in Iberia. Despite the differing levels of precision in the samples used to generate the maps, the Ebro River Valley is consistently predicted as an area of highly probable fundamental niche presence for nearly every population and time period, while the Pyrenees and the Sistema Iberico Mountains are typically predicted as areas of fundamental niche absence. This indicates that, even utilizing more conservative samples, ENM methods can still detect ecological hotspots and frontiers that might have affected Neanderthal extinction and EMH expansion.

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Nocturnal leopard (*Panthera pardus*) predation risk for olive baboons (*Papio anubis*) in Kenya

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Baboons (*Papio spp.*) are well known for their use of steep cliffs and tall tress as sleeping sites, presumably to avoid predators. Descriptions of nocturnal visits by leopards to baboon sleeping sites and the fact that predation on baboons is rarely observed despite decades of extensive study suggest that baboons indeed face high risk of predation at night. However, there are relatively few data on the behavior of predators at baboon sleeping sites or on site choice by baboons that address nocturnal risk. To investigate the nocturnal dynamics between baboons and leopards we deployed GPS/radio collars on 1-2 individuals in four olive baboon groups and four leopards during a 14-month field study in Laikipia, Kenya. Three of the four baboon groups slept on cliff-side sites significantly more often than at riverine sites. Baboons may be reducing their use of riverine sleeping sites to minimize exposure to leopards as collared leopards were 12 times more likely to visit riverine than cliff-side sites at night. Collared leopards visited cliff-side sites at night more often when baboons were at these sites than when they were absent but visited riverine sites more often when baboons were absent than when they were present. This suggests that leopards seek out opportunities to kill baboons near cliff-side sites. These findings and the fact that the three known leopard predation events on baboons during our study occurred at night at both riverine and cliff-side sites provide strong evidence that baboons face significant nocturnal predation risk from leopards.

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Understanding landscape variability from stable carbon isotope ratios of paleosols and enamel: a case study from East Turkana, northern Kenya

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Stable carbon isotope ratios from fossilized enamel and paleosol carbonates have long been used for insights into the ecological context of hominin evolution. Although these isotopic proxies of ancient environments are frequently used independently, they are rarely combined to understand landscape variability within a spatially- and temporally-resolute framework. In this study, we aim to understand the degree to which these two proxies reflect the paleolandscape of East Turkana, northern Kenya between 2 to 1.4 million years ago (Ma). We use a large dataset (n = 860) to compare the percentage of C_4 vegetation (e.g., grasses and sedges) consumed by the mammalian community at East Turkana to the percentage of open habitat (as indicated by paleosol carbonate isotopic ratios) and find that both proxies suggest an East Turkana paleolandscape dominated by C_4 vegetation during the Early Pleistocene. However, our analysis also indicates that enamel isotope data captures more vegetative variability than that derived from paleosols alone, particularly with regards to the prevalence of C_3 (e.g., trees and shrubs) vegetation on the landscape. Thus, our analyses suggest that stable isotope data from paleosols and enamel must be combined to fully capture the vegetative structure that was the context of hominin evolution on the paleolandscape of East Turkana and elsewhere in eastern Africa.

Genes determining Andean high-altitude adaptive phenotypes

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Hypoxia, or the decrease in oxygen levels caused by lowered barometric pressure at increasing altitudes, challenges the ability of humans to live and reproduce, i.e., adapt and/or acclimatize. Long term high-altitude residents of the South American Andes exhibit unique physiologic adaptations to their environment. Emerging genetic data supports an evolutionary origin for their observed adaptations to high altitude and documents the role of local adaptation, not simply acclimatization, to low ambient oxygen tension. However, clear links between adaptive alleles and phenotypic traits is lacking. To further refine our understanding of the genes contributing to the Andean pattern of high-altitude adaptation, we recruited four study groups with varying developmental exposures to high-altitude including: 1) Quechua ancestry born and raised at high altitude, 2) Second-generation low-altitude down migrants of Quechua ancestry, 3) First-generation low-altitude down migrants of Quechua ancestry, and 4) low-altitude study participants of European ancestry from upstate New York. Pulmonary and hematological phenotypic data were collected from each study participant at the time of enrollment and genotype data were generated using the Affymetrix Biobank genotyping array. Genotype-phenotype associations were assessed using multiple linear regression performed in PLINK. Significant associations were identified for key genes involved in the hypoxia inducible factor (HIF) pathway and arterial oxygen saturation (SaO_2) (repeated measures ANOVA, $p<0.05$ after FDR correction). Future work is underway to functionally characterize the putatively adaptive alleles. These results provide crucial insights into the genetic mechanisms underlying the Andean pattern of adaptation to high altitude.

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Forgotten but not Lost: Utilising underused museum collections for research

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In many museum and university collections are collections of specimens which although well curated have largely been forgotten or deemed unsuitable for teaching and research. This project is attempting to address this issue by using one such collection, the Osman Hill Primate Collection at the Royal College of Surgeons, London to show that such collections can still be of value. The Osman Hill Collection consists of over 400 specimens and were used by Osman Hill to produce his renowned volumes on primates (1953-74). The specimens have at least been partly dissected and thus vary in completeness. Each was fixed and then preserved in 2% formalin. However, since the publication of Osman Hill's volumes these remains have been largely forgotten outside the RCS for over 40 years. To test the possibility that this collection could still be of research and teaching value several new dissections of the forearm have been undertaken on three primate species, (*Macca assamensis*, *Theropithicus gelada, Pan troglodytes),* representing a range of arboreal and terrestrial locomotory preferences. Although only a small sample the results of the dissections reveal minor variations between species, which have implications for understanding small scale ecomorphological adaptations to habitat and lifestyle. This pilot project clearly demonstrates that collections previously thought to be lacking in utility, can, be revived into useful teaching and research resources. Additional work will now be

undertaken to expand the range of primates to produce new comparative primate anatomy resources making the collection once more available for teaching and research.

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Population Bias and its Advantages in Forensic Anthropological Casework

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Anthropological research often assumes that human remains being investigated are normally-distributed and that random sampling will provide an accurate representation of all members of a population. One of the primary problems of an assemblage-level approach in forensic anthropology is that the remains in question do not represent a cohesive "population." Epidemiological studies have indicated that decedents who receive autopsies in the United States do not epitomize a representational swathe of the population at large. In fact, most people who die in the U.S. do not receive an autopsy: only deaths that are unexpected or unnatural typically fall under the jurisdiction of the medical examiner or coroner. Thus, the "population" in question inherently differs between bioarchaeological and forensic studies. Forensic anthropologists have utilized this population bias in unique ways for the purposes of identification in medicolegal settings.

This study highlights how an assemblage-level approach to the study of unidentified decedents from a medical examiner's perspective can aid in the identification process. Recognizing that representational bias exists in domestic casework, this research employs a "biocultural approach" to explore biological, cultural, and socioeconomic variation of unknown decedents from the greater Houston area from 1999-2014. Results indicate that approximately 30% of unidentified decedents during this period likely represent chronically homeless individuals and migrants. These marginalized persons are less likely to be identified via traditional means. Recognition of vulnerable "populations" can inform the type of public outreach a medical examiner's office pursues, such as collaborating with community organizations, advocates, and consulates.

Salt, Spirits and the Soul: Exploring the Relationship between Health and the Use of Ceramics in the Mortuary Context, Savannah, GA

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The years after the Civil War in the United States were plagued by social and political unrest. While the institution of slavery established clear, artificial boundaries between blacks and whites serving to reinforce white superiority, Emancipation sought to dissolve these distinctions and strove for greater equality for African Americans. In response, the white population sought alternate methods of segregation and discrimination in the hopes of reestablishing and bolstering the dominant ideology. As a result, the years following were plagued by increasing turmoil affecting the lives and health of African Americans well into the twentieth century. During excavations at Hunter Cemetery, a turn of the twentieth-century African-American cemetery in Savannah, Georgia, ceramic saucers were recovered from inside the grave of several of the interments. Historical evidence suggests the impetus behind these inclusions lies at the intersections of functionality, spirituality and cultural beliefs, and is reflective of a European and African-derived creolized culture in the United States during the nineteenth and early twentieth centuries. This research investigates the possibility of a health correlate to ceramic inclusions as well.Four primary health indicators were examined: caries rates, degenerative joint disease (DJD), lesions indicative of anemia, and signs of infection. The majority of the interments containing ceramics were adults with very low DJD rates and no evidence of anemia or infection. Preliminary dental analysis suggests far higher caries rates than exhibited in the remaining cemetery population suggesting a possible correlation between dental health and the presence of ceramics in the grave.

Peruvian Ancestry: Morphoscopic Trait Frequency Comparisons

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This study examines the distribution of morphoscopic trait frequencies among a Peruvian sample and European, African, Asian, and Southwest Hispanic samples. Trait frequencies offer the potential to differentiate populations of divergent ancestry, even those that have previously been categorized as one group, such as "Hispanic". This study utilizes previously defined morphoscopic ancestry traits: 9 of the 11 from Hefner and 5 of the 8 from Hurst. All 14 traits were scored on 85 modern crania from Peru.

The published trait frequencies were standardized using percentages and compared to the Peruvian trait frequencies in two separate analyses. First, the Hefner trait frequencies for Africans, Asians, and Europeans compared to the Peruvian sample showed significant differences using chi-squared tests for 8 of the 9 traits. A principal components analysis (PCA) separated the ancestries using 28 variables and explained total variance with 4 components. Second, the Hurst trait frequencies for Africans, Europeans, and Southwest Hispanics compared to the Peruvians showed significant differences using chi-squared tests for all 5 traits. The PCA separated these particular ancestries using 13 variables and explained total variance with 3 components. In addition, the component loadings and biplots show which traits are strongly correlated and drive the separations of the ancestries along the different components. The resulting component loadings bring into question whether it is necessary to score highly correlated traits. Instead, combining separate trait sets, such as the two used here, would provide more fine-grained categorization results.

Validation of field methods for freezing whole blood for later analysis with flow cytometry

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Flow cytometry is a powerful tool for investigating immune function, allowing for the quantification of leukocytes by type and state. Yet it has not been used extensively for field work due to perishable reagents and the need for immediate analysis of samples. To make flow cytometry more accessible, we devised a simple protocol for freezing blood that involves mixing whole blood with 10% DMSO and freezing the sample in the vapor phase of a liquid nitrogen tank. We collected finger prick blood samples from 67 volunteers, age 18 to 40. Blood samples were analyzed immediately and two aliquots were frozen, to be analyzed after two and four weeks in liquid nitrogen. All samples were analyzed on a Guava EasyCyte HT. Lymphocyte fractions in frozen samples were correlated with fresh values, both at two and four weeks (at two weeks: T-cells: $r=0.87$; Natural Killer (NK) cells: $r=0.85$; CD4: $r=0.42$; CD8: $r=0.69$; Naïve CD4: $r=0.73$, Naïve CD8: $r=0.58$; B-cells: $r=0.69$; all p-values <0.001). In general lymphocyte fractions in frozen samples were similar to fresh, but yielded slightly higher NK and CD8 (+3.4%, +2.1%) and lower CD4 (-3.2%) and naïve CD8 fractions (-8.9%). Differences resulted in part from background fluorescence around 680 nm in frozen samples, interfering with antibodies labeled with PerCp/Cy5.5. Our results suggest that antibody/fluorochrome combinations should be validated before use on frozen samples, but that overall a simple freezing protocol is a viable method for obtaining samples for flow cytometry under field conditions.

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Temporal stability in social network metrics among wild vervet monkeys

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Within primate societies, individuals frequently differ in their propensity to behave affiliatively towards others. In animal personality research, consistent individual differences in social behavior are interpreted as an expression of the personality trait "sociability". Sociability has been measured using several methods in primate studies, including with trait ratings and behavioral observation-based methods. In this study, I investigate the degree to which individual vervet monkeys are consistent in their social network metrics, as these metrics may provide another measure of sociability. Study subjects were 30 adult and subadult wild vervets from one social group in South Africa. I extracted grooming bout data from focal follows (1918.5 focal hours) of individuals collected during a demographically stable time period of ~ 6.5 months. I divided the dataset into two time periods, one comprising the winter and early spring (June – September) and the other the birth season (October – December), and constructed social networks based on the proportion of total observation time that individuals spent grooming their partners for each period. I tested for correlations in six social network metrics across the two time periods. Both grooming in-degree and out-degree were correlated across time, as were in-strength and out-strength. There was a strong correlation in eigenvector centrality between time periods, but no correlation in individuals' betweenness across networks. This study demonstrates the use of social network analysis for the characterization of individual differences in sociability in primates.

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Heavy-handed: Can handedness be detected from bilateral degeneration of the medial end of the clavicle?

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Skeletal asymmetry has been associated with handedness and evolution of brain lateralization. Many studies have examined the relationship of upper limb asymmetry to function via metrics. However, bilateral variation in clavicular wear has been overlooked. Clavicles are impacted by a variety of stress loads. They are also the first to ossify in the upper limb and their medial end is among the last elements to fuse. Thus, clavicles have a long period of sensitivity to lateralization behaviors, including degeneration. The medial end of the clavicle has been suggested to provide accurate and narrower age range estimates for European adults over age 40 through observation of degenerative changes. Yet, whether significant differences exist in degenerative traits bilaterally and if occupation and handedness is a factor is left unresolved.

Three traits of degenerative changes (porosity, topography, osteophyte formation) were scored in the medial end of the clavicle as markers of behavioral lateralization. Paired T-tests were used to determine if significant differences existed in bilateral degeneration of medial clavicles in a historic population of African Americans (n=239) from the Hamann-Todd collection. Further, this study preliminarily explored the relationship of occupation to degeneration.

Results indicate that the difference in the means of the bilateral scores for each individual trait as well as a composite score is not significant (p= 0.36- 0.85). Degeneration of the medial end of the clavicle in this population is not then a useful indicator of functional lateralization or handedness. Nevertheless, composite scores may indicate nonspecific occupational differences between individuals.

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Phenotypic and genetic ontogenetic integration of squirrel monkey (*Saimiri boliviensis*) age-specific body mass

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Primate ontogeny is prolonged compared to other mammals of comparable body size and often includes growth spurts. This long duration and multiphasic nature of primate growth offers opportunities for both compensatory canalization of adult size and potential dissociation of sizes at distant age points. We addressed these factors in a large sample of captive Bolivian squirrel monkeys (*Saimiri boliviensis boliviensis*) interlinked through a well-known genealogy.

Phenotypic variances across developing age classes are consistent with compensatory growth while bivariate correlations identify dissociation between ages before and after the first birthday. Parallel "animal model" quantitative genetic analysis yielded narrow-sense heritability estimates of mass that were initially small but rose quickly to plateau near $h^2 \approx 0.5$ in adulthood. Additionally, we highlight normative patterns of mass ontogeny in *Saimiri*. These include clear sexual bimaturism with a strong adolescent spurt in males even after adjusting for seasonal fattening, and the absence of any sign of a previously suggested period of temporary growth cessation in late infancy.

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Terrestrial aridity and Plio-Pleistocene hominin environments

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The role of aridity in human evolution is not well understood, due to the difficulty of generating relevant terrestrial paleoclimate records. Here we use $\delta^{18}O$ values in 1224 teeth of extant mammalian herbivores from 37 locations in eastern and central Africa to identify taxa that are sensitive and insensitive to evaporation, primarily due to differences in drinking behavior. We show that the oxygen isotopic enrichment between evaporation sensitive (giraffids, tragelaphins, and hippotragins) and some evaporation insensitive (hippotamids, elephantids, and rhinocerotids) taxa can be used estimate paleoaridity. We use $\delta^{18}O$ values from 228 fossil teeth from paleontological and archaeological collections, primarily from the Turkana Basin, to reconstruct aridity over the Plio-Pleistocene. This method is insensitive to changes in vegetation, moisture source, soil temperature, and elevation. In the Turkana Basin, we find arid conditions at sites in the early Pliocene (Kanapoi), the late Pliocene (upper Lomekwi Member at Lomewki LO1/2/3 and Kangatukuseo KU1/3), and the early Pleistocene (upper Burgi Member at FwJj20, Kaito Member at Kalochoro KL3/6, Naiyena Engol NY1/2/3, Loruth Kaado LK4). We find humid conditions at sites in the early Pliocene (upper Lonyumun Member at Allia Bay), the mid-Pliocene (lower Lomekwi member at Lomewki LO4/5), and the early Pleistocene (upper Lomekwi/Lokalalei Member at Kangatukuseo KU2 and the upper Kaito Member at Kokiselei KS1/2). In Afar, Ethiopia we find arid conditions in the early Pliocene (Aramis), and in southwestern Kenya we find humid conditions in the early Pleistocene (Kanjera South). We do not observe long-term trends in aridity over the Plio-Pleistocene.

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Faces by the fire: Investigating facial affect around daytime and nighttime campfires

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Archaeological and evolutionary theory suggest that hearth and campfire use has greatly impacted human evolution, though the magnitude of controlled fire's influence on social complexity remains under-explored. Gowlett and colleagues suggest that the extensive period of human fire use before developing the ability to kindle fires would have selected for increasing social tolerance and cooperation. Wiessner reports differences in daytime versus nighttime fireside conversation among Ju/'hoan hunter-gatherers and suggests that firelight created a new landscape for social activity by extending the day. Nighttime fireside behavior may have been more conducive to relaxed and gregarious interactions relative to more functional subsistence behaviors around daytime fire. Our previous research using a simulated fire paradigm supports the relaxation and prosociality associations with fire use in modern populations. In this study, we predicted that real fires at night would be associated with a greater relaxation effect and facial expressions and body language consistent with social approachability. Our data include videorecorded day and nighttime fireside behavior. Purposive samples of participant behavior in videorecordings were coded by our research team for approachability. Preliminary analysis suggests that social context plays a large role in fire effects, which is consistent with participant feedback in previous studies. Social intimacy, creating bonds, and the creation of new social spaces by firelight will be discussed in a contextual framework that places greater value to the role of campfire in the rise of socially complex cooperation and the evolution of society.

Hormonal Correlates of Sexual Swellings During Pregnancy in Wild Chimpanzees (*Pan troglodytes schweinfurthii*) of Kanyawara and Gombe

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Sexual swellings appear in a variety of Old World monkeys and apes as a signal of female fertility and ovulation. In chimpanzees, this signal is exaggerated: the large anogenital swelling lasts for 10-15 days in a 35-day ovarian cycle. Estrogen induces swelling during the follicular phase while rising progesterone in the luteal phase leads to its collapse; ovulation is most likely to occur as detumescence approaches. Swellings often continue during pregnancy, when both estrogen and progesterone are high, and the mechanism of post-conception swellings remains enigmatic. We analyzed urinary estrone conjugates (E1C) and pregnanediol-3-glucuronide (PdG) in 372 samples from 26 pregnancies in 17 females from Gombe National Park, Tanzania, and the Kanyawara community of Kibale National Park, Uganda. We used a linear mixed model to test the effects of hormones on the level of swelling—none, partial, or full—on the day of sampling, while controlling for gestation day and repeated sampling within females. We found a negative effect of PdG on swelling (ES = -0.48, $p < 0.0001$), while E1C had a positive effect (ES = 0.19, $p = 0.044$). In accordance with preliminary analyses of records from Gombe and Kanyawara, older females were less likely to be swollen (ES = -0.02, $p = 0.037$). These results demonstrate that estrogen and progesterone exert similar effects on swelling before and after conception. Ongoing research into the behavioral correlates of post-conception swellings will help to determine if they have adaptive value or occur as a byproduct of normal hormonal activity during pregnancy.

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Secular change in the timing of epiphyseal fusion in the bones of the hand-wrist

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Epiphyseal fusion is the hallmark of the completion of skeletal maturity and also marks the end of longitudinal bone growth. Secular trends for earlier somatic maturation have been noted worldwide, yet secular changes in the timing of fusion as an independent indicator of maturity have not been addressed. Fusion is a particularly salient maturity indicator in an anthropological setting, where recovery of skeletal remains often does not include the subtle skeletal features used to identify maturity levels prior to fusion. Given its important role, we examined sex-specific changes in fusion timing of contemporary children versus those born decades earlier.

To address indicator-specific secular trends, 1,292 children born between 1915 and 2006 were examined for fusion timing in the bones of the hand-wrist. All bones were scored for the initiation and completion of fusion using the Fels Method. Subjects were stratified by sex and birth decade, and age at fusion stages were compared across groups using repeated-measures logistic regression.

Results indicate the initiation and completion of fusion during adolescence occurs consistently earlier in recent cohorts, with an average of 5.18 and 5.06 months earlier for boys and girls, respectively. The results also suggest that age at fusion initiation may be a more important indicator, as some bones initiate fusion nearly a year earlier in recent cohorts. The advanced timing of fusion in this population is not associated with pathology or shorter stature, suggesting the entire maturation process is shifting and may be occurring more rapidly in the most recent cohorts.

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Patterns of ossification in macerated thyroid cartilages: Implications for age and sex estimation

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The ossification process of the thyroid cartilage has been examined extensively through radiographs and CT scans. Some researchers suggest a standard progression of phases for age estimation, but others have found little correlation. Despite these conflicting results, ossification of the thyroid cartilage continues to be used as an indicator of advanced age.

To evaluate the null hypothesis that there is no correlation between the degree of thyroid cartilage ossification and age at death, this pilot study examines 32 macerated cartilages, 20 males and 12 females, from forensic cases. Cartilages were separated by sex and scored using standard techniques. The observed patterns of ossification were discordant with published phases, therefore photographs of the anterior aspects were taken and ordered by degree of ossification. Known age-at-death was re-associated with the samples.

No statistically significant correlation between degree of ossification and age-at-death was found, so we cannot reject the null hypothesis (Spearman's rank-order: male: $\rho=0.057$, $p = 0.813$, $\alpha=0.05$; female: $\rho=0.224$, $p=0.484$, $\alpha=0.05$). A statistically significant difference in the pattern of ossification was observed between the sexes ($\chi^2 = 8.5$, $p = 0.00349$, $\alpha=0.05$), specifically in the ossification of the superior horns. Six of 20 males (30%) and 10 of 12 females (80%) exhibit ossification of the superior horns.

The results of this study do not support any correlation between age-at-death and degree of ossification of the thyroid cartilage. Practitioners should not utilize this structure during an age-at-

death assessment. However, these results do suggest the utility of thyroid cartilage ossification for sex estimation.

Effects of visitor group size on the number of abnormal behaviors in captive bonobos (*Pan paniscus*) housed in outdoor and indoor zoo exhibits

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The welfare of animals held in captivity is of increasing concern, particularly in zoo environments where animals have closer contact and constant interaction with humans than they do in the wild. The effect of these interactions on the stress levels of captive zoo animals is not fully understood and difficult to quantify, but the observance of abnormal behaviors typically indicate higher stress levels. Most animals studied are negatively affected by constant interaction with visitors, but some species, like captive bonobos (*Pan paniscus*), actively instigate interactions indicating these may be positive. I completed instantaneous group scans and focal scans to determine if the number of abnormal behaviors changed when the bonobos were in an exhibit indoors (where interactions occur frequently) or outdoors (where interactions do not occur) at The Cincinnati Zoo. A Spearman's rank correlation test determined that there was not a significant difference in the number of abnormal behaviors observed with varying numbers of visitors (ρ=0.03, N=167, p=0.699). Mann-Whitney tests determined that there was not a significant difference in the number of abnormal behaviors exhibited at either exhibit (Z=-0.205, p=0.837). These results did not support the hypothesis, but do suggest that visitor interactions do not cause higher levels of stress in *P. paniscus*. In many zoo animal exhibits, it is best for zookeepers and exhibit designers to inhibit interactions between guests and the animals. Based on the results of this study, it may be better for *P. paniscus* welfare if healthy interactions are not inhibited.

Assessment of life stages of the individuals at Rising Star

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The Rising Star cave in South Africa has uncovered more than 1550 fossil specimens of adult and immature cranial and post-cranial remains. The assemblage represents a single species, *Homo naledi*, and its collection in one chamber represents deliberate disposal of multiple individuals over generations. The Dinaledi collection includes 190 teeth. We determined a minimum (MNI) of 15 individuals by associating dental remains using standard approaches based on fitting occlusal and interproximal contact facets, identifying antimeres, and comparable stages of tooth development and attrition. We then developed age classes based on dental development and wear: infant, deciduous teeth only; young juvenile, first permanent molars erupted; old juvenile, second permanent molars erupted; sub-adult, third molars erupted but unworn; young adult, all permanent teeth erupted with moderate wear; old adult, all permanent teeth erupted with heavy wear. We assessed the life stage of each individual, yielding the following: three infants, three young juveniles, one old juvenile, one sub-adult, four young adults and one old adult; two individuals are of unknown age class. The Dinaledi sample represents individuals across all life stages and is striking in the large number of non-adult individuals represented in the collection. Additionally, the sample contrasts with most other large hominin assemblages, such as *Australopithecus* at the Hadar 333 locality, or late *Homo* at Sima de los Huesos and El Sidrón, in having a high proportion of juveniles. The Dinaledi assemblage offers an opportunity to explore the pattern of growth and development and possible social behaviors of *Homo naledi*.

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Baboons (*Papio anubis*) in Kibale National Park, Uganda, disperse seeds into diverse habitats: preliminary results from spatial analysis and seed fate experiments

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Kibale National Park, Uganda, comprises multiple forestry compartments with different histories of logging, resulting in diverse habitats of unlogged/primary forest, logged/regenerating forest, and forest gaps. In Kibale, olive baboons (*Papio anubis*) travel and disperse seeds in a wide range of these forestry compartments and habitat types, although virtually nothing is known of how they impact forest regeneration. During baboon follows (2010-2011, 2014), we collected Geographical Spatial Positioning coordinates for 401 fecal samples and, using ArcGIS, analyzed the spatial data using kernel density estimation. A subset of these fecal samples (n=90) were collected and analyzed for seed content, a majority (68%) of which contained whole seeds (range=3-103/sample). A randomly-selected sub-sample of the fecal samples (n=10) comprised 1,131 whole seeds (mean=113 seeds/sample) that were used to establish three 50m transects in a logged forestry compartment (K-15; n=88 seeds) and three transects in an unlogged compartment (K-30; n=90 seeds) to monitor seed fate. Every 10m, we placed 5 seeds (either *Aframomum* spp. n=30; *Solanum* spp., n=81; Poaceae spp., n=67). After three weeks, the average proportion of whole seeds remaining in K-30 (0.022 seeds) was lower than K-15 (0.176 seeds) ($t(7)=4.6585$; $p<0.01$). Additionally, an analysis of variance showed that the effect of the seed species was a determinant of seed fate ($F(2,285)=3.107$; $p<.05$). These results suggest that baboon movement and foraging ecology contribute to seed dispersal at a landscape level through the distribution of seeds in diverse habitats, and with seed fate affected by logging history and seed species.

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Spinal Pathologies and Morphological Alterations in Native Populations of the Lower Tennessee River Valley

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Vertebrae are an effective, though highly debated, data source for understanding physical activities of a populace due to the osteological reactivity of the nuchal region to extensive weight and pressure. Consequently, there are several spinal pathologies and/or morphological alterations which may help indicate biomechanical differences in particular load-bearing strategies. A collection of 287 pre-Columbian Native American individuals was examined and analyzed for schmorl's nodes, deviated spinous processes, Porter's neck, and additional modifications. The collection consists of remains from six archaeological sites located in the lower Tennessee River Valley: three sites (Cherry, Eva and Kays Landing) from the Archaic period (~2500-1000 BC) that reflect an intensive hunter-gatherer subsistence strategy; and three sites (Link, Slayden and Thompson Village) from the Mississippian period (~AD 1000-1200) that reflect an agriculturalist subsistence economy. This overview suggests a co-association between certain pathologies and

morphological alterations on the spine and particular repetitive biomechanical, load-bearing movements (e.g., head balancing, forehead and chest level tump line use).

Central Saharan Population History as Inferred from Postcranial Limb Proportionality

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Population movement is a catalyst for numerous cultural adaptations. It is a critical part of human evolution, and modern humans owe much of our varied appearances and social behaviors to past episodes of migration. The intimate connection between population movement and ecological systems is particularly important to reconstructing the occupation history of North Africa ca. 9000ya. During the Late Pleistocene the Sahara Desert underwent a hyper-arid period of desertification (the Ogolian) forcing populations to abandon the region. A second climatic event, the Green Sahara period of the Early Holocene, facilitated repopulation of the Sahara Desert during the Early Holocene. The Gobero site in Niger represents the largest skeletal collection of its kind from this time period and is ideally suited for a study of population movement. This study sought to identify population affinities of the Early Holocene settlers of the Sahara using archaeological materials from two occupation phases at the site dating to between 10000 and 4000ya. Post-cranial measurements were used to compare the body proportions of Holocene North Africans from Gobero to populations from West-Africa, Sub-Saharan Africa, the Maghreb and the Nile Valley. Results of bivariate regressions and principal component analysis indicate that the Early Holocene occupants of the central Sahara show postcranial affinities with modern Sub-Saharan African body types (relatively long distal limb segments). Interestingly, despite major shifts in craniofacial morphology the pattern of limb bone proportionality does not change through time, despite a significant decrease in stature and a general gracilization of body form.

Infant handling and urinary oxytocin in sub-adult bonobos (*Pan paniscus*): support for the learning to mother hypothesis

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Natal attraction is widespread across the primate clade and non-maternal infant care (allocare) includes a variety of behaviors collectively known as 'infant handling.' Several hypotheses have been proposed to explain the adaptive function of infant handling, namely those associated with kin selection and learning to mother. The purpose of this study is to describe the basic pattern of expression and to investigate the function of infant handling in sub-adult bonobos. Data were collected on the Columbus Zoo bonobo colony (N=19 individuals) where handling was observed in 9 sub-adults (adolescents and juveniles) toward 4 infants and primarily consisted of carrying and grooming behaviors. Mothers of infants mostly permitted handling attempts and male and female infants were handled equally ($F=0.030$, $df=1$, $p=0.874$). Sub-adults handled infants significantly more than adults ($F=15.385$, $df=1$, $p<0.001$) and while there was no significant difference in handling between male and female juveniles ($F=1.750$, $df=1$, $p=0.317$), a significant sex difference was found among adolescents where females expressed handling significantly more than males ($F=37.733$, $df=1$, $p<0.01$). Furthermore, nulliparous females engaged in handling behaviors significantly more than parous females ($F=97.372$, $df=1$, $p<0.001$). Additionally, urine samples from all sub-adults were analyzed to examine the relationship between infant handling and oxytocin, a known facilitator of maternal behavior in mammals. Preliminary analyses suggest a significant positive relationship between mean oxytocin and handling behavior in sub-adult females ($p<0.05$) but not in sub-adult males ($p=0.1057$). Together these results support the hypothesis that infant handling functions as a mechanism by which females learn maternal behavior in bonobos.

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Just what the doctor ordered: Socioeconomic status and subsequent injury in Pre-Industrial and Industrial London

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Traumatic injuries are the leading cause of mortality in over ten percent of all deaths worldwide, and are becoming increasingly prevalent in industrializing societies. Treatment is vital for preventing mortality, but access to care is ultimately constrained by culture. Further, consequent variation in treatment produces an array of long-term health outcomes, which can induce long-term physiological stress that accumulates over time, predisposing the injured to future health insults, including subsequent injury (referred to as injury recidivism). The objective of this study was to examine the extent to which recidivist behaviors were influenced by culturally patterned variation in treatment through the analysis of human skeletal remains from pre-Industrial and Industrial London (A.D. 1598-1853). This study examined the skeletal remains of 51 injured adults housed at the Museum of London for evidence of fracture deformity and multiple traumata. The analysis indicated that (1) individuals from the lower social classes were more likely to exhibit evidence of two or more injuries than members of the upper classes (68.4% of 38 vs 38.5% of 13), (2) similar proportions of injured individuals from the upper (38.5% of 13) and lower (34.2% of 38) social classes exhibited evidence of deformity, and (3) when both social classes were combined, most individuals who exhibited fracture deformity did not present with more than one injury (78.4% of 51). These results suggest that factors other than access to treatment, such as residency and activity, may better explain the disparity in recidivistic behaviors between members of London's upper and lower echelons.

Dynamics of human-chimpanzee encounters at Fongoli, Senegal, 2006-2014

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In Senegal, human population and artisanal gold mining activities have increased rapidly over the past ten years. With these increases we hypothesized that the coexistence between humans and chimpanzees (*Pan troglodytes verus*) have changed, resulting in increased encounter rates and increased stressful encounters for chimpanzees. In this study we analyzed nine years of daily follow data collected by researchers at the Fongoli field site in southeastern Senegal. We determined the time and location of human-chimpanzee encounters, activity of the people encountered, and chimpanzee reaction to the encounter. Although daily encounter rates decreased from 2006 to 2007 from 1.14 to 0.56 encounters per day, by 2014 human-chimpanzees encounters rates reached a rate of 1.61 encounters per day. Additionally, we saw a shift in human activities in the chimpanzee habitat, with a reduction in *Saba senegalensis* collection (a fruit consumed by chimpanzees and local people) and an increase in gold mining activity. Contrary to our hypotheses, however, results indicate that chimpanzees may have increased their tolerance to human encounters. In 2013 and 2014 chimpanzee were less likely to flee from encounter sites and more likely to exhibit no reaction during encounters. Although further research is needed, changes in tolerance to human encounters may be due to longevity of the research project and habituation to humans. Additionally, people traveling to access a gold mining site may be less likely to threaten or interact with chimpanzees than local community members attempting accessing the chimpanzees' resources or hunt other wildlife.

The effect of natural substrate inclination on foot strike position in a habitually unshod population

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Foot strike position in runners has been assessed across various speed and substrate conditions, in several habitually shod and unshod populations. However, the results of some studies differ, raising questions about what factors drive footfall patterns. We examined the overlooked effect of substrate inclination on foot strike position in the habitually unshod Daasanach of Northern Kenya (n=44). Videos were recorded of 17 male, 17 female and 10 juvenile subjects on three naturally inclined, compact sand trackways of ~16 degrees (steep), ~11 degrees (moderate) and ~1.5 degrees (low). Subjects traveled up the trackways at self-selected walking, jogging, and sprinting speeds, for a total of 36 trials per subject, and foot strike position was quantified. We used linear mixed modeling to explore the effects of speed, substrate incline, age, and sex on foot strike position.

Preliminary results suggest that foot strike position is significantly influenced by the interaction between speed and substrate incline. On the lowest incline, rearfoot strike (RFS) is frequent and occurs across all speeds, midfoot strike (MFS) is employed at higher jogging and sprinting speeds (>2.5 m/s), and forefoot strike (FFS) is rare. On the moderate incline, MFS is most frequently employed, while RFS is much less common and only occurs at lower speeds (<2.0 m/s). On the steepest incline, MFS is most prevalent across all speeds, FFS is only employed at moderate speeds (2.0-3.5 m/s), and RFS is infrequent. These results demonstrate that substrate topography is a significant factor in foot biomechanics during running.

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Classroom optional: Service learning and community engagement in anthropology

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Education does not start in the classroom, so why should it be limited to the classroom? Here we present two techniques used to enhance learning and promote civic leadership outside classroom walls; service learning and internships for community engagement.

A service learning partnership with Zoo Boise provided introductory and upper level students opportunity to observe primates and create need-driven enrichments. Observations, keeper interviews, and out-of-class research prompted hypothesis development and testing. Assessment consisted of reflective exercises, team evaluations, and poster presentations in a Service Learning Exhibition. Student's perceptions on the Bloom's Taxonomy scale were analytical, evaluative, and creative rather than based on memorization. While a number of students discussed concerns about zoos, they gained appreciation and experience regarding the role of bioanthropology in primate enrichment and conservation.

An internship course allowed students to participate in and develop community engagement activities promoting anthropology as science. From supervisory meetings, students designed and led activities for two campus events; eGirls and STEM Day. Activities were created to allow interactive and experiential exploration of topics such as bipedalism, forensic mapping, and tool use. Student interns re-learned key concepts by teaching others, came away from the experience having creatively reignited their own interest in anthropological topics, promoted the relevance of the discipline, and gained an understanding of their role as stewards for science education in their community.

Though assessment of these teaching techniques in fulfillment of learning objective is preliminary, evidence suggests there are wide benefits to moving away from a traditional learning environment.

Quantifying Phenotypic Differences in Human Scalp Hair Morphology Associated with Ancestry and Sex

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Past studies of scalp hair form have primarily focused on morphological differences between ancestry groups. These studies need to be updated with more comprehensive datasets that also consider other sources of variation such as age, sex, and body size. We used light microscopy to measure scalp hair samples from persons representing five ancestry groups to test some of the less studied aspects of human hair morphology. The results indicate that there are significant differences in average diameter variance in hairs across ancestry groups. In terms of average diameter, East Asian and South Asian hairs are significantly larger than European, African, and Hispanic hairs. African hair has a significantly greater variance in diameter than hair of European ancestry. The coefficient of variance (CV), which gives an indication of the degree of this variation in hair form within a group, is significantly different between most ancestry groups. Hair of African ancestry has a higher average CV than all of the other ancestry groups while East Asian hair has a lower average CV than all other ancestry groups. Considering sex differences in hair form: Males show a greater average diameter and CV than females within their population groups. This research will lead to future studies on the role genes play in phenotypic variation of scalp hair morphology and an examination of prepubescent hair to assess potential hormonal mechanisms for the differences observed between the sexes.

A genetic survey of the bonobos (*Pan paniscus*) at the Iyema field site, DRC

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Research on wild apes is not only fundamental to elucidating human origins but to their conservation as well. Despite their relative size, apes are difficult to observe in the wild prior to habituation, limiting our ability to infer demography, relatedness, and kinship. Non-invasive genetic sampling provides an indirect source of this information. Here, we present preliminary findings of a genetic "survey" of a wild semi-habituated community of bonobos. 58 fecal samples were collected from nesting parties at the Iyema field site in the Lomako Forest, DRC. DNA was first extracted and quantified using a qPCR assay and samples that yielded >0.01 ng of DNA were further genotyped at 11 microsatellite loci and sexed using an amelogenin assay. 34/58 samples yielded a sufficient amount of DNA for complete genotyping. We identified 20 individuals, including 7 males and 13 females. Genetic diversity was high; mean allelic richness across all loci was 5.2 and expected heterozygosity was 0.70. We detected several kin relationships between individuals, including 7 parent-offspring dyads. Mean relatedness among males was only slightly higher when compared to the relatedness among females, which is consistent with results reported from wild chimpanzee communities. Our genetic survey indicates that this community has retained high genetic diversity. These results also validate our methods for the use of non-invasive genetic sampling of the bonobos at Iyema and are essential to our long-term research and conservation goals at the Iyema field site.

A reevaluation of taxonomic divisions within South African *Parapapio*

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The interpretation of variation in the fossil record and its subsequent taxonomic apportionment is a principal issue across paleoanthropology, although it is rarely a straightforward endeavor. The taxonomic history of fossil representatives of Tribe Papionini, particularly Genus *Parapapio*, proves especially complicated. Distinguishing between species of *Parapapio* has traditionally been problematic, in part because species definitions are largely based on absolute dental dimensions and continuously varying cranial morphological features. The continuous range of variation in dental size, alongside the absence of clear apomorphies between species has resulted in repeated reevaluation of *Parapapio* species validity. We undertook a qualitative assessment of a subset of relatively complete and well-preserved South African papionin craniodental specimens (n=29) intentionally blind to previous taxonomic identifications. Specimens were sorted by similarity in multiple qualitative cranial features. We then compared our results with published taxonomic classifications. Our results demonstrate that morphological traits do not pattern consistently across the published species categories within *Parapapio*. Further examination of qualitative cranial traits and dental metrics across *Parapapio* specimens (n=70) in comparison with five extant papionin species (n=321) also suggests that current species categories do not reflect clear biological entities, indicating that species categories within *Parapapio* are in need of revision. We propose a revised taxonomic scheme that considers morphological variation introduced by sexual dimorphism, allometric effects, and the temporal depth represented in fossil samples.

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Dominance styles of eight alpha male chimpanzees at Gombe National Park, Tanzania

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Alpha male chimpanzees have high reproductive success, yet body mass does not predict rank, begging the question: How do individuals acquire and maintain rank? One hypothesis is that large and small alphas exhibit distinct dominance styles that are suited to their body size. Indeed, there is evidence that body size affects how much and how equitably alpha males groom others. Here, we use 33 years of behavioral data from Gombe National Park to investigate mating behavior as a correlate of dominance style among eight alpha male chimpanzees. Using a generalized linear model to control for party composition and relatedness to the female, we found that alphas varied in the degree to which they monopolized matings with parous, sexually receptive females (mean ± SD = 21.6 ± 8.0% of all matings; range = 12.4 - 33.3%). This variation could reflect an alpha's tolerance for others' mating attempts (concession model), potentially in exchange for coalitionary support. Alternatively, this variation might simply reflect the degree to which each alpha is able to monopolize access to females (tug-of-war model). In preliminary analyses, we found no systematic relationship between either dominance (as measured by Elo ratings) or body size (relative to other adult males) and an alpha's degree of mating monopolization, although the most dominant and largest alpha was most successful at monopolizing matings. Further work on monopolization during the periovulatory period, and on grooming relationships and coalitions, is needed to test these hypotheses.

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Sexual dimorphism of the proximal ulna: An evaluation of metric analyses

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Determining sex of human skeletal remains is essential in forensic casework and archaeological investigation. Long bones have shown to be sexually dimorphic, of which the ulna displays reliable levels of accuracy in sex discrimination. Previous studies have demonstrated that the proximal ulna measurements discriminates sex as well as measurements of the whole ulna. The use of discriminant function analysis (DFA) for sex determination has shown to be population specific. Logistic regression is statistically more robust than DFA and may offer a new method that can be applied across populations. To investigate both metric analyses for successful discrimination of sex in the ulna, 322 individuals from the Terry Collection were selected and six ulnar measurements were taken: maximum length; olecranon breadth; olecranon height; notch length; coronoid height; and radial notch height. Results from discriminant function analyses derived from Cowal and Pastor (2008) yielded accuracy rates of 69.25% to 85.09% - though when individuals were considered by ancestry, accuracy rates varied by an average of 11% for each discriminant function. Logistic regression developed in this study yielded accuracy rates of 69.25% to 89.13% with an average of 2.18% difference in classification accuracy when individuals were grouped by ancestry. This study further demonstrates that while the proximal ulna is sexually dimorphic, DFA developed for these variables are population specific. Logistic regression was successful in assessing sex from the proximal ulna as well as demonstrated its robusticity in classification accuracies that differed little between the ancestral groups sampled here.

Impact of *Yersinia pestis* on immune response variation in humans

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The geographic distribution of a host population can strongly influence immune system evolution. *Yersinia pestis*, the bacterial agent of plague, is posited to be one of the strongest agents of pathogen-mediated selection in human history. Plague outbreaks during the 14th century are estimated to have killed roughly 40% of the European population. The current understanding *Y. pestis* spread in West Africa during this time is less clear, but suggests that these populations were not subject to the same pandemic dynamics as Eurasian populations. While plague is implicated in the selection of immune loci in European populations, studies of plague-mediated selection are limited and lack functional assessment of immune response to *Y. pestis*. To better understand how *Y. pestis* epidemics have affected variation in modern human immunity, we compared the whole genome responses of monocyte-derived macrophages from 19 African American and 22 European American males to stimulation with *Y. pestis* KIM D27 lysate for 4 hours via RNAsequencing. Between group differences in gene expression were noted across multiple genes families, including genes known to be involved in inflammation. Pathway perturbation and co-expression analysis, suggest there are gene pathways and modules that differ in regulation between these populations in response to immune challenge. These observations suggest that peoples of African and European ancestry have diverged in their innate immune responses to plague.

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Mesa of Sorrows: A History of the Awat'ovi Massacre

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The Hopi community of Awat'ovi existed peacefully on Arizona's Antelope Mesa for generations until one bleak morning in the fall of 1700 – raiders from nearby Hopi villages descended on Awat'ovi, slaughtering their neighboring men, women, and children. While little of the pueblo itself remains, five centuries of history lie beneath the low rises of sandstone masonry, and theories about the trauma are as persistent as the desert winds. The easternmost town on Antelope Mesa, Awat'ovi was renowned for its martial strength, and had been the gateway to the entire Hopi landscape for centuries. Why did kinsmen target it for destruction? Drawing on oral traditions, ethnography, archival accounts, and extensive archaeological research, the author unravels the story and its meaning. Mesa of Sorrows follows the pattern of an archaeological expedition, uncovering layer after layer of evidence and theories. The motives of the investigators are questioned, and this shows how interpretations were shaped by academic, religious and tribal politics. Piecing together three centuries of investigation, the author offers insight into why some were spared—women, mostly, and taken captive—and others sacrificed. He weighs theories that the attack was in retribution for Awat'ovi having welcomed Franciscan missionaries or for the residents' practice of sorcery, and argues that a perfect storm of internal and external crises triggered a deep history of ritual bloodshed and purification.

A morphometric examination of *Homo naledi* teeth from Dinaledi Chamber, Rising Star cave system, South Africa

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The Dinaledi Chamber of the Rising Star cave system is a hominin-bearing deposit in the Cradle of Humankind World Heritage Site, Gauteng, South Africa that contains a newly defined species, *Homo naledi*. To date, excavations have uncovered ~1550 hominin skeletal specimens that include 190 whole or fragmentary teeth from at least 15 individuals. A crown shape analysis was performed on the occlusal surface outline of Dinaledi mandibular P_3, P_4, M_1, M_2, and M_3 using the digitizing program MLmetrics and Elliptical Fourier Function Analysis. Interspecific variation and, when samples sizes allowed, intraspecific variation were assessed. The Dinaledi fossils were compared with teeth from hominins classified as *Australopithecus robustus*, *A. africanus*, *A. sediba*, *H. erectus*, *H. habilis*, *H. rudolfensis*, *Homo sp*., and *H. sapiens*. Principal component analyses were performed on the amplitudes of the digitized teeth. The results indicate that while there is overlap in the form (shape and size) and shape (size standardized) of the P_4, M_1, M_2, and M_3, *H. naledi* P_3s are unique in their occlusal outline morphology. In addition, the occlusal outline form of the *H. naledi* teeth, not unexpectedly given their single provenience, demonstrate the least amount of intraspecific variation, while *A. africanus* exhibits the greatest amount. These results support the taxonomic designation of the Dinaledi specimens as a new species, *Homo naledi*.

Sex differences in hair cortisol and self-reports of stress in college freshmen during their first final exam period

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Correlations between biomarkers and self-reports of stress are modest, in part because self-reports generally measure chronic stress while biomarkers generally measure acute stress. Hair cortisol is a biomarker of chronic stress. Both hair cortisol and self-reports of stress were collected in a sample of college freshmen during their first final exam period, potentially a stressful time. Participants filled out the Perceived Stress Scale (PSS). Hair samples (5-10 mg) within 2 cm of the scalp were collected. Cortisol concentrations were determined using an immunoassay. Participants who were not able to provide hair samples were excluded; analysis was limited to the 111 participants who provided both stress measures.

For all participants there was no significant correlation between the amount of hair cortisol and the PSS ($r = 0.06$, ns). Women had higher scores on the PSS than men ($t=2.2$, $p<.05$) and men had higher levels of hair cortisol than women ($t=3.3$, $p < .001$). Among men ($N=28$) there was a negative correlation between hair cortisol and the PSS score ($r=-0.39$, $p < .05$). Among women ($N=83$) hair cortisol and the PSS score were positively correlated ($r=0.27$, $p=.01$). Previous studies showed that women generally report greater perceived stress than men. The higher level of hair cortisol in the men suggests that women are not necessarily under greater stress; they may simply report stress differently than men. The sex difference in direction of correlation between perceived stress and hair cortisol suggests that sex should be controlled in any population-level analysis of stress.

Short- and long-term consequences of intergroup interactions in redtail monkeys (*Cercopithecus ascanius*) and grey-cheeked mangabeys (*Lophocebus albigena*) in Kibale National Park, Uganda

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When a group successfully contests access to a feeding site, it displaces the losing group from the area. This pattern is expected to result in an immediate skew in resource access and a long-term skew in home range quality and reproductive success. I examined the outcomes of intergroup encounters in groups of grey-cheeked mangabeys (*Lophocebus albigena*) and redtail monkeys (*Cercopithecus ascanius*) in Kibale National Park, Uganda, to determine whether between-group contests resulted in differential access to resources. In 39 mangabey encounters, success was unrelated to group size, did not result in greater short-term access to the feeding site, and did not result in higher long-term access via increased home range quality. However, mangabey encounters were clearly motivated by the presence of high-value feeding patches and resulted in different travel costs for winning and losing groups. The absence of skewed resource access likely arose from symmetries in resource-holding potential and fluctuating payoff asymmetries. In 54 redtail encounters, group size (but not territorial boundaries) predicted success in limited contexts, and losing groups did not exhibit reduced food intake but did travel farther after encounters. Larger redtail groups had higher-quality ranges, and intergroup dominance relationships existed. The combination of long-term skew in resource access and dominance relations indicates that contest competition differentially affected the average fitness of redtail groups. Though both species contested access to feeding sites, the fitness effects of intergroup contests were greater for redtails than for mangabeys.

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Evidence for precuneus expansion in recent human evolution

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The evolution of neurocranial morphology in our species is characterized by bulging of the parietal region, a feature unique to *Homo sapiens*. In modern humans, expansion of the parietal surface occurs during the first year of life, and this expansion is absent in chimpanzees and Neandertals. Similar variation in brain shape among living adult humans is associated with expansion of the precuneus. Using MRI-derived structural brain templates, we compare medial brain morphology between humans and chimpanzees through shape analysis and geometrical modeling. We find that the main medial brain morphological difference is a prominent expansion of the precuneus in our species. The precuneus is a major hub of brain organization, a central node of the default-mode network, and plays an essential role in visuospatial integration. Together, the comparative neuroanatomical and paleontological evidence suggest that a conspicuous enlargement of the precuneus is a specialization of *Homo sapiens* that evolved in the last 150,000 years and that may explain the evolution of recent human cognitive specializations.

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Reorganization of Temporal Association Cortico-cortical Connectivity in Hominoids

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Humans and other great apes possess relatively large association cortices compared to Old World monkeys. In order to explore modifications of multimodal temporal areas, responsible for language and conceptual processing in humans, we interrogated patterns of connectivity between unimodal primary areas and temporal association areas in humans, chimpanzees, and macaques using diffusion-weighted MRI. Specifically, we seeded the central representation of area V1 (V1c) and the auditory core, and tracked to a large temporal lobe mask in humans (n=10), chimpanzees (n=15), and macaques (n=10). In macaques, seeding V1c labeled extrastriate visual areas. In humans, tracts also extended into the fusiform gyrus (FG), a region involved in face perception, and a large territory of the anterior temporal lobe (ATL), known to be involved in higher-order social cognition and semantic representation. The pattern in chimpanzees was very similar to that of humans. Currently there is independent evidence of a fusiform face area in chimpanzees, but not for the ATL. Interestingly, we found that the auditory core is connected with ATL in humans, but to a much greater degree than in chimpanzees, which suggests language-related modification of ATL in human evolution. Diffusion tractography is vulnerable to false positives; it could be picking up fibers that travel in or near V1 without originating in V1. However, our results suggest there are tracts in the occipital lobes of humans and chimpanzees that reach very similar destinations in the anterior temporal lobe, highlighting the possibility of real differences in organization between macaques and hominoids.

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Fatty food or fertile females? Consortships and raiding behavior in male chacma baboons in the Cape Peninsula, South Africa

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Primate males may face a tradeoff between two resources crucial to fitness: food and fertile females. This tradeoff may be heightened in habitats in which human-derived foods are available, as these foods are often easier to obtain and more energy-rich than naturally-derived foods. We examined the relationship between consortship status and feeding behavior of adult male chacma baboons (*Papio hamadryas ursinus*) in the Tokai Section of the Table Mountain National Park in South Africa from June 2013 to February 2014. Previous research at this site suggests that human-derived foods eaten by the baboons are higher in fat than natural foods, making them particularly attractive. We hypothesized that male rank, female sexual swelling size and number of raiding partners would influence the likelihood that a male would leave a consortship to raid. Of all raiding events involving adult males (N=222), 50% included only one male, while the other half included multiple individuals. Twenty percent of raiding events occurred while males were in consortship, while 80% of raiding occurred when males were not; only 9% of raiding occurred *after* consortship behaviors that day, suggesting less disruption to investment in fertile females than expected. High-ranking males participated in more raiding overall than low-ranking males (Mann-Whitney U test, $p=0.0011$), suggesting a lower cost to high-ranking males of leaving resources such as females to go raid. We discuss further links between consortship status and raiding behavior and address how our results demonstrate a unique tradeoff faced by male primates in environments with anthropogenic disturbance.

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The meaning of means: the (mis)use of adult age estimates in bioarcheology

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The classic position paper 'Farewell to Palaeodemography' revealed that age-at-death profiles (as computed from skeletal markers) mimic the age structure of the reference population used to develop a given method. Despite this, mean ages are still commonly used when estimating the age of an individual. In addition, error and bias (calculated from the mean age estimate of the reference population) are utilised when methods are tested on different known-age populations. Age estimates based on mean ages typically produce results that over-age younger adults, and under-age older adults. These problems are compounded when we use the resultant age estimates to categorise skeletons into ordinal groups such as young adult, middle adult and older adult (e.g. 20-34; 35-49; 50+). These pre-conceived age categories often result in an over representation of middle adults and a lack of confidently identified older adults in bioarcheology, leading to the misconception that few individuals lived to a great age in the past. Although there is a clear relationship between chronological age and biological age, individual variation means this might not be fully linear.

This paper will explore the meaning of 'mean age-at-death' and its (mis)use in bioarchaeology, highlighting key questions: Should we make better use of full age ranges when testing methods? Do we need to think more carefully about the way we present individual age estimates? Are 'most likely to be' but 'would not exclude' age ranges appropriate?

How well do biological ages reflect stages in the life-course?

Investigative Anthropology: Holistic approaches to case resolution

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The holistic approach used by anthropologists can assist in investigations of "cold" criminal cases and of missing military personnel from past conflicts. Biological and cultural information can be useful to consider for preparation in advance of the investigation. This includes witness statements, cultural context of the body recovery location, and any known circumstances that contributed to the loss/death. The use of archaeological methods in the recovery of the purported remains location allows for a systematic and thorough search and well-documented collection of evidence. Finally the application of biological (physical) anthropological techniques to determine identity, traumatic injury, and any taphonomic changes that may have occurred can bring final resolution to missing persons cases. International and local cases will be presented as examples of the utility of anthropological training in both military and criminal "cold" cases.

Ontogenetic variation in limb bone structure in *Pan paniscus* compared to *P. troglodytes*

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Despite substantial research documenting adult bonobo (*Pan paniscus*) and common chimpanzee (*P. troglodytes*) morphological differences, their functional and/or genetic underpinnings remain unclear. The current study examines bonobos in the context of the range of variation across common chimpanzee subspecies, both as adults and through ontogeny, to provide a more comprehensive picture of the role of developmental plasticity and phylogenetic constraint in the production of morphological variation.

The sample includes bonobos (27 adult, 15 immature) and three common chimpanzee subspecies (*P. t. schweinfurthii,* 21 adult, 26 immature; *P. t. troglodytes,* 43 adult, 37 immature; *P. t. verus*, 39 adult, 22 immature). Long bone lengths were measured with calipers, and diaphyseal strengths determined from pQCT scans. Chronological age was estimated from dental development.

Inter-limb length proportions distinguish adult bonobos from all common chimpanzees, are apparent from early ages and become more exaggerated with growth; in contrast, strength proportions follow behavioral differences and substantiate recent suggestions of similarity in terrestriality between bonobos and some sexes/subspecies of common chimpanzee. Ontogenetic decreases in inter-limb strength proportions do not track limb lengths, and follow age-related decreases in frequency of forelimb-loading behaviors in the two subspecies with available ontogenetic behavioral data. Differences among age groups are more pronounced in taxa characterized by more abrupt behavioral change, both in the current sample and in previous studies of gorillas. These associations are consistent with previous research demonstrating greater developmental plasticity in diaphyseal morphology than in length proportions and suggest similar ontogenetic decreases in suspension and climbing in bonobos.

Hormones and behavior in same-sex male parents: implications for the evolution of paternal care in humans

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Paternal care in mammals is rare. However certain primates, including humans, exhibit some of the highest levels of biparental care found in mammals. Two theories have been proposed as to what the target of this care might be in humans: the mating effort hypothesis posits that humans evolved paternal care in order to increase male mating opportunities. The paternity certainty hypothesis argues that high levels of paternity certainty are necessary for the evolution of paternal care because the beneficiary is the offspring.

To test which of these hypotheses is more compelling it is necessary to remove the maternal factor. Gay male couples offer a natural experiment to assess if pair-bonded males exhibit responses that promote offspring care even when there are no fitness benefits accrued through greater mating opportunities. Hormone levels are a good measure of this shift from mating to parenting effort. Across cultures men exhibit significant changes in hormones in response to fatherhood.

Here, we present preliminary results from our study investigating the effects of paternal care and hormones in a cross-section of gay male couples in the United States, both with and without children. Blood and salivary samples were collected to measure hormonal differences between fathers and nonfathers and within couples. Demographic, anthropometric and behavioral data was also collected. We evaluated how hormonal measures vary with 1) father-status; 2) time spent with children; and 3) the nature of that childcare; among other demographic information.

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Historical Demography of Todos Santos, California Baja Sur, Mexico: population growth and environmental constraints

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The Baja California Peninsula is ecologically defined by the presence of sporadic springs that provide small wetland oases in the harsh, arid desert. The fragility of the desert-oases habitats creates resource limitations and susceptibility to overconsumption. However, these desert-oases have supported a traditional ranching population, oasiana-rancheros, for over 300 years. Utilizing previously untapped historical documents stemming from parish records of marriage, births, and deaths, we created a demographic profile for Todos Santos, Baja California Sur, Mexico, a late 19th century oasiana community. We hypothesized that due to the resource constraints of desert-oases, 1) age at marriage would have been relatively late, 2) age at first birth would be relatively late, and 3) inter-birth intervals would be relatively long compared to other traditional groups. Utilizing the family reconstitution method and the software program *Descent*, we were able to calculate estimates of family size, marriage times, age at first birth, and inter-birth interval. Our analysis showed that age at first marriage was relatively late in Todos Santos. The age at first birth was relatively late and favorably correlated to age at marriage (usually within one year). Inter-birth interval was greater than expected for agricultural populations and was closer to the upper range of hunter-gathering populations. Our results confirm that changes in the life history of Todos Santos may have helped this population negotiate the constraints of their environment and avoid overconsuming resources.

More than meets the eye: Paget's Disease within archaeological remains

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Paget's Disease of Bone (PDB) is a chronic disease disrupting normal bone turnover. Through radiographic analysis PDB can be traced within an individual by stage. There are three stages; an osteoclastic phase comprising of increased bone resorption, followed by disordered osteoblastic remodelling. Consequently, this leads to bone enlargement, fragility and further complications such as pathological fractures and osteosarcoma. This condition is reported to occur more commonly in

males and older individuals, but in the earlier stages it is often asymptomatic and can often remain undiagnosed, meaning its true frequency is unknown in archaeological and Modern individuals affected by PDB.

Six cases have been previously diagnosed in the Medieval Norton Priory Collection, Cheshire, U.K. (n=130) and two within the Medieval Poulton Collection, Cheshire, U.K. (n=791). Each present macroscopic changes of PDB across 40-50% of their skeleton. Re-examination of these individuals through full radiographic analysis provided a more detailed view concerning the distribution and progression of the disease. Interestingly, lesions in earlier stages of PDB can be seen exhibiting bones internally, leading to >75% of the skeleton being affected.

Full radiographic analysis is now in progress for all individuals from both Medieval collections. Here, we present a subsample from the Norton Collection (n=65) and the Poulton Collection (n=194) that have been examined. For Norton, an additional 22 cases of PDB have been identified and 73 for the Poulton Collection. These results suggest a much higher frequency than previously thought of PDB which warrants further investigation within these and other archaeological skeletal collections.

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Skeletal evidence of malaria at Tombos: Disease patterns from the New Kingdom through Napatan Periods in Upper Nubia

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The site of Tombos, located in Upper Nubia (modern-day Sudan) at the Third Cataract of the Nile was occupied from the mid-18th Dynasty of the Egyptian New Kingdom through the Napatan Period (~1400-650 BC). Previous research exploring the frequency of pathological conditions revealed relatively low levels of nutritional deficiency and infection. The newly developed method for recognizing the skeletal manifestation of malaria, by Guzman-Smith, provides the opportunity to investigate the rate of a disease known to be present in the past within the Tombos sample.

Because lesions need to be identified on several skeletal elements in this method, only individuals from intact burials were examined. Of the 60 individuals observed from all time periods, 22 (36.7%) displayed the diagnostic pattern of malaria in the skeleton. For the New Kingdom period, 11/37 (30%) showed signs of malaria; for the Third Intermediate/Napatan periods 11/23 (48%) displayed the diagnostic pattern of disease. The frequencies presented may be biased by preservation issues as not all individuals had all of the skeletal elements present for observation. If only complete individuals are included/considered, the frequency for the New Kingdom is 35% (7/20) and for the later sample is 56% (10/18). These results suggest that despite the low levels of nonspecific stress, many people at Tombos were suffering from malaria. Some of the orbital lesions and osteoperiostitis previously found in the samples may be attributed to this specific disease process. Additionally, the spinal lesions associated with the skeletal manifestation of malaria were ubiquitous in the Tombos sample.

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Deconstructing human cranial phenotypes to clarify individual prehistoric population histories

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Clarifying individual population histories depends on parsing out how skeletal morphology not only represents biological affinity, but also climatic, geographic, and temporal variable relationships. Covariation among nine individual cranial bones from two case studies, one from Sudanese Nubia and the other from the Southwest U.S., were examined to infer relative level of plasticity and integration, in addition to correlation with other potentially related variables. The hypothesis tested is that the frontal, zygomatics, and maxillae have significantly higher shape covariation and variation relative to the temporals, occipital, and sphenoid, and thus show higher phenotypic plasticity and integration that is consistent across time. First, geometric morphometric techniques were used to gather data from 83 cranial landmarks with a Microscribe 3D digitizer, and then generalized full Procrustes superposition was used to extract shape information. After controlling for size and grouping by sex, covariation and principal component analyses (PCA) were conducted to explore integration and variation of each cranial bone. Next, multiple matrices are constructed to test covariation and correlation between climatic geographic space, and time variables with individual cranial bones using Mantel and Dow-Cheverud (DC) tests. Results partially support the hypothesis proposed as facial bone matrices showed significant covariation and higher variation relative to other bones tested ($p < 0.05$) indicating greater phenotypic plasticity in both samples. Results indicate support for previous research suggesting the hominoid temporal's relatively strong fit with neutral expectations, and therefore utility in exploring individual population histories to reconstruct regional microevolutionary trends and patterns.

The functional morphology of douc langur (genus *Pygathrix*) brachiation and the justification of the old-world semibrachiator category

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The term "semibrachiator" has led to confusion because many of the taxa originally ascribed to this category do not express suspensory postures or brachiator-like anatomy throughout the upper extremity. Modern studies demonstrate that the genus *Pygathrix* is intermediate between true-brachiators and arboreal quadrupeds in the frequency of forelimb mediated below branch activity. Until now, samples to test the functional and morphological validity of the semibrachiator category using *Pygathrix* were not available. We hypothesize that this taxon will justify the continued use of this category in both morphology and kinematics.

Eighty-nine skeletal metrics were collected from 35 individuals of the genus *Pygathrix* and compared to phylogenetically-related sympatric colobines. Additionally, kinematic gait variables were collected from shoulder, elbow, and wrist movements during brachiation in *Pygathrix nemaeus* (25 strides), *Ateles fusciceps* (18 strides), and *Hylobates moloch* (13 strides) in order to determine overall dynamic similarities between semi- and true-brachiators.

Our results indicate that compared to other Asian colobines, *Pygathrix* has a significantly greater intermembral index (93% ± 2.8% vs. 81% ± 1.9%) and brachial index (105% ± 4.2% vs. 97% ± 3%). Functionally, shoulder, elbow, and wrist movements recorded from *Pygathrix* during arm-swinging closely match other suspensory specialists. Of note, *Pygathrix* exhibits high degrees of elbow extension (175.9° ± 0.8°), medium levels of shoulder excursion (104.0° ± 3.0°), and high degrees of wrist excursion (55.3° ± 3.9°) when compared to *Hylobates* and *Ateles*. We conclude that morphologically and functionally *Pygathrix* approaches species classified as true-brachiators, supporting the Old-World semibrachiator category.

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Paleogenomics interpretation of admixture between polar bears and brown bears

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A number of recent studies have revealed significant admixture between polar bears (*Ursus maritimus*) and brown bears (*Ursus arctos*). These closely related but ecologically divergent species, provide a potentially powerful model system for investigating how climate and ecological niche divergence mediate admixture. Using both modern and paleo-genomic analysis we will investigate the asymmetric impact of hybridization on these species gene pools. We will examine the temporal signature of admixture events, to show how genetically intermediate populations may arise in zones of admixture, and then once admixture ends in an area, return to relatively low levels of introgressed ancestry. Finally, we will explore the role of the rapid climate warming after the Last Glacial Maximum in promoting admixture between polar bears and brown bears.

Bone-years: Accounting for differences in preservation and age distribution when comparing lesion prevalence between skeletal collections

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Populations are routinely characterized and compared through their prevalence of skeletal lesions. Prevalence is generally calculated by counting the number of lesions over the number of elements present, which controls for intergroup differences in preservation, but not age. Conversely, using a denominator of person-years and testing with the Z-statistic controls for differences in age composition, but not preservation.

To investigate the effects of both age structure and differential bone preservation on intergroup prevalence comparisons, counts of healed nasal trauma were compared between individuals from two populations with different age compositions and nasal preservations: the Grant collection (n=172) and the Lopes collection (n=161). The Grant collection displayed significantly more left and right nasal fractures than the Lopes collection when complete elements was used as denominator (χ^2=10.44, p=0.01; χ^2=6.41, p=0.011) as well as when bone-years was used (Z=2.71, p=0.007; Z=0.03318, p=0.033), but not when person-years was used (Z=1.4174, p=0.16; 1.3536, p=0.18). Bone-years is a newly devised variable for this study and is the sum of the ages of each element analyzed. It is therefore affected by both age composition and preservation. Similar to the chi-square results, the Z-statistic using bone-years displayed statistically significant differences between nasal fracture rates of the two populations, but can be considered a more robust and accurate representation of differences as it inherently controls for both differences in population age structure an element preservation. Before bone-years can be suitably applied to prevalence comparisons involving multiple elements, however, issues of fracture independence and partial element preservation must be addressed.

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Metastatic Carcinoma... and other Differential Diagnoses

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The aim of study is to provide a differential diagnosis of pathologic lesions on a prehistoric cranium (AD1160-1260) based on both macroscopic and radiological analyses, as well as the bio-cultural profile of the individual. Dubbed "Individual A," the cranium pertains to an adult male between the ages of 30 and 60 at the time of death. Notable pathological alterations include a perforated, destructive lesion of the frontal bone. Three other lesions, on the left and right parietal bones, are in the beginning stages of destruction.

Given the locality of and proliferative nature of lytic lesions, metastatic carcinoma, syphilis, multiple myeloma, specific infectious diseases such as tuberculosis, and histiocytosis X, are all considered in this differential diagnosis. However, the irregularity of the margins and extensive bone reaction surrounding the destructive lesion on the cranium of the adult male points to metastatic carcinoma, metastasis of prostate cancer to the bone, as a probable etiology.

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Physical activity, sedentary behavior and pubertal maturation among the Tsimane'

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Understanding the factors that underlie physical activity behavior can have important implications for public health. Several epidemiological studies have noted that physical activity decreases through adolescence in modern, Western contexts. We examined physical activity patterns among Tsimane' adolescents from a life history perspective to test the hypothesis that physical activity trades-off against investments in reproductive maturation and is sensitive to individual condition. Physical activity was measured with accelerometers among a cross-section of Tsimane' children, adolescents and young adults (N = 110; age 8-22). Minutes of the day spent being sedentary significantly increased with Tanner stage of pubertal maturation (β = -28.66, t = 3.47, p < 0.001) when controlling for age (*ns*) and sex. Overall, knowing an individual's Tanner stage, sex, and age accounted for over half of all the variation in sedentary time (R^2 = 0.51). Meanwhile, minutes of the day spent in moderate to vigorous physical activity significantly decreased with Tanner stage, again controlling for the effects of age (*ns*) and sex (β = -9.00, t = -2.00, p < 0.05). We also report how behavior was related to testosterone (as a proxy for pubertal maturation), and current individual condition, measured by urinary C-peptide and cortisol. Results are interpreted from a life history framework and considered in light of implications for public health in modern contexts.

In the Wake of War: Population Health and Ottoman-Occupation in 14th – 16th Century Croatia

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The effects of endemic warfare are far-reaching and crippling. Slavery, civil war, and invasions can have a dire effect on the well-being of the people subjected to these influences. Croatia from the 14th to the 16th century faced these forces head on in the form of repeated attacks by the Ottoman Turks. Over the course of 200 years there were at least 10 historically documented invasions by the Ottomans that led to massive refugee exodi, increasing severity of civil wars, and development of a slave trade with Istanbul. This flood of Ottoman invaders served to scatter the existing population and create disorder; a goal which was readily achieved. It is hypothesized that these incursions would have left markers on the skeleton in the form of changes at entheseal points, specifically in the spinal column, as well as indications of violent injuries and non-specific indicators of disease and nutritional deficits. The effect of violence and warfare on degenerative skeletal changes is well documented in the bioarchaeological record. Through the multifaceted lens of bioarchaeology this pilot project served to examine the effects of this violence on the health of a collection of Croatian individuals curated at the Croatian Academy of Sciences and Arts in Zagreb. Our preliminary findings indicate that the consequences of incursions by the Ottoman Turks into Croatian territory were severe enough to reveal changes at musculoskeletal attachment

sites and increased incidence of arthritis on the spinal column.

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High terrestrial mobility is geographically widespread among southern African Later Stone Age populations

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Southern African Later Stone Age (LSA) forager skeletons from the southern and western Cape coasts have very high biomechanical indicators of terrestrial mobility based on lower limb cross-sectional geometric properties (CSGP). A previous study by Cameron and Pfeiffer investigated the geographic distribution of lower limb CSGPs by examining LSA skeletons from the central interior of contemporary South Africa. This study found that individuals from the central interior shared lower limb CSGPs with coastal individuals. However, sample sizes were small (n=15), and tibiae were not examined. In the present study, the central interior sample size was increased (n=51), and tibial CSGPs were also examined to clarify if high terrestrial mobility signatures extend beyond the Cape coast. Torsional strength (J), total subperiosteal area (TA), and diaphyseal shape indicators (I_{max}/I_{min} and I_x/I_y) of femora and tibiae were compared between coastal and central interior males and females. CSGPs were calculated from periosteal contours obtained from the midshaft (50%) location of femora and tibiae using periosteal molds and 3D laser surface scans.

There are no significant differences in J or TA for femora or tibiae among coastal and central interior males and females. I_x/I_y and I_{max}/I_{min} however are significantly higher among coastal femora, while I_x/I_y was significantly higher among coastal male tibiae. These results suggest that a high degree of terrestrial mobility was geographically widespread among LSA individuals. In the southern African LSA context, diaphyseal shape indices may reflect differences in terrain relief between the mountainous coastal and flat central interior regions.

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Eating oneself? Stable isotopic enrichment during weight loss and tissue turnover in humans

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In recent years, it has been demonstrated that different metabolic states can have a noticeable effect on the isotopic signatures of body tissues. Specifically, the metabolism of bodily tissues for energy (catabolysis) has been shown to affect isotope ratios through the recycling of carbon- and nitrogen- containing compounds. This has significant implications for the field of paleonutrition, as our interpretations of past diets are often based on stable isotope analysis, but rarely take the potential effects of dietary insufficiency into account. We present carbon and nitrogen stable isotope ratios of hair samples taken from three subjects who experienced tissue loss. Two of these subjects had recently undergone gastric band surgery, while the third had experienced muscle wasting as the result of a vehicle accident. We monitored isotope ratio changes over time prior to and following these metabolic milestones in a longitudinal and minimally invasive manner. All subjects displayed a marked enrichment in their $\delta^{15}N$ values corresponding to their period of metabolic stress, consistent with tissue recycling during this time. However, all subjects also showed a noticeable enrichment in $\delta^{13}C$ corresponding to the stress event, implying that lipid catabolism did not provide most carbon for hair synthesis.

The preauricular sulcus and its link to sex and parturition: a test on a British Medieval collection

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The aim of the research was to examine the effects of sex and parity status on the preauricular sulcus. Physical anthropologists, anatomists and clinicians have long suggested that pregnancy and parturition may leave 'scars' on the skeleton, especially the *os coxae*. However there has been much debate on these marks and no clear method for examination has been established. The collection used in this research was a British Medieval collection (n=116), 56 females and 60 males. A grading system was constructed to examine the different types of sulcus, ranging from Grade 0-4. Grade 0 was given when no preauricular sulcus was present and Grade 4 for a large, well-defined sulcus that was characteristic of pregnancy 'scars'. The age and sex of the individual was also recorded as well as the maximum length and width of the sulcus.

The results showed a significant difference in the occurrence rates of the preauricular sulcus in males and females. A preauricular sulcus was present in 78.6% and not present in 21.4% of females while for males preauricular sulci were present only in 20% of cases and not present in the majority, 80%. The research not only indicates that the preauricular sulcus is a sexually dimorphic trait that can be scored, but also suggests the parity status could affect its morphology. This conclusion is supported by the absence of Grades 3 and 4 in male subjects as they were only found in females.

An examination of early stress, longevity, growth and childhood socioeconomic circumstances in a modern juvenile skeletal sample from Portugal

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Collections of documented juvenile skeletons provide the unique opportunity to elucidate in more detail how early-life stress events place constraints on future investments in growth and longevity. In this study a sample (n=30) of juvenile skeletons between the ages of 1 and 6 years was assessed for presence of macroscopic enamel surface defects on the deciduous dentition. These were used as proxies for stress events occurring up to 6 months of age. About a third of the individuals showed at least one defect. Age at death and z-scores for femur length were used as measures of longevity and growth status and compared between individuals with and without enamel defects. Although differences between the groups were not statistically significant, the two groups seem to differ more noticeably in growth status (one defect=-1.6 mean z-score, no defect=-1.1 mean z-score). These differences seem to increase from childhood (one defect=-0.9, no defect=-0.5) to the juvenile period (one defect=-2.9, no defect=-1.6). Findings suggest that early life stress events are associated with socioeconomic circumstances and that surviving these events seem to be placing constraints on future growth, particularly further in the future. Although these results point to consequences of early stress to reproduction and longevity, sample size and methodology are also discussed as important constraints in the analysis

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Implications of the interpretation of homoplasies in *Oreopithecus* and other Miocene ape genera for elucidating the chimpanzee-human LCA

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The inference of the Chimp-Human common ancestor (CLCA) has at once greatly benefited from and been occasionally confounded by the interpretation of the recovered remains of the diverse Miocene ape fossil record. Many of these forms exhibit unique aspects of their body plans, their positional behavior, and associated locomotor anatomy that have proven useful in the determination of the polarity of characters employed in the resolution of relationships between these taxa. However, considerable homoplasy evident in this clade has occasionally led to the obfuscation of key hominid (all species on the human side of the Chimp-Human split) characters and reliable extrapolation of the CLCA from fossil early hominid remains.

While now generally accepted as an extremely specialized insular extinct ape, the peculiar morphology of Oreopithecus (~9-7 Ma) and its interpreted similarity to hominids has been the subject of considerable debate articulated in decades of published literature and most recently since 2009 as a means of introducing doubt as to the hominid status of Ardipithecus. This study investigated the veracity of these hypothesized parallelisms, particularly in terms of the hypothesized orthograde anatomy of the pelvis and lower limb. While the capacity for homoplasies in hominoid taxa has been hypothesized in other fossil ape taxa, comparative analysis of depositionally deformed Oreopithecus remains against a broad sample of hominoid material reveal no support for claimed homoplasies in key hominid traits or for the confusion of the multiple shared derived character complexes pivotal to the elucidation of the CLCA.

Subchondral properties of the hominoid distal tibia: an indicator of loading during habitually dorsiflexed ankle postures

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The hominoid tibiotalar joint transmits weight-bearing loads between the foot and more proximal parts of the lower limb. Its loading history reflects hominoid foot interaction with substrates during stance phase, and summarily during locomotor modes in which hind limbs bear weight. Radiodensity within subchondral bone reflects habitual joint reaction forces in a number of primate joints, meaning it is useful for inferring joint loading regimes. Areas of higher compressive forces are relatively denser than areas of lower compressive forces. More expansive areas of relatively high radiodensity indicate more expansive joint areas subjected to these high compressive forces. Here we test whether variable degrees of habitual dorsiflexion in the tibiotalar joint of hominoids are reflected in radiodensity patterns of subchondral bone in their tibial plafond. Specifically, we predict more frequent (habitual) dorsiflexion of the tibiotalar joint is associated with more expansive areas of relative high radiodensity in the anterior half of the joint than the posterior. To evaluate this hypothesis, we quantified radiodensity in distal tibiae of a large sample of primates, emphasizing hominoids, using computed tomography osteoabsorptiometry (CT-OAM). African apes tend to exhibit greater high radiodensity areas in the anterior compared to the posterior half of the joint. Interestingly, many hominoids, including some humans, tend to exhibit local high radiodensity areas where the neck of the talus contacts the anteromedial margin of the distal articular surface. Internal properties of hominoid distal tibiae provide evidence that may be useful for interpreting functional morphology of external features of the hominoid distal tibia.

A phylogenetic hypothesis of fossil colobine relationships

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The evolutionary history of the Colobinae has remained largely unknown, because despite advances in molecular phylogenetics, parsimony analyses of colobine phylogeny based on morphology are rare, leading to difficulties discerning the relationships among fossil colobines. Species of this group exhibit geographical ranges, dietary preferences, and locomotor adaptations unparalleled in their extant relatives. However without a robust phylogenetic framework, informed character-based hypotheses about the evolution of folivory and arboreality in this group are nearly impossible to formulate. Researchers are able to comment on the adaptive responses of individual fossil species, but the potential links between living and fossil taxa have yet to be tested within a strictly cladistic framework. To assess the phylogenetic relationships within the Colobinae, over 300 morphological characters were scored for nearly all fossil genera and 88% of living species.

Parsimony and Bayesian analyses utilizing a variety of coding methods suggest that majority of the African fossil taxa, such as *Rhinocolobus* and *Cercopithecoides,* are more closely related to the living Asian colobines, based primarily on nasal and dental morphology. *Mesopithecus* was nested within the odd-nosed group, while *Dolichopithecus* was supported as a stem Asian colobine. These phylogenetic placements can provide a foundation for biogeographic hypotheses about colobine dispersal or theories about the mechanisms of pollical reduction. Additionally, as fossil colobines represent a significant part of the Neogene catarrhine community in Africa, an improved understanding of the adaptive shifts that characterized colobine evolution may also shed light on the ecological context of the hominins that lived alongside them.

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The need for revising and modernizing postcranial measurement definitions: New standards

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Clear and unambiguous measurement definitions are necessary in skeletal analyses to minimize inter-observer errors, whether the observations come from dry bone or CT scans. Two often-cited references, *Standards for Data Collection from Human Skeletal Remains,* edited byBuikstra and Ubelaker, and *Data collection procedures for forensic skeletal material* by Moore-Jansen et al., heavily cite Martin's *Lehrbuch der Anthropologie*. Unfortunately, the definitions in the three are inconsistent, and rely on subjective measurement definitions involving the most superior or most inferior points on a bone when in anatomical position. Recently Meadows, Jantz et al. addressed these inconsistencies by testing the reliability of measurement definitions in light of *Daubert* guidelines. This study investigates the utility of maximum measurements in the classification of population and sex.

Martin's innominate height, iliac breadth, and maximum innominate height were taken from 126 left innominates from the Hamann-Todd Collection at the Cleveland Museum of Natural History. Four-way discriminant function analyses were performed using Fordisc 3.1 to classify into groups defined by ancestry and sex.

Results show that using maximum height of the innominate does not affect classification accuracy; the difference in accuracy between maximum height along with iliac breadth (66.7%) and Martin's innominate height along with iliac breadth (67.5%) was minimal. Interobserver differences when using Martin's innominate height are much higher, affecting classification rates in unpredictable ways. While other measurements still have yet to be tested, a maximum innominate height measurement seems to better record the morphological variation that is meant to be recorded.

Pathophysiological isotopic fractionation: Assessing the impact of anemia on enamel apatite and bone collagen $\delta^{15}N$, $\delta^{18}O$ and $\delta^{13}C$ values

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Despite the many benefits afforded by the current state of stable isotopic analyses, only a limited number of paleopathologists have examined the ways in which chronic diseases influence isotopic fractionation. As such, systemic conditions such as 'anemia', one of the most commonly reported disorders within paleopathology, are commonly overlooked as underlying mechanisms for intra and inter-individual variation in isotopic signatures.

The purpose of this research is to examine if, and how, the pathophysiology of genetic hemoglobinopathies affect the assimilation, diffusion and metabolization of stable carbon, oxygen and nitrogen isotopes, using bone collagen and enamel apatite as indicators. A total of 20 individuals exhibiting lesions characteristic of sickle cell and/or thalassemia anemia were sampled isotopically, and compared to 11 individuals with non-specific indicators of disease, and 14 controls. All 45 individuals were excavated from *el Plaza de Espana* (AD 8th-12th centuries) in Écija, Spain; a region where malaria is endemic, and sicklic and thalassemic mutations are present within the contemporary population. Most significantly, results indicate that Anemics exhibit the greatest degree of intra-cohort variation in $\delta^{15}N$ values (p=0.001), and that only bone collagen $\delta^{15}N$ values are statistically different (p=0.014) between Anemic and Control cohorts. Additionally, unlike the Controls (p=0.017), Anemics did not exhibit a significant relationship between bone collagen $\delta^{15}N$ and $\delta^{13}C$ values (p=0.715). While more research is required, particularly on the role fetal hemoglobin may play in 'normalizing' pathophysiological isotopic fractionation, this research highlights the need to consider disease as an underlying mechanism in local and systemic isotopic fractionation.

Object preferences and the function of object play behavior in a provisioned troop of long-tailed macaques (*Macaca fascicularis*) at Wat Khao Takieb, Thailand

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Object play is characterized by the playful manipulation of inanimate objects. While object play has been examined in *Macaca fascicularis* in Bali, Indonesia, no reports exist regarding object play in *M. fascicularis* in Thailand. Object play behavior is of interest to researchers because it is posited to be a possible precursor to tool use. Object manipulation has been studied at sites along the Andaman Sea in Thailand, where unprovisioned troops of *M. fascicularis* use tools for processing shellfish; however no study has reported observations of object play. We collected data from July 1st to August 15th 2015 at Wat Khao Takieb, a temple site with provisioned long-tailed macaques in Prachuabkirikhan Province, Thailand. We divided the temple area into eight sections for the purpose of collecting observational samples. We utilized an all-occurrence sampling technique to collect object play data and recorded the duration of object manipulation time on each occasion it was observed in the designated section. Data collection lasted for 15 minutes per section and was video recorded with an Olympus OM-D E-M5. The most notable types of objects used in object play were stones, plastic bags, plastic bottles, glass bottles, leaves, sticks, and glass shards. We discuss the possible functions of object play behavior in long-tailed macaques at Wat Khao Takieb and how it may differ from conclusions in the existing literature on object play in other long-tailed macaque troops. Additionally, we discuss the possibility of tool-use occurring in long-tailed macaques prior to provisioning at the temple.

New insights on the evolution of third molar agenesis and impaction

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Human third molars are frequently either missing (agenesis) or fail to properly erupt into occlusion (impaction). While fossil evidence for these uniquely human features date back to the early Pleistocene, it is unknown whether these two features are related, and whether changes in the human diet can predict changes in the traits' expressions. This study is an investigation into the use of morphological data to assess how the third molar pathologies of four different populations from Serbia, Egypt, Japan and Southeast America (n=974 individuals) changed with the adoption of agriculture and the beginnings of industry. I tested the assumptions underlying three previously proposed hypotheses, selection against impaction, the probable mutation effect, and developmental timing shifts, using caliper measurements and radiography. Impaction frequency correlated with jaw length and breadth, but agenesis could not be predicted by any jaw metric. Furthermore, while agenesis was present in populations undergoing the agricultural transition, impaction is rarely seen until the industrial transition. This indicates a separate origin for impaction and agenesis, contrary to the selection against impaction hypothesis. Across the agricultural transition, wear rates and agenesis rates increased for three of the four populations, contrary to the predictions of the probable mutation effect. Fluctuating asymmetry, a measure of developmental timing shift, predicted agenesis in three of the four populations. In Japan agenesis rates have remained at modern levels since before the agricultural transition. These results help shed light on the biological and health effects of major changes in the human diet.

Forensics in the Classroom: Anthropology as a Tool in K-12 Education

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Data show that students in the United States have fallen behind those in similarly developed countries. The achievement gap is widening among American students partially due to socioeconomic disparities in summer education opportunities. Forensics in the Classroom (FITC) is a STEM summer bridge program aimed at "at-risk" middle schoolers that focuses on forensic anthropology and forensic science techniques to increase interest in STEM fields. FITC is a collaboration between anthropologists from The Ohio State University and The PAST (Partnering Anthropology with Science and Technology) Foundation, a non-profit organization in Columbus, Ohio. In 2013 and 2014, PAST took FITC to Rapid City, South Dakota to work with ninth and tenth-graders from several area Indigenous American reservations. The forensic science modules included crime scene mapping and sketching, evidence collection, fingerprint and footprint impression, and blood spatter analysis. Additionally, anthropology comprised two days of instruction; students learned the basics of human osteology as well as how to build a biological profile and interpret bone trauma. Many of these modules required math and science knowledge; directors and teachers approached each lesson in accordance with the U.S. Common Core Standards. The week culminated in a mock crime scene investigation, in which the students applied the skills learned throughout the week to investigate a crime scene. This curriculum uses anthropology in a unique way to increase K-12 interest in STEM, decrease summer learning loss, and narrow the achievement gap.

Testing Transition Analysis Aging Method on a Modern Colombian Skeletal Sample

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Colombian forensic anthropologists traditionally rely on phase-system methods to estimate age. In fact, the most common methods

used in Colombia include Suchey-Brooks for pubic symphysis and the Iscan method for sternal rib ends. The problem with these and other phase-based methods is that they often offer subjective interpretations of trait morphologies, which results in high error rates. Transition Analysis (TA) is a multifactorial aging method that uses components from multiple anatomical elements (cranial sutures, pubic symphysis and auricular surface) to capture the sequential aging process that occurs among individuals at different rates. The objective of this study was to test the applicability of TA method in a sample of modern Colombian population.

63 individuals of the Antioquia Modern Skeletal Collection and the Prosecutor General's Office were analyzed (males=49, females=14, mean age=46.6 years, SD=20.2, range=16-99). 53% of the total individuals lacked the cranium and 7.9% lacked the cranium and one os coxa. Researchers applied the method blind to chronological age and raw scores were input into the ADBOU software package. Best point age estimates as well as 95% posterior density regions were obtained using the forensic prior distribution. Results indicate that 50 cases were correctly estimated (79.36%) into confidence intervals in comparison to 13 individuals whose age estimation was incorrect (20.63%). Although TA should be tested on a larger sample of Colombian individuals in order to validate the method, results suggest that component-based methods decrease observer error and produce more accurate age estimates.

Dominance Rank and Nutrition in Forest-Dwelling *Papio anubis*

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The socio-ecological model posits that female fitness is closely related to the ability to obtain food resources. Differential access to high quality foods through dominance hierarchies has been proposed as a mechanism by which high ranking females gain fitness benefits. Previous studies have shown a correlation between dominance rank and food intake rates in female baboons (*Papio anubis),* and high ranking females ate more food, including greater amounts of protein and fiber than lower ranking. This study aimed to further explore the relationship between rank and nutrition by examining whether there is a difference in the balance of protein to non-protein energy in relation to rank. Using the Elo rating method and focal animal sampling, we calculated dominance ranks and nutritional intake of eight female olive baboons in Kibale National Park, Uganda from May to August 2015. Feeding intake rates of the top 10 foods were recorded and these were collected for nutritional analysis. Preliminary results from the analysis of a high protein and energy rich food, insects, revealed that higher-ranking females consistently consumed greater amounts of insects than lower-ranking females (F-value: 7.3032, $p<0.05$). These results suggest that higher-ranking females consumed more energy and protein than subordinates. While further data are needed, this may help explain the patterns seen of longer lifespans and greater reproductive success for high ranking females compared to lower ranking.

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Testing biomechanical models for lumbar lordosis variation in hominins

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Lumbar lordosis is widely considered an essential adaptation for bipedalism, functioning to balance and stabilize the center of mass (CoM) of the upper body over the hips. Yet measurements of lordosis in modern humans and estimates from the fossil record suggest substantial variability within and between hominins, with Neanderthals having especially low degrees of curvature. Given its purported biomechanical importance, what factors explain variations in lordosis? In order to test several alternative biomechanical models, we first assessed lumbar architecture in 30 subjects (age 18-35) using MRI to measure curvature, cross-sectional areas of epaxial and hypaxial muscle groups, and dimensions of lumbar vertebrae. We then used a 3D camera system to collect positional data from a full-body set of 43 markers placed on the same subjects standing normally. Lumbar range of motion was assessed, and postural variables and segment inertial properties were calculated. Results indicate that anteroposterior position of the upper body's CoM relative to the acetabulum is largely invariant and not correlated with lordosis. Nonetheless, variables related to Euler buckling theory (lumbar length, sagittal bending moments, and cross-sectional area of vertebral bodies) are highly predictive of lordosis, particularly in the standing position. However, lordosis was best predicted using an interaction model between hypaxial / epaxial muscle size and lumbar range of motion. This biomechanical trade-off explains 65% of variation in standing lordosis, suggesting that soft tissue properties related to trunk strength and mobility may play a crucial role in lordosis evolution and have important functional implications.

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The inner structural organization of a (likely) paranthropine patella from Swartkrans Member 2 (SKX 1084): human- and nonhuman-like features

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Topographic variation in bone organization beneath the tibial plateau reveals structural coherence in extant primates to the locomotion-related loads experienced at this site. Within the limits imposed by some developmental and rheological constraints, the patella, which actively takes part into the complex dynamics at the knee joint, should similarly express inner functional variation. However, its structural organization is poorly considered in nonclinical literature and unreported in any nonhuman hominin specimen.

We used micro-focus X-ray tomography to assess the textural properties of SKX 1084, a superior two-thirds of a left patella from the Early Pleistocene Member 2 of Swartkrans, South Africa, attributed to *P. robustus*. Acquisitions were performed at the South African Nuclear Energy Corporation at a resolution of 16.2 µm.

Internally, SKX 1084 is relatively well preserved around its central part, towards the base and at various sites of the incomplete lateral facet, while the inter-trabecular spaces are filled throughout most of the otherwise whole medial facet. Besides spots comprising the outer cortical shell and the immediately underlying network, we investigated the textural properties across a mediolateral and a superoinferior section around the central portion, and two cubic volumes of interest sampling the medial and central portions. The results have been compared to homologous evidence from 20 extant adult human patellae.

While trabecular thickness and, mostly, bone volume fraction in SKX 1084 exceed the average human estimates, for trabecular spacing, proportions of the honeycomb-, plate- and rod-like trabeculae, and anisotropy the fossil patella does not differ from the human condition.

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Diets of Plio-Pleistocene Cercopithecidae from the Lake Turkana and Lake Victoria regions, Kenya

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A wide range of mammalian lineages consumed a significant amount of C_4-derived resources during the Plio-Pleistocene, including hominins. However, the prevalence of C_4 foods in the diets of other Plio-Pleistocene primates is not well understood. Tooth enamel from more than 130 specimens of Cercopithecidae from the Lake Turkana and Lake Victoria regions, where Colobini and Papionini are well represented in the fossil record, were analyzed for $\delta^{13}C$. The $\delta^{13}C$ enamel value of -8‰ represents a diet that is dominated (>75%) by C_3 derived resources. *Theropithecus (*Papionini*)* have the most positive $\delta^{13}C$ values (-0.9±2.0‰, n=69) of primates for any stratigraphic interval, with a range from -7.2 to 2.4‰, and by *ca*. 1.5 Ma *Theropithecus* had a diet consistent with >90% C_4. Colobini have the lowest $\delta^{13}C$ values (-8.8±3.7‰, n=43) but range from -14 to 0‰, showing that at least some Colobini had a C_4-dominated diet. Papionini, excluding *Theropithecus*, have intermediate $\delta^{13}C$ values (-6.4±3.3‰, n=24) with a range from -10.5 to 1.2‰. By contrast, our preliminary survey of modern primates from Africa shows that Colobini and Papionini (excluding *Theropithecus*) have average $\delta^{13}C$ values of -15.1±1.2‰ (n=22, min: -17.0‰, max: -12.0‰) and -12.6±3.1‰ (n=70, min: -17.8‰, max: -4.1‰), respectively. This study shows that Plio-Pleistocene primates in the Lake Turkana and Lake Victoria regions consumed more C_4-derived foods than most modern African primates. Therefore, the evolution of hominin diets must be understood in the context of ecological interactions with cercopithecids and other C_4-feeders, including many large mammalian herbivore (Artiodactyla-Perissodactyla-Proboscidea) taxa.

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Quantifying urinary C-peptide levels in wild tufted capuchins: a validation of filter paper storage methods

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The measurement of urinary C-peptide has been shown to be an effective, noninvasive method to monitor energy balance in wild primates; however, much of this research has focused on catarrhine taxa. Here, we validate the use of urine samples stored on filter paper for quantifying C-peptide levels in tufted capuchins. Urine samples were collected from captive *Sapajus apella* males (n = 2). Fresh samples (n= 10 voids) were either frozen in 200µl aliquots or pipetted onto filter paper (Whatman 903 protein saver cards). C-peptide levels were determined using Human C-peptide RIA kits. C-peptide levels recovered from filter paper were lower than those recovered from frozen samples and, occasionally, below the range of detection. Filter paper extractions from the same void were combined into one volume prior to assay and concentrated in buffer. Preliminary results suggest that C-peptide levels from frozen samples are correlated with those extracted from filter paper.

We compared these results to C-peptide levels measured from wild *S. libidinosus* juveniles (n = 12 voids; 8 individuals) and adults (n = 7 voids; 5 individuals) at Fazenda Boa Vista, Piauí, Brazil. Urine samples collected in the field were stored on filter paper. Wild tufted capuchin C-peptide levels were within the range of the captive samples. These results demonstrate that, when a sufficient volume can be collected to compensate for the relatively poor recovery, filter paper is a viable option for storing tufted capuchin urine in the field and provides a noninvasive method to quantify energetic status in these primates.

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Paleodiet of Rural and Urban Medieval English Populations: Further Studies of Extracting Stable Carbon and Nitrogen Isotopes from Dental Calculus

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Fifty-nine dental calculus samples obtained from two medieval sites in the United Kingdom were tested for stable carbon and nitrogen isotope compositions. Poulton, Chester (n=28) was a rural village with monastic ties located close to the England-Wales border. St. Owen's Church (n=31) was located in Gloucester, a medieval port in southwest England. Stable isotope results show almost identical means for $\delta^{13}C$ (-21.31 and -21.51) but $\delta^{15}N$ was significantly higher in the urban sample from Gloucester (12.56) than in the rural sample from Poulton (11.84; P = 0.006). The mean C/N atomic ratio was similar for the two samples (7.55, 7.52). Individual values show similar dispersion for carbon and nitrogen isotope compositions although standard deviations were greater for nitrogen (0.934, 1.004) than for carbon (0.415, 0.468). One individual provided samples of both calculus and hair. Almost identical results were obtained for $\delta^{13}C$ (-20.4, -20.8) but $\delta^{15}N$ was lower for hair (10.6) than calculus (12.8). Although individual correlation of isotope compositions from calculus and protein-based biomaterials are not perfect, the means for both carbon and nitrogen are consistent with isotope values for other medieval English populations. This provides additional support for the use of calculus in paleodietary studies when it is not possible to carry out destructive testing on bones or teeth.

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Mitochondrial relationships of red colobus monkeys from the TL2 region (Tshuapa, Lomami, Lualaba River Basins), Democratic Republic of Congo, relative to other central African populations

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Red colobus monkeys (*Procolobus* [*Pilicolobus*] *badius*) present a perpetual problem to systematists, and these problems in turn affect efforts to conserve this endangered taxon. Although recent phylogenetic work has clarified some discrepancies, some confusion persists regarding the mitochondrial phylogeny of central African red colobus. In order to weigh in on this issue, we expanded on earlier studies of mitochondrial DNA and included the first high-quality (i.e., tissue) samples of *P. b.*

tholloni and *P. b. parmentieri*. In particular, the *P. b. tholloni* samples derive from the easternmost portion of the range for this subspecies, for a population that has hitherto remained unstudied. These samples were collected opportunistically from bushmeat hunters in the region comprising the Tshuapa, Lomami and Lualaba River Basins – an area of high endemism for primates and other mammals – in the Democratic Republic of the Congo. Following extraction, we amplified and sequenced a portion of the *NADH4* gene and compared the sequences with those previously published from a diverse array of red colobus populations. The results offer additional insight into the mitochondrial relationships of red colobus taxa, a topic that is relevant for both the conservation and the evolutionary history of these endangered populations.

Evaluating the use of long bone segments to estimate bone lengths for stature estimation

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Estimating stature and overall body dimensions from skeletal remains is a classic component of physical anthropology. Most stature estimation methods utilize total lengths of one or more skeletal elements, most often long bones. However, complete elements are often not available. For this reason, Steele introduced a now classic method to estimate stature from long bone segments. The aim of the present study was evaluating the replicability of Steele's landmarks/segments and examining more closely the relationships between long bone segments and maximum long bone lengths. The study sample was comprised of radii, humeri, femora, and tibiae from 240 individuals from the Hamann-Todd Collection, of both sexes and African and European ancestries. Maximum length and six segment lengths were recorded per element. Sex and ancestry differences were tested through analysis of covariance (ANCOVA). Overall utility of segments to estimate long bone lengths were assessed through regression and correlation,, and compared to Steele's results. The majority of the bone segment/bone length allometries displayed sex and ancestry differences. Short epiphyseal segments displayed very low or no correlations at all with total length in most cases. However, diaphyseal segments generally displayed higher intra-observer errors. As expected, the correlation with total length and, thus, the precision of the estimate increased with the length of the segment considered.

Secular Change in Pelvic Morphological Age Indicators

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Studies demonstrate skeletal maturity occurs earlier in modern humans than a century ago. This, coupled with possible secular trends in adult degenerative changes, may affect adult skeletal age estimation methods. The goal of this study was to evaluate possible secular changes in the auricular surface and the pubic symphysis using the Buckberry-Chamberlain (B-C) method, the Brooks-Suchey method, and transition analysis using ADBOU software, along with determining the accuracy of the methods. Two observers scored a total of 212 right innominates of 35 to 50 year old white males from the historic Hamann-Todd Human (HTH) Osteological Collection (n=106) and the modern W.M. Bass Donated Skeletal (UTK) Collection (n=106). The samples had identical age composition by quintiles, means, and standard deviations with a median age of 44.0. Each innominate was scored using all three methods. Monte Carlo significance tests were run on contingency tables for each component by sample.

Out of the 20 components and phases observed, seven showed significant differences between the collections, suggesting secular changes in these traits are present. For the B-C traits, the HTH individuals appear older in surface texture (p=0.0123) and microporosity (p=0.0001). For the ADBOU traits, the HTH individuals appear older in ventral symphyseal margin (p=0.003), and the dorsal symphyseal margin (p=0.001). The UTK sample appears older in the ADBOU traits inferior surface texture (p=0.001), superior posterior iliac exostoses (p=0.018), and symphyseal texture of the pubic symphysis (p=0.001). Differences in median age estimates were no greater than about 8 months using ADBOU.

Co-variation in the maturational timing of cortical GABAergtic interneurons and pyramidal neurons in primate brain evolution

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The expansion of isocortical neuron numbers in primates relative to rodents is due, at least in part, by selectively delaying isocortical neurogenesis. These isocortical neurons originate from two distinct precursor pools in development. A number of GABAergic inhibitory interneurons are generated from the ganglionic eminence and migrate to the cerebral cortex whereas excitatory glutamatergic pyramidal neurons are generated within the developing cortical progenitor zones. Primates exhibit increased pyramidal neuron and interneuron numbers relative to rodents. The mechanisms accounting for the concomitant expansion of interneurons and pyramidal neuron numbers in primates relative to rodents is unclear. We hypothesized that the timing of interneuron and pyramidal neuron maturation co-evolve and accounts for the co-increase in the numbers of these distinct neurons types in primates relative to rodents. We examined this hypothesis by collecting data on the timing of over 40 developmental events relevant to cortical neuron proliferation and maturation in macaques, humans, rats, and mice. These data were obtained from the literature and from The NIH Blueprint Non-Human Primate (NHP) Atlas. Neural events constitute rapid changes in brain morphology (e.g., emergence of corpus callosum; peak ganglionic eminence volume) or protein expression (e.g., emergence of cortical GABAergic subtypes). We found co-variation in the timing of interneuron and pyramidal maturation, which occurs for longer in primates than in rodents. Our findings demonstrate that different cell types follow similar developmental trajectories in evolution despite their different developmental origins. Our findings highlight that developmental duration is an important substrate for evolutionary changes in cell types.

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Proportions among stature, leg length, and foot size in Dinaledi Chamber early *Homo* and limb disproportions in Liang Bua LB1

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Dinaledi Chamber of South Africa has yielded early hominin remains (>1500 bones, >15 individuals) with many repeated skeletal elements. In contrast Liang Bua on Flores comprises ≤100 identified bones, of which 62 (including the only skull and femurs) belong to LB1, with most of the remaining ~14 individuals comprising 1-2 bones each. Advocates of the hypothetical taxon "Homo floresiensis" divide on ancestral candidates for the Liang Bua remains. Earlier speculations favored *Homo erectus* ancestry whence dwarfing over >800,000 years via island isolation; recent notions favor derivation from an early *Homo* ancestor already small in brain and body size before reaching Flores. Both groups accept skeletal anatomy of

LB1 as representative of its hypothetical taxon, said to exhibit a blend of primitive, derived, and unique characteristics. In contrast our group documented the anomalous defining features of unusually small brain and body size of LB1, as well as its asymmetry and other developmental abnormalities consistent with Down syndrome.

Abundant Dinaledi remains show stature of 144.5–147.8 cm, congruent with tibia length of 300 mm and foot length ~160 mm. In contrast reported LB1 191 mm foot length is disproportionately large against stature of 106 cm misestimated from abnormally developed short leg segments (tibia 235-240 mm, femur 280mm) inconsistent with burgeoning evidence. "Homo floresiensis" now stands apart in morphology, time and space from the best documented sample of early *Homo*.

Post-Marital Residence and Patterns of Cranial Morphological Diversity

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In human populations, marriage often results in the relocation of one of the two parties involved to the residence of the other. Most ethnic groups favour the migration of one sex over the other. These sex-specific population migration patterns can be traced through the analysis of mitochondrial and Y-chromosome diversity. As human skull morphology is under strong genetic influence, the detection of similar patterns would be expected. Here, we investigated the relationship between cranial morphological diversity and post-marital residence patterns using a pre-existing database of craniometric measurements of modern populations and post-marital residence data for 1,430 crania from 23 ethnic groups in Murdock's Ethnographic Atlas from across the globe. In particular, the sex-specific disparity of cranial morphology was compared with post-marital residence preference to identify potential increases in the diversity of the preferentially migrating group, as expected in a situation where more non-local individuals of one sex were present in a given group.

Although results indicate a consistently higher morphological diversity in males than in females, patrilocal populations exhibit a proportionally higher diversity than matrilocal populations. These results suggest that, similarly to the sex-specific mtDNA and Y chromosome data, post-marital residence patterns do have an impact on sex-specific cranial morphological diversity through the preferential introduction of foreign morphologies. This however only has a small impact on total cranial diversity, which remains dominated by other processes favouring a high male diversity.

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A Comparison of Statistical Techniques to Assess Age-Related Skeletal Disorders in Bioarchaeology

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When studying skeletal pathologies, many authors cite the lack of consistency between studies as the product of differential data collection protocols. Much less attention is given, however, to the choice of statistical techniques that will be used to evaluate the data. These observations are particularly true when dealing with age-related skeletal disorders, particularly when it comes to the statistical power of these analyses. This presentation addresses how different techniques correct for age in the study of osteoarthritis prevalence from osteological populations, given the impact that this data has in the study of activity patterns in the past.

Osteoarthritis prevalence was scored in 291 individuals from seven prehistoric sites in Central California. Osteoarthritis prevalence was compared between sites using three statistical tests: Chi square, ANCOVA, and odds ratios. The results obtained through the use of chi square tests and odds ratios were similar, though the results obtained through the use of ANCOVA differed from the other results. Given the discrepancy in results, we tested the power of each analysis in rejecting the null hypotheses present in our data by using bootstraps of the data as well as hypothetical populations with similar structures. The results demonstrate that, even though osteoarthritis prevalence fails to meet some of the ANCOVA assumptions (e.g. normal distribution and linearity), this technique has higher ability power than the other two analyses, and therefore should be favored in similar studies that aim to test the different prevalence of age-related osteological markers among past populations.

Social identity through the life-course at historical Middenbeemster: A biocultural approach

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Despite arguments over methodologies, clinical and osteological studies have provided evidence that patterns in human skeletal morphological variations can be correlated with general patterns of activity. A whole-body life-course approach, which combines a variety of activity pattern analyses, provides the strongest support for activity related morphological variations and their development during life. This study presents the preliminary results of a larger research project examining gender and age identity in the post-Medieval dairy farming community of Middenbeemster, NL, through the examination of skeletal markers of bone growth and maintenance and activity-related stress. It is hypothesized that the high demand for Dutch dairy products during the occupation of Middenbeemster will be reflected in the manifestation and intensity of skeletal markers of activity, suggesting age/sex specific workloads.

In this initial study 88 adults (M=46, F=42) were chosen to be analyzed for the following variables: non-pathological osteoarthritis of all appendicular joints, 8 non-genetic non-metric traits, and 27 entheseal insertions (per side) chosen to represent a variety of major muscle groups/movements. Statistically significant differences in upper limb activities between the sexes as well as in lower limb activities between different age groups were found, suggesting workloads divided by both age and sex. Combined analyses of the data with historical and archival records on this Medieval community, provide a unique opportunity to more fully examine and interpret patterns of activity related markers over the life course, refining non-destructive osteological methodologies, and a nuanced approach to gender and age related identity.

Femoral angles and cross-sectional geometry across subsistence economies

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The reconstruction of activity patterns from the morphology of the human skeletal relies on the developmental plasticity of skeletal features. In the lower limb, cross-sectional geometry and femoral angles are two sources of data commonly used to infer activity and behavior patterns of past populations. Although much attention has been directed toward the independent study of cross-sectional properties and femoral angles, the direct relationship between these two features has not been explored. This study examines the pattern of relationship between femoral neck-shaft angle, version angle, and cross-sectional geometric properties among a diverse sample of remains from varying subsistence economies (n=273). Data reveal that there is a significant relationship between femoral angles and cross-sectional geometric properties, and that the same general morphological patterning is evident across all samples in this study, regardless of subsistence economy. Cortical areas are largely affected by declination of the neck-shaft angle; while second moments of area are largely affected by version, with the greatest effect of both angles expressed at the proximal (subtrochanteric) femur. Taken together, theses data suggest that variation in diaphyseal structural morphology may be explained, in part, by changes in lever angulation and orientation by altering body mass distribution and mechanical advantage of the muscles about the hip. This research highlights the inter-relationship between diaphyseal and

metaphyseal modeling in response to the mechanical loadings of the femur as a weight-bearing element, and relates to the developmental plasticity responding to the intrinsic and extrinsic mechanical loadings associated with gait patterns and postural behaviors.

Epigenetic signatures of high-altitude adaptation in the Andes

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High-altitude Andeans show distinct circulatory, respiratory, and hematological adaptations to chronic hypoxia. Emerging genetic data support an evolutionary origin and a genetic basis for these observed physiological adaptations to high altitude. However, the epigenetic contribution to adaptation to hypobaric hypoxia has not been characterized. We performed a LINE-1 DNA methylation analysis of whole blood in a cohort of n=600 young adults of Quechua ancestry from Peru (n=300 high altitude residents, n = 300 low altitude residents). LINE-1, a repetitive element present in the human genome, is often used as a marker for global DNA methylation. We used quantitative bisulfite sequencing to assess four CpG sites within the LINE-1 element. Multiple regression analyses demonstrated significant differences in LINE-1 methylation associated with developmental exposure to high altitude ($p<0.01$) as well as sex ($p=<0.01$) in the Quechua cohort. These data show that developmental exposure to high altitude has a persistent effect on the epigenome, and contribute to our understanding of ways in which the human organism can respond and adapt to environmental conditions.

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Reconstruction of breastfeeding and weaning practices in aboriginal populations from Western Cuba

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Paleodietary studies in the insular Caribbean have traditionally focused on the adults, while infants and children have rarely been considered by bioarchaeologists or analyzed separately from adults. Previous findings reported variability in subsistence strategies and food consumption patterns among fisher-gatherers populations from Western Cuba. In this paper, we evaluate whether or not these differences lead to variations in: 1) the age at the start and the end of weaning and 2) the kind of resources they chose as weaning foods. For these purposes, forty juveniles (determined to be between 3 months and 6 years old) were selected from three chronologically similar populations from Western Cuba: Canimar Abajo, Cueva del Perico I and Cueva Calero and processed for carbon and nitrogen isotope analyses. Two open source Bayesian probability mixing models (Weaning Age Reconstruction with Nitrogen isotopes: WARN and Stable Isotope Analysis in R: SIAR) were used to characterise the weaning practices of theses populations. Although there are some variations among the groups, these probability models all agree on a major dependency on breast milk before 3 years of age. Subsequently, other supplementary foods such as root cultigens, legumes and Zamia increase in their importance in all the juvenile diets. Interestingly, while animal protein and maize were part of the Canimar Abajo adult diets, these resources appear to have not been used to feed Canimar Abajo juveniles.

Ethoinformatics I: Developing a Standard Vocabulary and Data Model for Behavioral Field Research

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Recent years have seen increased calls for new techniques capable of synthesizing and processing large quantities of information in many disciplines. In the behavioral sciences, including field primatology, the ability to compare organisms across time and space in aspects of their behavior, social organization, life history, etc. is of critical importance. Such efforts, however, are often hampered by a lack of standardization in the terminologies and technologies used to collect, organize, and disseminate data.

Here, we present a draft for a standard vocabulary (EthoCore) and data model (EthoGrammar), both of which have grown out of two meetings of the Ethoinformatics Working Group (EWG). The EWG comprises a group of over 50 researchers—ranging from professors emeriti to graduate students—whose research spans the geographic, taxonomic, and technological breadth of field primatology and related disciplines. The draft EthoCore vocabulary comprises a set of metadata classes and associated terms that adopts and extends a core vocabulary recommended in other biological metadata standard initiatives (e.g., Darwin Core). EthoGrammar comprises a community-derived data model that outlines how data described using the EthoCore terminology can be flexibly packaged, archived, and shared among researchers in an open and technology-independent manner.

EthoCore and EthoGrammar are versatile enough to accommodate a broad range of database types and designs already in use by members of the community. These products facilitate data sharing and comparison by enabling the conversion of project-specific datasets and databases into a common language and structure.

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Trabecular bone density in recent modern humans

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Despite a complex relationship between mechanical loading and skeletal morphology, reductions in diaphyseal cross-sectional strength and epiphyseal trabecular bone density have been consistently observed among Holocene humans and attributed to a decline in physical activity. Recent work on a limited number of samples also suggests that trabecular bone density (i.e., bone volume fraction) of the femoral head is lower among more sedentary agricultural populations than among foragers. These findings imply that activity levels have a significant effect on trabecular bone morphology. However, the extent to which trabecular bone density differs among groups with varying activity levels (i.e., farmers, urban-industrial dwellers, foragers, and populations transitioning from foraging to farming) and the variation across multiple skeletal elements is still unclear. This study tests the hypothesis that sedentary populations will exhibit lower trabecular bone density than active populations across elements.

We measured trabecular bone density in lower and upper limb articulations of recent (Holocene) modern humans (five population samples, N=120) using peripheral Quantitative

Computed Tomography. Our results show that the active groups have significantly greater trabecular bone density in most limb elements of the upper and lower limb than the sedentary groups from different geographic locations. This result indicates that a decline in activity levels associated with the adoption of agriculture and industrialization contributed significantly to the reduction in trabecular bone density in recent modern humans. In addition, joint size did not have a correlation with activity type across elements, suggesting that articular surfaces are not environmentally plastic.

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The application of volumetric x-ray technology to skeletal biology

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The Digitome® x-ray imaging technology is a useful tool for skeletal biologists. The technology is comprised of a cabinet with an x-ray source, an image detector plate, unique volumetric imaging software, a turntable, and a calibration device. The software constructs 3D images from 8 ~32 images taken from multiple perspectives. The user may view the 2D slices from any orientation and position of the object. The technology is non-destructive, fast, accessible, portable, scalable to objects of different sizes and shapes, and provides accurate and repeatable dimensioning. Unlike computed axial tomography, Digitome® can generate single 2D images or assemble a series of images in a fly-through movie in almost real time with small file sizes in standard formats.

The technology was applied to a third century AD Roman subadult skull from Bir Madhkur, Jordan. A mid-facial anomaly was present, including abnormal outgrowths of the frontonasal area, absence of a frontonasal suture, deviated nasal septum, and thick ethmoid cribriform plate. The 3D fly-through movie of the entire skull provides additional perspectives of the anomaly not observed in photographs or 2D x-rays. Digitome® was also applied to a cortical bone thin section produced for histological analysis and an uncut bone block to investigate the degree of resolution of microstructures. While the current technology may not produce the resolution necessary for histomorphometric analysis, it provides 3D perspectives of trabeculation along the long axis of bone. A different spot size of the x-ray source and pixel size of the image detector may improve the resolution.

Change in Nonspecific Stress through Time in Durres, Albania

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This study addresses changing levels of skeletal stress in a population from Durres, Albania during periods of Greek and Roman occupation. We test the hypothesis that levels of nonspecific stress, evidenced by cribra orbitalia, porotic hyperostosis, and linear enamel hypoplasia, increased through time. To test this hypothesis, 116 skeletons from Durres, Albania were observed for evidence of cribra orbitalia, porotic hyperostosis, and linear enamel hypoplasia using standard data collection protocols. The skeletons were observed from the Greek to the Late Roman periods. Skeletal stress increased from the Greek to the Late Roman period (40% to 45.8% for cribra orbitalia (n=39), 27.8% to 28.6% for porotic hyperostosis (n=46), and 57.1% to 74.4% for linear enamel hypoplasia (n=57)). However, none of these differences were statistically significant. Although skeletal stress did increase somewhat through time, lack of statistical significance means that we cannot support our hypothesis with these data. The slightly higher levels of physiological stress we observed could have been caused by larger populations living in one area or increasing migration that introduced new diseases into the area. Small sample sizes make interpretation of these data difficult.

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Environmental change in Kenya following a strong-weak monsoon transition: implications for the Pleistocene paleoenvironmental record

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Reconstructions of East African environments surrounding important evolutionary transitions in the hominid lineage have long relied on assumptions of changes in local paleoecology based on regional monsoon dynamics. These relationships, however, are poorly understood. An inter-basinal reconstruction of Holocene paleoecology in Kenya may clarify these climate-ecology dynamics over time. Previous studies indicate that climate near northern Lake Turkana responded abruptly to a weakening monsoon system at the end of the African Humid Period (~11 to ~5.5 kya), whereas climate near southwestern Lake Victoria responded more gradually. Using archaeological tooth enamel ($\delta^{13}C$; n=333) and leaf wax biomarker isotopes ($\delta^{13}C$; n=18), we built a comprehensive paleoecological record of these two lake basins during this climatic transition. We show that herbivore diet increased in C_3 intake over time in the Lake Turkana Basin, whereas both leaf wax biomarker and tooth enamel isotopes indicate an abundance of C_4 resources in the Lake Victoria Basin throughout the Holocene. These data do not support a uniform shift in ecology across Kenya in accordance with regional monsoonal forcing, indicating that local responses to changing climate are site-specific and must be assessed basin-by-basin.

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Effects of X-ray microtomography on stable isotope values and sample quality

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X-ray microtomography is commonly considered a non-destructive research procedure despite the potential for damage to skeletal remains. Damage may include temperature-independent damage from photon energy, the creation of free radicals that drive ionization, and a breakdown of the crystal lattice in hydroxyapatite. The extent of damage is related to the intensity of the photon energy, with third generation synchrotrons having the greatest potential to induce chemical alterations. Although some progress has been made in understanding the impact of ionization on bone and tooth samples, little is known about how isotope values may be affected.

A pilot study was conducted to evaluate the potential impact of synchrotron light on stable isotope values. Stable isotope analysis was conducted on four archaeological human bone samples under two testing conditions. The samples were first analyzed for stable carbon and nitrogen isotopes of bone collagen and stable carbon and oxygen isotopes of bioapatite using a standard preparation method. Second, another set of samples from the same bones were irradiated at 45KeV for 3 hours at the Advanced Light Source, Lawrence Berkeley National Laboratory and then analyzed for variation.

The collagen samples analyzed after being exposed to the synchrotron showed more negative $\delta^{13}C$ and $\delta^{15}N$ values, lower collagen yields, and heavily altered C/N ratios compared to the original test run. For bioapatite, $\delta^{13}C$ values became more negative after exposure to the synchrotron; however, $\delta^{18}O$ values became

less negative after exposure. These results suggest significant chemical alteration to collagen and hydroxyapatite after exposure to x-ray tomography.

Environmental factors associated with luteal phase endometrial thickness in a sample of rural Polish women

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Pregnancy loss is a major determinant of interbirth interval and thus total offspring, yet we can explain few of the reasons for non-chromosomal pregnancy losses. The endometrium, as the site of implantation, is an understudied yet crucial component of cycling women's reproductive physiology. Developing foundational datasets on variation in endometrial function across human environments should in turn reveal what influences risk of pregnancy loss. We hypothesize that life history and energetic factors vary with luteal phase endometrial thickness (ET), which has been shown to correspond to rates of pregnancy and pregnancy loss. We offer a preliminary analysis of this hypothesis in a sample of rural, agricultural women at the Mogielica Human Ecology Study Site in Poland (n = 41). Participants had up to 3 (mean = 2.46, stdev = 0.78) ET measurements taken through the luteal phase of one menstrual cycle. We found that participants with a later age at menarche (r^2 = 0.12, adjusted throughout; p = 0.04) or a younger gynecological age (age minus age at menarche) (r^2 = 0.08, p = 0.07) had an increase in ET through the luteal phase. Gynecological age was significantly, positively associated after Bonferroni correction with breast size, waist size, and waist to hip ratio (r^2 = 0.08, 0.08, 0.21; p = 0.003, 0.003, <0.0001), and significantly, negatively associated with cycle length (r^2 = 0.11, p = 0.003). These early results suggest life history and energetic variables correspond to reproductive variables, including endometrial function.

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Diet and Weaning in Late Iron Age Dorset

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The purpose of the present study was to use incremental dentin sectioning to examine childhood diet in individuals from late Iron Age Britain, a period characterized by a reliance on terrestrial resources. Four males and three females from Dorset dating from the late 1st century BC to early 1st century AD who were interred with high-status grave-goods or died during the Roman conquest (48AD) were selected. Collagen was extracted from permanent molars (n=3) and or canines (n=4), and the $\delta^{13}C$ and $\delta^{15}N$ values were analyzed as indicators of childhood diet. Results showed first, that all individuals were generally well-nourished in childhood ($0.52 \leq r^2 \geq 0.90$). Second, their diet was consistent with that of the wider British Iron Age population and did not include isotopically detectable marine resources ($\delta^{13}C$= -20.1, $\delta^{15}N$= 10.06). Third, the age at weaning (between two and four years) was found to conform to the results of an earlier study using rib bone collagen. Finally, statistically significant (p=0.05) sex differences in $\delta^{15}N$ were observed ($\delta^{15}N_{females}$=10.7±0.2‰, $\delta^{15}N_{males}$=9.5±0.2‰, p=0.034); a finding not identified in an earlier study using rib bone values, suggesting that the sexes were treated differently during childhood, a result not observed in the bioarchaeological data.

A preliminary investigation into the femoral neck cortical thickness of another obligate biped

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The distribution of cortical bone in the femoral neck has been used to infer bipedalism in the hominin fossil record. Humans and hominins appear to have thin cortex on the superior aspect, while the apes have thick cortex around the whole neck. The theoretical explanation for this difference is that the femoral neck acts like a loaded cantilevered beam, but the contraction of the human abductor complex mitigates the tensile stress that normally should be present on the superior aspect. Humans, however, are not the only obligate bipeds. Paleognath birds, though they have substantially different evolutionary histories, developmental trajectories, and anatomies, are still an informative comparison, for as bipeds they must have a method to keep their body from tipping over to the unsupported side during stance phase. Ostriches are known to have a complex of muscles that insert on the femoral trochanter and abduct the femur – this action should have the same biomechanical effect in paleognaths as it does in humans. The proximal femora of ostriches and emus were μ-CT scanned and segmented. The ratio between the superior/inferior cortical thicknesses in all scanned individuals was very low, meaning that the superior cortex is relatively thin. Paleognaths thus appear to be similar to modern humans in their degree of femoral neck cortical asymmetry. This very well could be due to similar biomechanical circumstances, though further investigation is needed given the vastly different developmental trajectories of humans and paleognaths.

Does Industrialization Always Result in a Reduction in Skeletal Robusticity?

JOSHUA G.S. CLEMENTZ and ANN L. MAGENNIS. Anthropology, Colorado State University.

This investigation challenges the assumption that with industrialization there is a gracilization of the skeleton with a reduction in skeletal robusticity. Working class skeletal samples from the 19th Century Colorado Insane Asylum; First African Baptist Church, Philadelphia; Dunning Cemetery, Chicago; and Eastern State Hospital, Lexington, KY are compared to each other and to individuals in the Terry Collection. Femoral and humeral data are used to calculate four robusticity indices: the femoral robusticity index, the humeral robusticity index, the femoral robusticity index standardized by femur head diameter, and the humerus midshaft robusticity index. These measurements were used to compare, sexual dimorphism, skeletal asymmetry, and differences between populations. The femur exhibited little sexual dimorphism while there is marked sexual dimorphism in the humerus, with males being more robust than females. The implication is that there were similar mobility levels between males and females but there was still a pronounced sexual division of labor. Males were engaged in more physically demanding occupations than females. The comparison of the four archaeological samples and the Terry Collection industrial samples showed an increased skeletal robusticity in the archaeological samples, particularly notable in the First African Baptist Church and the Colorado Asylum. This supports the need to re-evaluate the generalized trend of gracilzation with industrialization, for just as when evaluating other subsistence transitions, the skeletal response is variable and context specific.

Somatic senescence in female chimpanzees (*Pan troglodytes*) occurs earlier and more rapidly than in women

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Female fertility ends at similar ages in chimpanzees (*Pan troglodytes*) and humans. Yet, unlike humans, chimpanzees suffer geriatric symptoms during their fertile years and usually die while still cycling—even in captivity. Such marked differences in general physiological senescence during the years preceding menopause imply differences in perimenopausal biology. Yet we know little of those differences, even though chimpanzees are favored models for the ancestral life history from which our distinctive post menopausal longevity evolved.

Here, we improve current characterizations of those differences by adding to quantitative indices of somatic aging in female chimpanzees across adulthood. Over three weeks, we trained seven female chimpanzees (ages 21-48) at the Yerkes National Primate Research Center to voluntarily and maximally squeeze a device engineered to measure grip strength in the species. All training and experimental sessions were completed using a positive reinforcement regimen.

Having compared our results to published values of these measures on women through the same ages, it is clear that chimpanzee females experience somatic aging at an accelerated rate than their human counterparts. Linear regression models demonstrate that the age-dependent slope in chimpanzees is steeper than evidenced in humans.

By directly addressing the interaction between somatic and reproductive aging, we aim to strengthen the foundation for describing and explaining life history similarities and differences between chimpanzees and humans. Results advance our understanding of the proximate mechanisms that influence age-dependent changes in chimpanzees, providing a crucial comparative standard for identifying distinctively evolved features of the perimenopausal experience in humans.

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An Epigenetic Investigation of Methylation Complex Genes in Relation to Stress in Mothers-Newborn Dyads

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Environmental stressors can have enduring biological effects, particularly when experienced early in life. Epigenetic modification, specifically DNA methylation at a CpG site, is a model describing how environmental stressors may alter gene expression and contribute to phenotypic plasticity. Working with 25 mother-infant dyads from the Democratic Republic of Congo, we previously found a correlation between stress and global mean methylation (GMM) in maternal blood. Infants, represented by cord blood, were affected only at a specific gene.

Here we investigate a possible molecular mechanism underlying the relationship between sociocultural stressors and methylation. Ten genes related to the methylation/demethylation complex (*DNMT1, DNMT3A, DNMT3B, DNMT3L, MECP2, MBD2, MBD4, TET1, TET2*, and *TET3*) were examined using the same mother-infant cohort. In addition to the previously found correlation of maternal GMM with stress, we found that maternal GMM correlated with maternal methylation at *DNMT3A*. *DNMT3A* codes for a *de novo* methylase which aids in maintaining adult methylation. However, no correlation was seen between maternal methylation at *DNMT3A* and stress. The lack of a direct correlation between stress and *DNMT3A* methylation suggests that the change in maternal *DNMT3A* methylation may be downstream of the change in GMM. Cord GMM correlated with cord methylation at *DNMT3A*, *DNMT3B*, and *DNMT3L*, consistent with a well-characterized feedback loop among these genes and gene products to establish methylation profiles *in utero*. These results illustrate how the methylation of methylase genes may help identify molecular mechanisms of phenotypic plasticity in response to environmental stressors.

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Dental development and life history in *Homo naledi*

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Dental maturation, comprising tooth formation and emergence, is closely linked to life history and social behavior. To shed light on these ecological adaptations in *Homo naledi*, we analyze dental maturation in this extinct species, based on visual appraisal and CT scans of the well associated, largely *in situ* dentitions of both an infant and an adolescent mandible. In the infant, occlusal wear and root development of the deciduous teeth indicate a human-like eruption sequence, with dc preceding dm_2 in contrast to the chimpanzee sequence. Both deciduous and permanent tooth formation of this infant cannot be distinguished from a human pattern. The adolescent shows delayed M_2 eruption and formation relative to the premolars, but slightly delayed canine eruption and advanced M_3 formation compared to most living humans. The overall picture of infant and adolescent dental development in *H. naledi* is derived compared to apes and australopiths, comparable to Early and Middle Pleistocene *Homo*. In the context of the hominin fossil record, the combination of largely derived dental development and primitive brain and body size in *H. naledi* conflicts with current theories linking dental development and life history. Primitive brain size and canine eruption imply a rapid life history on par with australopiths, whereas delayed M_2 emergence is associated with a slowed life history according to "Schultz's Rule." *H. naledi* suggests that a derived pattern of dental development evolved early in the genus *Homo* before increased in brain size.

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The Importance of Culture and Biology in the Analysis of Contemporary Migration: Approaching stress among Latino immigrants to Columbus, Ohio

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Migration is a stressful process rooted in cultural beliefs, social practice, biological processes and physiological well-being. While migration and settlement narratives and physiology often match, there is no reason to assume such parallels are common. In fact, there can be a mismatch between our measures of migration. This was clear in our investigation of Latino immigrants and settlement in Columbus, Ohio. The narratives of settlement and biomarkers that we collected were sometimes contradictory. While the narratives generally focused on positives of settlement, stress was manifest in biomarkers, physiological measures and self-reports of health status. We use our paper to argue that this mismatch is part of the complexity that confronts us as we develop a biological-cultural approach to understanding the stressors of human life. The stress responses that are evident in the biomarkers demonstrate the physiological tensions that surround migration and settlement. At the same time, the stories our informants share are one way that difficult, stressful moments are processed and organized. We argue that the differences in our measure are constitutive of complex patterns that reference how informants create possibilities in the difficult situations associated with migration and settlement. While the biomarkers we collect produce snapshots of human biology and physiological responses to stressors; the narratives reflect and define sociocultural expectations that are organized around an ethnographic moment. It is clear to us that biomarkers and narratives are central to understand migration and how immigrants respond to settlement.

Bootstrap-based comparison of the elevations of reduced major axis (RMA) regression lines

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Reduced major axis (RMA) regression has been used by physical anthropologists for more than 30 years. However, some parts of the RMA "toolkit" remain lacking. Primary among these is an analogue of analysis-of-covariance (ANCOVA) for comparing regression-line elevations. Some studies have combined RMA slope comparisons with ANCOVA comparisons of elevations. However, this approach uses different models of error distribution to estimate regression parameters for the same data, a situation we wish to avoid.

We introduce an alternative approach to comparing elevations using only RMA and employing the Hall-Martin (HM) test. The HM test uses bootstrapping to compute a confidence interval for the difference between two sample elevations. If the interval excludes zero, we reject the null hypothesis of equal elevations. The comparison can be conditional on any x-axis value, and unlike ANCOVA, the HM test does not require parallel slopes.

Simulations show the HM test is valid (correct Type-I error rate when the null hypothesis is true) for both bivariate-normal and highly skewed ("comet-shaped") distributions. Test power increases with both effect size and sample size, as expected. Simulations also show the HM test is generally more powerful than Tsutakawa and Hewett's commonly used "quick test."

To illustrate the method, we compare ontogenetic series of "untufted" and (more robust) "tufted" capuchins, regressing mandibular corpus thickness on mandible length. The HM test shows that the "tufted" regression line is elevated significantly higher at the smallest common length, indicating that "tufted" capuchins already exhibit relatively thicker corpora early in postnatal ontogeny.

Identification of osteoporosis with the parabolic index varies based on the method of adjustment for porosity

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Histological methods for identification of osteoporosis have forensic and bioarchaeological application in understanding bone health and fragility in individuals and populations. The parabolic index (PI) was developed by Epker and Frost (1964) to quantify bone loss as Y = (Cortical Area x Marrow Area) / Total Area^2. Metabolically normal ribs approach a maximum of 0.25, while osteoporotic ribs do not exceed 0.19. Intracortical pores have increasingly been recognized as major contributors to osteoporotic bone loss and considered in calculating bone mass metrics. This study weighs three methods of PI correction for porosity, including 1) subtracting pore areas from cortical area, 2) adding pore areas lost from cortical area to the marrow area, and 3) subtracting pore areas from both cortical and total area. A semi-automatic protocol identified both cortical and trabecularized pores on overlapping microscopic images of femora, tibiae, and ribs from nine elderly, modern individuals. Only method 1 consistently and significantly differed from uncorrected PI in the femur ($p<0.0009$ cortical, $p<0.0009$ total), tibia ($p<0.0009$ cortical; $p=0.001$ total), and rib ($p<0.0009$ cortical, $p=0.001$ total). Method 1 commonly revised cross-sections from originally "normal" to "osteoporotic", as PI is reduced when cortical and marrow areas no longer sum to total area. Some tibiae initially "osteoporotic" were revised to "normal" by methods 2 and 3 balancing a highly porous cortex. No method produced intraskeletal consistency in identification of osteoporosis, suggesting PI may be applicable for the rib only. Bone loss quantification through PI is sensitive to methods chosen for porosity quantification and correction.

Optimisation of metagenomic next generation sequencing shotgun techniques for the study of ancient anthropogenic sediments

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Traditional approaches to assess anthropogenic sediments (AS) focus on flotation and wet sieving for macro- and micro-organisms. While informative, they offer limited breadth of the wide range of organisms available. Metagenomic Next Generation Sequencing shotgun methods provide a means of analysing AS by comprehensively listing genes within a sample. Current methodologies, however are optimised for contemporary sediments, increasing the margin of error for ancient samples.

This research aims to develop an optimised protocol for aDNA isolation from AS. Key steps in DNA isolation were identified and split into three stages of experimentation to determine the 1) impact of dispersal and separation (DS) techniques, 2) sample size and 3) water saturation on aDNA quality and overall yields. Bulk samples from well-documented Irish Early Medieval (1100 BP) sites were subdivided into sizes ranging 1µg to 10g and subjected to a range of DS methods. aDNA was isolated using an optimised method based on published techniques. Samples were cleaned and prepared according to Dabney's method and sequenced using an Illumia MiSeqTM.

Preliminary results indicate that the method of DS greatly impacts overall aDNA quality and yields, with yields increasing regardless of the aDNA isolation method ($p<0.05$). Larger sample sizes introduced complications with aDNA catchment and aDNA yields increased depending on water saturation ($p<0.05$).

In conclusion, the DS technique before introduction of extraction buffer plays a direct role on quantity and quality of aDNA. An optimised protocol for aDNA isolation would allow for new analyses of anthropogenic activity through previously untapped ancient sediment.

Prehistoric Vertebrate Faunal Exploitation On Cuba

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Cuba is the largest and most ecologically complex island in the Caribbean and its prehistoric inhabitants were able to exploit a great array of resources. The prehistoric economy of Cuba's indigenous people is not well documented, however, due to the limited amount of quantified faunal data from the island. In this poster we present quantified vertebrate faunal data from three Cuban pre-ceramic sites and a later ceramic era location and discuss the taxonomy and ecological implications of these data. The animal remains from archaeological sites on Cuba reflect the narrow array of terrestrial mammals native to the island but also include a diversity of habitats and taxa. The most abundant animal remains in these sites are fish and a variety of rodents, primarily hutia. Remains of birds, reptiles, and manatee were also recovered and the relative abundance of species varies among the sites.

Characterizing differences in seminal plasma proteomes among hominids

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Humans (*Homo sapiens*), chimpanzees (*Pan troglodytes*), and gorillas (*Gorilla gorilla*) have differing mating systems with varying levels of sperm competition. Previous genomic studies suggest that several seminal plasma genes have evolved under positive selection and others altered or lost in these hominids. In this study we characterized biologically relevant similarities and differences among seminal plasma proteomes. The overall patterns are striking; chimpanzees possess a more complex mix of proteins in their semen, while gorillas show a dramatic reduction in the number of different proteins expressed, as observed from SDS-PAGE and two-dimensional gel electrophoresis. More quantitatively, seminal plasma from three individuals of each species were run in triplicate in shotgun liquid chromatography-tandem mass spectrometry (LC-MS/MS); 8,960 peptides were identified across all individuals. Five hundred and twenty-four proteins were identified overall. Only 63 proteins were shared between two or more species. We used immunoblot detection of the prostate-specific transglutaminase (TGM4) to verify results from the LC/MS-MS, confirming that

chimpanzees have approximately 7.7 fold higher TGM4 expression than humans, and the complete absence of TGM4 in gorilla, confirming pseudogenization of this gene. The structural protein SEMG2 was detected in one of three gorillas, and in all human and chimpanzee samples. Overall, our results support the hypothesis that the reduced seminal proteome complexity and pseudogenization events seen in gorilla are related to their predicted lower levels of sperm competition, while the increased complexity and increased expression of several key proteins in chimpanzees are driven by higher levels of sperm competition than in humans.

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Thinking spatially: Human behavioral ecology and forensic anthropology

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A paradigm shift within forensic anthropology has brought increased attention on theory and methods from archaeology and cultural anthropology. Forensic anthropologists are increasingly consulted to search for remains of missing persons. Understanding human behavior in victim body disposal affects all aspects of forensic anthropology from approaching a site/scene through skeletal analysis and interpretation. A fundamental concept of human behavioral ecology (HBE) is that human decision-making is patterned, as is their interaction with the landscape. Using HBE, optimal foraging theory can be modified to fit the often clandestine deposition of human remains, both on individual (domestic homicide) and mass scales (war dead); for example, when faced with disposing remains, the perpetrator(s) might aim to maximize the clandestinity of the deposition location while minimizing time spent with the remains as to avoid detection. Consequently, perpetrators must make a series of conscious and unconscious decisions, which are guided by the landscape and individual agency. We hypothesize that disposal locations are chosen to benefit an individual or group and/or at a cost to an opposing individual or group. Evaluating this behavior in the context of, for example, wars fought along ethnic lines is particularly parsimonious with HBE. Studying behavioral patterning will aid in the search and recovery of missing persons. Analysis of mass graves in Bosnia shows highly significant spatial clustering (Nearest Neighbor Ratio, $p<0.001$), with the highest clustering occurring at a radius of 8.5-9 km (Ripley's K). HBE theory helps us understand how bodies are disposed of and where we will find them.

Ancestral and Sex Differences in the Posterior Nasal Aperture

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The nasal aperture has been of interest to researchers in estimating ancestry for decades. Meanwhile, the posterior nasal aperture has been studied in periphery studies on respiration and the functionality of the nasal cavity. While much has been discussed on the anterior nasal aperture, the posterior nasal aperture (the choanae) has been largely ignored. Some studies on the choanae suggested there are differences in the sexes due to different respiratory needs. The goal of this study was to measure the anterior and posterior nasal apertures and compare ancestral and sex groups. Five measurements were collected from 55 black males, 52 white males, 51 white females and 51 black females of known age, sex and ancestry from the Hamann Todd Museum in Cleveland, Ohio. Results indicated that there are significant differences between blacks and whites in anterior nasal width but choanae width only differed between black and white males. The height of the choanae showed significant differences between males and females. Classification accuracy for ancestry was 55% and for sex it was higher at 74%. The results confirm that morphological differences in sex in the choanae are real and should be explored further in order to further understand the mechanics and sexual differences in respiration.

The paleontology "connectome" project: Predicting the location of fossiliferous sediments using Remote Sensing (RS) and Geographical Information System (GIS) techniques

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Paleoanthropological fieldwork is time-consuming, expensive, logistically challenging, and often serendipitous. We have been testing various RS and GIS techniques to help increase the odds of detecting fossil localities, particularly those in remote and geospatially extensive badland areas. We describe a promising technique for increasing the probability of finding fossiliferous sediments in the extensive Eocene badland exposures near South Pass, Wyoming, an area important for documenting biotic change in the Early Eocene Climatic Optimum (EECO), the hottest sustained period of the entire Cenozoic. Employing relatively simple unsupervised classification spectral signature models using the spatial analysis and image classification functions of ArcGIS®10, we demonstrate how these tools can be uniquely combined to "interrogate" this vast geospatial landscape to inform paleontological exploration. First, we plotted the GPS coordinates of known fossil localities on Landsat satellite imagery in the southern Great Divide Basin (GDB) and then ran an unsupervised land classification algorithm to characterize the spectral signatures of those fossiliferous sediments. Next, we highlighted all pixels in the South Pass region having spectral signatures similar to those of the most fossiliferous GDB sites. We predicted these highlighted pixels would reveal those sediments having the highest probability of being fossiliferous, and therefore, the areas "targeted" for exploration. We tested our model by superimposing the GPS coordinates of 171 known South Pass fossil localities onto our predictive map. Our model correctly predicted the location of 61/171 (~36%) of these fossil localities *even though these South Pass sites were some 25-50 miles from the original GDB sites*.

Comparative assessment of human enamel tufts

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Teeth can adapt to diet through variation in size, shape, enamel thickness, and prism decussation. Another potential mechanism of dental adaptation is the presence of enamel tufts. Tufts are hypocalcified, protein-filled fissures that extend outward from the enamel-dentin junction (EDJ) between enamel prisms. Initially thought to be undesirable byproducts of human tooth development with no real function or value to the tooth, tufts are now believed to prevent catastrophic tooth failure by absorbing tensile stresses that build up along the EDJ. If true, one would expect to find tufts in animals that eat hard foods and/or apply high stresses to their teeth. However, almost nothing is known about the phylogenetic distribution of tufts in non-humans. We examined more than 25 species of primates, carnivores, and suoids (pigs and peccaries) to determine tuft presence/absence. When present, we collected data on tuft distribution, density, length, and angle relative to the occlusal surface. We found tufts only in humans, sea otters, and suoids. Their absence in animals like hyenas and wolverines challenges the notion that they are solely related to high tooth stresses, while their presence in sea otters but no other carnivores argues against phylogeny as the sole determinant of their occurrence. It appears that tufts are only present in animals that experience high tooth stresses *and* have a bunodont tooth form. Other notable findings include an inverse relationship between tuft length and density, and a different spatial arrangement of tufts in suoids compared to humans and sea otters.

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Genomic identification of recent positive selection in populations from Andean highlands and south-central Chile

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The first settlers of southern South America reached the area by at least 14.6 KYA, and inhabited environments associated with selective pressures that contributed to modify patterns of genetic variation among indigenous populations. We evaluated genomic evidence of microevolutionary processes in three Amerindian populations from the Andes highlands in Peru (30 Aymara) and South-Central Chile (13 Pehuenche and 9 Huilliche) by genotyping with the Axiom LAT1 platform. We found high levels of population differentiation between these populations. The smallest Fst value was observed between Pehuenche and Huilliche (Fst=0.025) comparable to what has been reported between Russians and Palestinians (Fst=0.020). To identify recent selective sweeps (less than 30 KYA), we calculated iHS and XP-EHH scores in 7834 windows (200 kb). Among the windows with the 1% highest scores in both statistics, we detected 10 genomic regions with positive selection signatures that are not present in populations from Asian, European and African ancestry. Among these, we highlight a region on chromosome 6 (52-52.6 Mb) that shows strong evidence of selection in all the three groups analyzed. Comparative analysis between Aymara and the groups from South-Central Chile showed 8 regions selected in Aymara only and 7 in Pehuenche and Huilliche only. This comparison revealed highly differentiated genomic regions enriched for genes associated with lipid metabolism and immune reactions. These results suggest that selective pressures on these biological mechanisms may have been present during the recent history of native South American populations.

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New primate femur from Pedernales Province, the Dominican Republic extends the range of Hispaniolan monkeys

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There are currently two endemic primate species known from Hispaniola. A large collection of cranial and postcranial specimens of *Antillothrix bernensis* have been recovered from the eastern and northern Dominican Republic. The second species, *Insulacebus toussaintiana*, was described from craniodental remains from southwestern Haiti; the sample also potentially includes a humerus and femur. Biogeographically, this species distribution is unsurprising as Hispaniola once comprised two paleoislands, divided by a shallow channel running in a southeastern direction just north of the Sierra Bahoruco. Parque Jaragua lies on the southern side of this intersection, making the region biogeographically important. For several years, we have sampled caves for fossil remains of endemic fauna, and in July 2015, a nearly complete primate femur was recovered from a large, paleontologically rich cave.

The femur is complete with some breakage on the patellar surface; all epiphyses are fully fused. It is within the size range of *Antillothrix*, but more robust than femora previously allocated to this genus. This new femur also shows morphological differences from the *Antillothrix* material, including: a more medially projecting and anteriorly directed lesser trochanter; a short intertrochanteric crest; an obvious boss on the posterior aspect for the insertion of the external rotators; and a more anteriorly extensive insertion point for the gluteal muscles. In some of these features it shows a strong similarity to the femur cautiously attributed to *Insulacebus*. This fossil indicates for the first time that endemic monkeys were also found in this portion of the island.

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Dental morphological variation in autochthonous Cuban populations

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The present study analyses the dental morphological characteristics, by means of the ASU Dental Anthropology System, of 1262 individuals from the Caribbean. The individuals, dated from 2000 BCE to the end of the 15th century AD, and relative to the islands of Cuba, the Dominican Republic, Puerto Rico and Guadeloupe were organized on the basis of chronology, cultural affiliation, and geographic provenance in 13 distinct groups and analysed for 66 discrete dental characteristics.

When investigated using multivariate statistics the groups map out clearly: the Cuban Guanahatabeys and the Cueva Roja pre-ceramic sample from the Dominican Republic separate from all of the other groups. A second indication emerges within the cluster that includes all of the more recent, pottery-bearing, groups. These do not appear to separate on the basis of cultural affiliation but of geography: with all the individuals from the north-western portion of the area under investigation well distinct from the more south-eastern ones.

The results suggest the Guanahatabeys and Cueva Roja populations shared a common origin and settled into the Caribbean after one of the earlier migratory waves. It furthermore indicates that the transition from these two groups to the pottery bearing cultures was accompanied by substantial immigration and population change, once again supporting theories discussed in some of our previous studies according to which there must have been at least two distinct migratory waves into the Caribbean.

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Baboon social neurobiology: Comparing the distributions of oxytocin and arginine vasopressin receptors in hamadryas (*Papio hamadryas hamadryas*) and anubis (*Papio hamadryas anubis*) baboon brains

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Several forces shape an organism's social behaviors; influencing decisions to cooperate or compete, to live gregariously or alone, or to approach or withdraw from social interaction. Research has shown that the hormones oxytocin (OXT) and arginine vasopressin (AVP), and in particular the distribution and density of their receptors in the brain, are essential forces that influence the social decisions of animals. Although the roles of OXT and AVP receptors have been well described in mediating pair-bonding, affiliation, territoriality, and group size across a range of vertebrates, their potential role in mediating primate sociality remains unknown.

To investigate how OXT and AVP receptors influence primate sociality, this study compared receptor distributions between baboon subspecies, the hamadryas (*Papio hamadryas hamadryas*) and anubis (*Papio hamadryas anubis*) baboons. Although closely related, these baboon subspecies present different social behaviors, with the hamadryas baboon displaying greater degrees of cross-bonding between males and females, while anubis baboons have a more promiscuous mating system. Using receptor autoradiography to visualize the receptor differences between the two subspecies' brains, this study hypothesized that the hamadryas baboon would display patterns of OXT and AVP receptors similar to that found in pair-bonding species. Conversely, it was predicted that the anubis brain distributions would more closely resemble that of a more promiscuous species.

Receptor autoradiography revealed differences in the density and distribution of OXT and AVP receptors between the two subspecies. These differences are interpreted in light of known relationships between receptor distributions and social behavior across vertebrates.

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A Case Study of Skeletal Dysplasia Inheritance and Maternal/Fetal Health from a Middle Woodland Context at the Elizabeth Site (11PK512), Illinois

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Two individuals, an adult (EZ 3-7-1) and a fetus (EZ 3-7-2), were excavated from Mound 3 at the Elizabeth site (11PK512) in Pike County, Illinois, by the Center for American Archeology Contract Archeology Program and the Northwestern University Archeological Field Schools in 1980. Following a paleopathological evaluation, it was determined that EZ 3-7-1 had a combined skeletal dysplasia of achondroplasia and Leri-Weill Dyschondrosteosis, as well as abnormal bone addition that may be osteomyelitis, primary periostitis, or treponematosis. The skeletal remains of EZ 3-7-2 were disturbed by postmortem taphonomic processes, but were found situated in breech position on the sacrum of EZ 3-7-1, suggesting that EZ 3-7-1 was pregnant at the time of death, or perhaps died during childbirth. This poster presents the examination of the fetal remains, which revealed: the near full term development of EZ 3-7-2; abnormal, active, woven bone addition on the ulnae, femora, and tibiae; and abnormal morphological development of the long bones and cranial elements recovered. We propose that EZ 3-7-1 had passed on the developmental abnormality of the skeletal dysplasia(s), as well as the active bacterial infection, to the fetal remains of EZ 3-7-2. This poster also explores the possibility that the pathological woven bone proliferation of EZ 3-7-2 was caused by non-infection-related, maternal stressors of EZ 3-7-1. This study contributes to the new and current research on inheritance of skeletal dysplasias, systemic physiological disruption in fetuses, and the possible role of fetuses and neonates as indicators of maternal health in the bioarchaeological record.

Gene flow and species boundaries in howler monkeys

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The study of introgression in natural hybrid zones provides the opportunity to determine the ways in which divergent genomes interact and are influenced by different selective forces. Advantageous alleles in both parental genomes will easily spread through the hybrid zone and neutral alleles will be freely exchanged, but genomic regions that contribute to reproductive isolation will have restricted levels of introgression. Here, we analyzed levels of introgression between two species of howler monkeys that diverged ~3MA. We quantified levels of genetic admixture of individuals based on evaluation of autosomal microsatellite loci and used mtDNA, autosomal, Y-chromosome, and X-chromosome markers to characterize patterns of introgression among different genomic regions. We found bias in mtDNA introgression, but haplotypes characteristic of both parental species are present in admixed individuals, proving backcrossing in both directions. The distribution of genotypes among admixed individuals reveals a bimodal hybrid zone, suggesting strong levels of reproductive isolation. In all male hybrids, the Y-chromosome marker was always coincident with the majority of the nuclear background, supporting the hypothesis that Haldane's rule is operating in this hybrid system. X-linked markers showed reduced introgression, a pattern that is congruous with expectations based on the "large X effect" and implies a potentially important role of the X chromosome in reproductive isolation of howler monkeys, as observed in other hybrid systems. The howler monkey hybrid system may serve as a natural model to understand mechanisms associated with the incorporation of alleles from currently extinct hominids into modern humans.

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Grandparent Contribution to Child Nutritional Status: Evidence from the Young Lives Study

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Population aging through increased longevity and declining fertility has far-reaching demographic and economic implications across country contexts, including shifting burdens of disability, labor force and pensions, household composition, and care for aging adults. Though individuals are living longer without severe disability, the presence of persistent low-level disability is well documented. This additional longevity holds implications for the care of aging adults and children, as parents 'sandwiched' between two generations seek to provide care within a single multigenerational household. At the same time, grandparental presence in the household is positively associated with improved child nutrition and survival outcomes.

This study examines the intersection of aging and early child development and the role grandparents play in providing care using child-centered cohort data from the Young Lives cohort study. Longitudinal data from Ethiopia, Andhra Pradesh (India), Vietnam, and Peru are analyzed to consider grandparents as both primary caregivers and non-primary contributing household members. Repeated measures of child nutritional status including height-for-age (HAZ), weight-for-height (WHZ), and weight-for-age (WAZ) z-scores measured every 4 years from ages 1 to 8 years are predicted as a function of household composition, grandparental contribution, grandparental disability, and household wealth. This study contributes to a comparative perspective on the impact of grandparents to child nutrition in resource-limited contexts with varying levels of human capital.

Megan Costa is funded by University of Pennsylvania Population Studies Center NICHD Training Grant, #5T32 HD-007242.

The Relationship of Estradiol to Paternal Care Behavior in Wild-living Red-bellied lemurs (*Eulemur rubriventer*)

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Allomaternal care is significantly more prevalent among primates than other Mammalian orders, indicating there has been strong selection for this infant care strategy in primate taxa. However, research on the hormonal correlates of paternal care has been limited largely to cooperatively breeding species such as humans and tamarins. Little is known about the determinants of individual variation in care behavior. Additionally, care behavior in cooperative breeders is highly derived and research on species where care is restricted to a narrower behavioral repertoire is necessary to better understand the evolution of paternal involvement and its hormonal mechanisms. In red-bellied lemurs (*Eulemur rubriventer*) paternal care is facultative and variable, allowing for investigation of factors associated with the presence or absence of allomaternal care. Estradiol levels were measured in fecal samples from 6 pair-bonded male red-bellied lemurs, three who carried infants and three who did not. Samples were analyzed from the last 4 weeks of the pairmate's pregnancy through parturition and the infant-carry period (~4-11 weeks postpartum). A two-tailed t-test (t= - 0.542; sig. = 0.617) determined there was no significant difference in percent change in estradiol across the study period between helpers and non-helpers. These preliminary data do not necessarily indicate that estradiol has no role in preparing males for fatherhood, but do suggest it is not predictive of individual variation within this single species. Alternatively, elevations in estradiol as a mechanism facilitating paternal care may have evolved in other primate species after their divergence from a common ancestor with lemurs.

Cranial Deformation from Two Skulls in Romania

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Artificial cranial deformation is a practice that was used worldwide as cultural identification, social status, and cosmetically both for notions of beauty and for intimidation in battle. Two crania exhibiting intentional deformation were discovered in separate sites in Romania, both crania dating from the 4th-6th c AD. The discovery of the crania from two Christian burial plots suggests the presence of people with a cultural background dissimilar to that of Romania at this time. This paper combines anthropological and scientific information on intentional deformation and evaluates anthropological influences from the surrounding cultures on intentional deformation. With this information the study will explore the probability of societal integration of other cultures into Romanian villages.

Pelvic shape variation through growth and its implications for subadult sexing

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A series of 315 Medieval Danish (1000-1536 AD) adult and subadult skeletons from the ADBOU collections at the University of Southern Denmark were analyzed through growth using geometric morphometric methods to study the development of pelvic shapes and shape variation. The iliac crest, greater sciatic notch, arcuate line, and sub-pubic angle were all analyzed separately to determine how various factors affect the development and outcome of adult shapes. Results in the subadults indicate that in most of these features, the shape variation present changes and decreases with age as the shapes homogenize and the more extreme shapes are lost. Infant shapes show the most variation and are the farthest from the mean, indicating more extremes of shapes, while older children have less variation and/or are closer to the mean. While sex is unknown in these populations, the evidence suggests that this change in variation is related to a loss of sexual dimorphism through growth that does not reappear until the very last stages of adolescence. Conclusions of this research show that infants might be more sexually dimorphic in shape than older children and that the difficulty of assigning subadult sex increases with age.

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Witnessing Exploited Bodies: The Bioarchaeology of Violence Recidivism and Labor Abuse in 19th-Century Chinese America

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Injury recidivism can be defined as the reoccurrence or accumulation of trauma (and their sequelae) over time as a result of interpersonal conflict or workplace injury. In forensic, anthropological, and clinical literature, injury recidivism patterns may identify victims of social inequality and exploitation. Injury recidivism is particularly high in correctional facility populations, the homeless, victims of domestic abuse and minority populations yet it is unclear whether this is only a modern, Western trend. Bioarchaeologists have only just begun to explore injury recidivism despite being ideally positioned to identify the social, ecological and cultural forces which explain how, when, and where individuals will face repeated exposure to injuries. In this paper, we examine the human skeletal remains of thirteen Chinese migrants who worked in Carlin, Nevada to extend the Central Pacific Railroad after 1868. We provide an examination of their skeletal pathologies, trauma, and demography to assess whether injury recidivism also shaped the morbidity and mortality of racial minorities at the turn of the 20th century. Trauma analysis reveals that 10 of 13 individuals (76.9%) exhibit multiple traumatic injuries across the body which exhibit different degrees of healing. Like modern immigrants and disadvantaged racial minorities, overseas Chinese workers in Northern Nevada experience particularly high rates of injury recidivism within our study. Injury patterns vary greatly and we consider the causes of this variability. We link trauma patterns to unsafe labor. Carlin's Chinese railworkers suffered injury while being exploited by railroad monopolists in unsafe work camps plagued by poverty and violence.

Causes and evolutionary consequences of human migration: Anthropological genetic perspectives

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Anthropological genetics reconstructs human evolution of past and present migrating populations. The Aleutian Islands provide a unique opportunity to examine the relationship between geography, genetics and climatic influences on migration. Archaeological and historical evidence shows: (1) the earliest migration into the eastern islands occurred 9,000 years ago; (2) Russian contact, starting with explorations of the 18th century, resulting in the establishment of settlements on the Commander and Pribilof Islands by 1825.

From 1999 to 2006, 11 Aleutian Islands were sampled (N = 267) for DNA variation. MtDNA and NRY were sequenced and haplotyped. Analytical procedures utilized were: multidimensional scaling, mismatch analyses, SAMOVA, Mantel correlations, spatial autocorrelation, admixture, and Monmonier algorithm--used to detect genetic discontinuity.

Relationship between maternal genetics and geography yielded highly significant correlations with $r = 0.72$, $p < 0.000$. Regions of genetic discontinuity and the presence of barriers suggested that the islands were settled through three consecutive migrations—each associated with climatic changes. Spatial autocorrelation

plots revealed fission and kin-migration driving settlers to adjacent islands. Chronology based on mtDNA mutations: A2a1a (162126G) with coalescence of 6,529 +/-3,511 and D2 with 5,408 +/- 2,550 are suggestive of similar demographic processes. While 85% of the NRY was of Russian origin, mtDNA only exhibits indigenous haplogroups. A comparison of mtDNA haplogroups of ancient to modern Aleuts, reveal a reduction in genetic diversity of contemporary populations due to founder effect and kin migration. Anthropological genetics provides tools and methods to reconstruct the evolutionary consequences of past migrations.

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A multivariate approach to primate socioecology

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Primates live in an extraordinary diversity of societies. Historically, researchers have developed socioecological models seeking to explain how primate social systems relate to ecological factors. Presently, however, primate social behavior is underdetermined by current models because of (i) the sheer number of variables involved and (ii) a shifted focus toward observing categorical, rather than continuous, variation in order to better manage these variables. Current statistical tools can mitigate these analytical limitations by allowing for a more comprehensive examination of the associated socioecological factors. Here, as a first step toward developing a multivariate understanding of primate socioecology, I conducted a series of Discriminate Function Analyses (DFA) on a comparative dataset that includes 157 populations of 46 extant primate species (44 hominids, 27 hylobatids, 38 cercopithecines, 39 colobines, 6 platyrhines, 3 strepsirrhines; each species is represented by 1 to 26 populations with a median of 3). For each population, I surveyed 21 continuous and 7 discrete life history, morphological, demographical, dietary and behavioral variables. These analyses provide insight into ongoing debates in the field. For example, one DFA analysis classified the dataset by presence or absence of infanticide (cross-validation: 95.4% presence, 81.6% absence). As expected by socioecological theory, infanticide is driven primarily by degree of sexual swelling (R^2=.349) and canine dimorphism (R^2=.353). Lactation duration, however, a factor proposed to influence infanticidal payoff, contributes very little to this classification (R^2=.029), suggesting that no such influence exists. These preliminary results demonstrate how a multivariate approach may better inform current and future socioecological models.

Isotopic profiling of diet, health, and mobility amongst the non-adult Gepid population buried at the Archuid Cemetery in Transylvania, Romania (4th – 7th centuries AD)

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The Gepids were a migratory, barbarian population that inhabited the Carpathian Mountain basin from the 3rd to the 7th century (AD) in what is now Transylvania, Romania. The Gepids were subsumed into the histories of other clans, leaving very little reliable information about how this population lived and died. It is hypothesized that the continued migration/emigration would affect the Gepid's ability to access adequate nutrition, resulting in skeletal evidence of nutritional stress and/or metabolic. The Archuid cemetery (Transylvania, Romania), was occupied by the Gepids from the 4th-7th centuries AD, was excavated by Romanian archaeologists (1979-1982), unearthing 30 individuals.

Seventy-one percent of the individuals excavated displayed evidence of nutritional stress and/or metabolic disorders. In order to advance our knowledge about the Kingdom of the Gepids, stable carbon and nitrogen isotope analyses were employed to identify sub-annual, dietary life-course profiles for 7 non-adults from incrementally sampled dentine (range $\delta^{13}C$:-17.7 to -11.5‰, $\delta^{15}N$:9.4 to 15.1‰). The overall dietary pattern shows a mixed C_3 and C_4,omnivorous diet. Strontium and oxygen isotope analyses were utilized to determine the migration status of these non-adults. The $\delta^{18}O_p$ values range from 15.1 to 16.6‰. $^{87}Sr/^{86}Sr$ values range from 0.70959 to 0.71016 and indicate all individuals (with one exception) are consistent with local origins in a region of young sedimentary rocks of Tertiary age. The results of this research provide new insights as to how this Gepid population lived and died, in addition to adding new data to the growing corpus of studies combining isotopic analysis and palaeopathology.

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Being a Royal: Dental Anthropology of Ancient Maya Paramounts

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The ancient Maya was a highly stratified society. A relatively reduced group of paramounts ruled over large populations, benefiting from their social status in terms of preferential access to qualitatively richer and varied dietary resources, as well as better living conditions in comparison with the more popular segments of society. This should be reflected in better oral health, both in terms of developmental stress and infectious ailments. This paper contrasts caries, abscesses, linear enamel hypoplasia, tartar and occlusal wear from eighteen royals from various sited in the Classic period Maya area with the dental evidence from commoner individuals. Infectious lesions in royals are significantly lower than among commoners, with females always exceeding males. On the contrary, hypoplastic defects do not differentiate royals from non-royals, and tartar greatly exceeds that scored in normal people. Last, occlusal wear, when calibrated by age at death, reflects the pattern of less abraded teeth that one can expect from a softer, more processed diet. Within generalized heterogeneous conditions among individuals, belonging to the Classic period Maya elite did provide benefits in terms of oral infectious ailments, as well as in a reduced attrition, while also pointing to sex differences within the very elite sector, a pattern also known for commoners. Yet, it seems that their status did not buffer them against physiological stress, exposing royals to the same risk as non-royals in terms of developmental disruption. This is even more true in light of the lack of infant and juvenile royals in the skeletal record

Ancient Mitochondrial Genome Reveals Trace of Prehistoric Migration in the East Pamir by Pastoralists

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The complete mitochondrial genome of one 700-year-old individual found in Tashkurgan, Xinjiang was target-enriched and sequenced in order to shed light on the population history of Tashkurgan and determine the phylogenetic relationship of haplogroup U5a. The ancient sample was assigned to a subclade of haplogroup U5a2a1, which is defined by two rare and stable transversions at 16114A and 13928C. Phylogenetic analysis shows a distribution pattern for U5a2a that is indicative of an origin in the Volga–Ural region and exhibits a clear eastward geographical expansion that correlates with the pastoral culture also entering the Eurasian steppe. The haplogroup U5a2a present in the ancient Tashkurgan individual reveals prehistoric migration in the East Pamir by pastoralists. This study shows that studying an ancient mitochondrial genome is a useful approach for studying the evolutionary process and population history of Eastern Pamir.

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Biocultural evidence through taphonomic observations in the Karluk Salmon Cannery Chinese of Kodiak Island, Alaska

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A skeletal series of Chinese immigrant salmon cannery workers were excavated in 1931 in Kodiak Island, AK, under the direction of Ales Hrdlička. One of the aims of the biocultural investigation of this series was to explore the relationship of skeletal taphonomy with burial practices. Observed in this investigation was a variety of staining ranging in intensity and color. Inventory and macroscopic review of 45 nearly complete individuals from the series identified approximately 91% of the remains having some evidence of staining from the dye in the textile materials buried with the individual (either shroud/blanket or clothing) and/or staining from metallic materials attached to, or part of the clothing (e.g. brass button or rivets). To assess possible burial hierarchies, individuals exhibiting staining were compared to craniometric data indicating the presence of two main clusters within the series. Of the individuals exhibiting diffuse textile staining, 53 percent come from Cluster 1, 29 percent from Cluster 2, and 18 percent from the outliers group. Of individuals with copper alloy staining, 52 percent come from Cluster 1, 28 percent from Cluster 2, and 21 percent from the outliers group. These findings suggest that there was no clear pattern of differential burial treatment of "inclusive" individuals relative to the "outliers" in the skeletal series. In addition, the patterns of taphonomic change and preservation of the skeletal remains reflect differential environmental effects related to their proximity to wooden planks that covered the burials.

3D Morphometrics of the cercopithecoid distal humerus: implications for the reconstruction of paleohabitats

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Given the locomotor diversity and relative abundance of Old World monkeys in Plio-Pleistocene African fossil assemblages, the ecomorphology of ceropithecoids can serve as a valuable indicator of early hominin paleohabitats. The morphology of the distal humerus is informative regarding the extent to which the elbow joint is adapted for terrestriality versus arboreality.

This study utilizes geometric morphometrics to visualize 3D shape variation of the distal humerus among extant terrestrial, semi-terrestrial, and arboreal cercopithecoids. Shape is digitized using 18 landmarks and analyzed in conjunction with quantitative measures of substrate utilization. Multivariate analyses of coordinate data are used to determine the precision with which individuals can be placed along a terrestrial→arboreal spectrum.

Results show a significant correlation between distal humeral shape and percentage of terrestriality, $t_{(26)}$=-6.662, $p<0.0001$. Discriminant function analyses reveal 87.3% accuracy in reclassifying individuals by group and 86.5% accuracy in predicting degree of terrestriality—herein defined as the percentage of time spent on the ground—within a 10% range. Overall, this study demonstrates the potential for more precise determination of substrate utilization among fossil cercopithecoids. The results serve as proxies for predicting substrate preferences in individual specimens of fossil cercopithecoids and these can be compared with modern-day Old World monkey communities to infer the structure and vegetative composition of habitats at fossil sites.

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A preliminary analysis of the behavioral contexts of red langur (*Presbytis rubicunda*) loud calls in the Wehea Forest, East Kalimantan, Indonesia

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Male loud calls are hypothesized to play several roles in primate societies including intergroup spacing and spatial coordination. Field studies examining the behavioral correlates of vocalizations are essential to evaluate the function of these calls. From July 2011 to January 2012, we collected data for a preliminary exploration of the behavioral contexts and correlates of male loud calls in a habituated group of red langurs (*Presbytis rubicunda*) in the Wehea Forest, East Kalimantan, Indonesia. During 418 hours of data collection, we recorded a total of 87 vocal behaviors, including bouts of multiple calls in rapid succession (i.e., calling events) and individual loud calls. We found most vocal behavior took place in the morning with 59% of calling events taking place before 08:00. During this study, the mean rate of calling events was 0.11 events per hour and the mean rate of individual loud calls was 0.21 calls per hour. The mean number of calling events per day was 1.31 (range: 0-4) and the mean number of individual loud calls per day was 2.81 (range: 0-13). We found the rate of calling events was highest in the context of intragroup conflict, followed by intergroup encounters, predator threat, group travel, and the highest number of individual loud calls occurred during intergroup encounters. Although these results are preliminary, they suggest that adult male loud calls among red langurs at Wehea may play a role in both intergroup spacing and social coordination, supporting the hypothesis that these calls can serve different functions.

Evidence of malaria in a preliminary sample from the Amarna North Tombs Cemetery

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Ancient DNA (aDNA) analysis conducted on mummies from Egypt has provided evidence of the presence of malaria. The mummy of King Tutankhamun and both of his great-grandparents, Thuya and Yuya, have been shown to have suffered from the disease. Tutankhamun, who likely grew up in the city of Akhetaten (archaeological site Tell el-Amarna), links this city to malaria in a direct way. However, aDNA analysis of the many non-elite skeletal individuals from the North Tombs Cemetery at the New Kingdom capital is impractical due to lack of funds and the logistics of aDNA analysis. Therefore, this work examines the presence of malaria using macroscopic examination of the skeletal remains looking for cribra orbitalia; porosity of the neck of the humerus and femur; porosity of the vertebral bodies; and evidence of periostitis in the entire skeleton. Individuals exhibiting any of the first three types of porosity and evidence of either vertebral porosity or periostitis are diagnosed as having had malaria. The raw prevalence rate for the NTC sample (n=33) is 72.4%, with adults having a slightly higher frequency of malaria (76.9%) than subadults (68.8%), but this may be due to the small number of individuals examined to date. These results support previous research suggesting malaria was present at the ancient capital city of Akhenaten and Nefertiti. Additionally, malaria may contribute in a significant way to the overall poor health and difficult lives of the non-elites at Akhetaten previously reported by other authors.

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Sexual Fluidity Positively Influences Group-Oriented Prosocial Behavior

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Studies show male same-sex relations are evolutionarily adaptive on group level selection, as well as links between same-sex sexual behavior and benefits for groups as a whole in primates. We hypothesize that when sexual fluidity is prevalent within a group, it will be positively correlated with prosocial behavior within that group. "Sexual fluidity" is the frequency of same-sex sexual behaviors within a given group, and "prosocial behavior" is behaviors that benefit others in the group or group welfare without necessarily being altruistic. We performed preliminary comparison of sexual fluidity and prosociality using ethnologic data from HRAF. For sexual fluidity, we searched keywords "sexual fluidity, "fluid sexuality," "free sexuality," and "mutual masturbation." For prosociality, we searched keywords "assist," "aid," "status," and "gift." We are collecting data from young adults aged 19-30 of all genders, with purposive sampling for women, who are an understudied demographic in this regard. This sample is being surveyed with regard to the Big Five personality traits, sexual fluidity, and prosociality. Preliminary regression analysis indicates a significant positive association between sexual fluidity and prosociality when controlling for openness to experience (r = 0.292, p = .031). Findings from this study will shed light on the evolutionary implications of human sociosexuality.

Pellagra in the Mississippi State Asylum: An examination of differential survivorship

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Pellagra dramatically affected the early 20th century American South, particularly institutionalized populations. This research assesses pellagra survivorship in the Mississippi State Asylum (MSA) between 1910 and 1933. We hypothesize that survivorship varied, evidenced by changes in pellagra survivorship curves, prevalence, and incidence. We additionally hypothesize that differential survivorship existed between recorded sexes and social races (i.e. white, colored), evidenced by differences in their respective survivorship curves. These hypotheses are assessed using MSA records documenting admission diagnoses, stay duration, county of origin, and cause of death. Incidence and prevalence were calculated using the MSA's biennial reports on cause of death recorded by age. Kaplan-Meier survival curves for pellagra were plotted by sex and race. Preliminary results indicate differential pellagra survivorship in the MSA. Of the total patient mortality (N=3334) during the study period, 15% died of pellagra. Of these, 69% were female, 31% were male. Admissions records show that 28% of those who died of pellagra were admitted with pellagra-related diagnoses. Pellagra mortality percentages increase each year, starting at 4.6% in 1910, peaking in 1913 (26.7%), and declining through 1933 (10.2%). Smaller peaks occur in 1923 (21.3%) and 1929 (22.2%). Since the geographic origins of patients are available in relation to cause of death, recorded sex, and race, final results provide an understanding of pellagra's impact on the MSA patient population as well as Mississippi at large. These findings can be compared to other historic asylums to improve our limited understanding of the health and demography of institutionalized populations.

Identifiable properties and accurate identification of hammerstone-broken long bone fragments

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Accurate identification of skeletal element, bone portion, and side in hammerstone-fragmented long bone assemblages underlies archaeological interpretations of carnivory including skeletal part profiles, minimum number of element (MNE), and individual (MNI) estimates. This project used actualistic hammerstone and anvil fragmentation of domestic goat (*Capra hircus*) limb bones in ten half-carcass trials to document how percussion for marrow access influences fragmentary specimens' identifiable properties and impacts precise identification of skeletal element, long bone portion, and side. All specimens greater than two centimeters in maximum dimension were retained and their original element was recorded to compare a specimen's actual skeletal location and identified skeletal location (*e.g.* right femoral midshaft versus unsided upper limb midshaft). Specimens were assigned to identifiability categories that described the anatomical precision with which they could be identified to side, element, upper, intermediate and lower limb segment, and long bone portion. Additionally, maximum dimension, proportional shaft circumference, and the presence of diagnostic landmarks like muscle scars or nutrient foramina were recorded. Only 36% of specimens could be completely identified. Pairwise Mann-Whitney tests indicate that specimen size distributions are positively related to identifiability because larger specimens retain more identifiable features like epiphyses, relatively complete circumferences, and anatomical landmarks. ANOVA tests on average specimen count per trial indicate that fragmentation produces a similar number of specimens across elements. Most elements fragment into highly identifiable ends which generate accurate skeletal part profiles, MNE, and MNI estimates, and sets of less identifiable shaft specimens which cannot be sided and significantly underrepresent element abundance.

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Patterns of trauma, recidivism, and violence in urban and institutionalized 19th-century-born African Americans and Euro-Americans

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This study examines patterns of trauma, recidivism, and violence in a sample of 19th-century-born African Americans and Euro-Americans from the Cobb, Hamann-Todd, and Terry anatomical collections. All individuals will be analyzed according to ancestry, sex, age, and collection cohorts to determine if fracture patterns and repeat trauma differ amongst these groups. Documentary and primary historical records have been consulted to reconstruct the life history of the individuals studied and determine why specific patterns of trauma exist amongst African Americans and Euro-Americans. These records indicate that most of the sample was of low socioeconomic status. A majority of the African Americans researched in the Hamann-Todd and Terry collections were part of the Great Migration to Cleveland and St. Louis, the cities associated with these collections. More than 32% of the Euro-American women examined were institutionalized, many for more than a decade. Traumatic findings will be contextualized in regard to this information and case studies will be presented that illustrate the relationship between violence, race, social marginalization, migration, institutionalization, and trauma.

Insight into the population history of the Chilean Patagonia through the analysis of ancient and modern genomic data

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The human population history of Patagonia has been of great interest in the context of the peopling of the Americas. However, less attention has been paid to the local population structure of the groups that inhabited the area during later times. The main goal of this work is to investigate the population history of the Chilean Patagonia using genomic data. We sequenced four ancient genomes from two marine hunter-gatherers (Kawéskar and Yámana) dated between 910±30 BP and 1320±30 BP and genotyped 96 modern individuals from Southern Chile and Patagonia using the Axiom LAT1 microarray. These samples were compared with genotyping data from 51 modern populations and four ancient individuals (Anzick-1, Selknam and Yámana) from America. The PCA analysis shows a group composed by most of the samples from Southern Chile along with the ancient individuals, clearly separated from the northern groups. An outgroup-$f3$ analysis reveals a closer proximity between the ancient and modern samples from the same ethnic group, suggesting their continuity in the area. Considering only the ancient individuals, we see a closer affinity between Yámana and Selknam, a terrestrial hunter-gatherer group from Tierra del Fuego. Their relationship may be a result of the admixture between those groups or suggest independent origins of the coastal tradition seen in Kawéskar and Yámana. Archaeological evidence has suggested multiple origins of a coastal tradition but this is the first genetic evidence contributing to the debate.

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Life, Death, and Time: Rethinking the Social Process of Undocumented Migration in the 21st Century

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In 1998, demographers Audrey Singer and Douglas Massey proposed a theoretical model that characterized undocumented border crossings by Mexican migrants as a "well-defined social process influenced by the quantity and quality of human and social capital that migrants bring with them to the border, and constrained by the intensity and nature of U.S. enforcement efforts." In this poster, I revisit this theoretical framework and argue that much has happened in the world of undocumented migration since this publication that needs to be accounted for. This includes increases in border security and enforcement efforts, changes in the demographic profile of migrants, the development of more sophisticated smuggling techniques, and a dramatic rise in migrant fatalities. Using a combination of archaeological, ethnographic, and forensic experimental data collected by the Undocumented Migration Project along Mexico's northern and southern borders, I expand on Singer and Massey's theoretical model. I argue that physical suffering, material culture, death, post-mortem trauma, and various forms of time need to be incorporated more fully into conceptions of border crossing as a social process in order to account for both the current realities experienced en route and the dynamic and violent sociopolitical settings where clandestine movement happens. I conclude the poster by demonstrating how this more nuanced framework for examining undocumented migration in North America can also significantly improve our anthropological understanding of (and approaches to) this global phenomenon in places such as the Mediterranean, Saharan Africa, and beyond.

Dietary inference from P_4 topography in prosimians

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Primate tooth form often appears to correlate with aspects of diet. Dental topographic metrics express tooth shape in a potentially functionally meaningful way, and have been used to assess dietary ecology of both extant and extinct primates. Previous research has shown that topography of second mandibular molars (M_2) accurately predicts dietary food preferences of various extant primates.

This study investigates whether an association between diet and topography also exists for P_4 crown shape in a diverse prosimian sample, and if so, whether the topographic signal follows patterns previously observed for M_2 crown shape. Our sample consisted of 20 prosimian genera with known diets sorted into four dietary categories. For each tooth, Dirichlet normal energy (DNE; quantifying curvature), relief index (RFI), and orientation patch count (OPCR; quantifying complexity) were calculated.

Discriminant function analyses on these variables and M_2 length as a proxy for body size indicate that accuracy of diet classification is in general similar but slightly lower compared to M_2 (73.13% and 76.76% respectively). Interestingly trends of P_4 topography differ from patterns for the M_2. Folivores show the lowest relief (corresponding with generally low-cusped but blade-like P_4 crowns) whereas frugivores show the highest relief (reflecting raised basins and tall protoconids). This is in sharp contrast with their M_2 topography. Because P_4 topographic values differ by diet, but in a way unlike that of the M_2, their signals should be complementary and may allow more refined predictions of dietary preference when used in combination.

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Looking for suspensory apes and climbing hominins (in all the wrong places): Evaluating multivariate approaches to inferring fossil hominoid locomotor behavior from manual phalangeal shaft length and curvature

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Analyses of manual phalangeal shaft curvature and length are frequently used to infer locomotor adaptations for fossil hominoids because their direct and repeated contact with substrates results in predictable responses to locomotor specific patterns of mechanical loading. Despite this, prior analyses of manual phalangeal curvature and length differ considerably in their conclusions, specifically in the identification of suspensory fossil apes (i.e. *Pierolapithecus*) and in their interpretations of the significance of inter-specific morphological variation in the Plio-Pleistocene hominin fossil record with respect to climbing.

The present study uses a multi-variate statistical approach combining intermediate and proximal manual phalangeal curvature and length to evaluate the reliability of locomotor inferences drawn from a large sample of extant anthropoid (n=538), fossil ape (n=28) and fossil hominin (n=65). Results indicate that phalangeal shaft length and curvature are less well correlated in intermediate manual phalanges than in proximal manual phalanges. Likewise, analyses employing both proximal and intermediate phalangeal shaft curvature and length have the greatest predictive accuracy, however analyses excluding the intermediate manual phalanges are only slightly less accurate. Although analysis of the fossil sub-sample reconfirms previous locomotor inferences for the majority of fossil taxa, *Pierolapithecus* is identified as most similar to brachiating hominoids and platyrrhines suggesting it may be an early adopter of suspensory locomotor adaptations and positional behaviour. Similarly, Plio-Pleistocene hominin interspecific variation is shown not to exceed the range of phalangeal shaft length and curvature for extant *Pan* suggesting that if Plio-pleistocenehominins were climbing then this ability may have been relatively uniform.

Hard-tissue markers of face flanges in male *Pongo*

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Sexual selection produces variation in mating systems and competitive regimes, which in turn results in diverse secondary sexual traits. Reconstructing the socio-sexual behavior of extinct primates represents a major challenge in paleoanthropology since only hard-tissues are preserved in the fossil record. Consequently, estimates of canine and body size sexual dimorphism are often used as proxies of such behavior, although these measures have limited implications. Here, we assess the fatty cheek flanges present in some adult male orangutans (*Pongo pygmaeus* and *Pongo abelii*) in order to identify potential osteological markers associated with this secondary sexual characteristic. Since cheek flanges are accompanied by more substantial underlying facial musculature, we predicted that flanged males would be characterized by larger and more robust zygomatics (relative to estimates of overall cranial size) than unflanged adult males and females, due to the need for extra bony support for these soft-tissue structures. Additionally, we predicted that flanged males would exhibit relatively larger infraorbital and zygomaticofacial foramina, which encircle the vessels that innervate and vascularize the cheek tissues. Results show that two of the facial measurements examined, maximum bizygomatic breadth and maximum zygomatic process height, were significantly larger and more variable in males than in females, and significantly larger in flanged than in unflanged males. The total estimated area of facial foramina did not significantly differ between groups. This suggests that fatty cheek flanges can be identified in craniofacial skeletal morphology in the genus *Pongo*. We discuss implications for the possible identification of this trait in fossil primates.

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Tooth Tales from Lima: Dental Health and Socio-Political Change Along the Pre-Columbian Central Coast of Peru

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Changes in political, economic and social organisation may affect diet and access to resources, and consequently dental health. This study aimed to assess the dental health of two populations from Peru and to establish differences over time. Caries, Linear Enamel Hypoplasia (LEH), ante-mortem tooth loss (AMTL), and calculus were recorded for Tablada de Lurín (TL; 1 AD – 200 AD) and for Pueblo Viejo (PV; 1476 AD – 1532 AD). Frequencies were examined in order to assess sex and inter- population differences. The data was compared to earlier research. Seventy-three individuals from TL and 39 individuals from PV were selected. Results show no significant inter-sex or inter-population differences in LEH and calculus frequencies. Significantly higher caries frequencies in PV can be attributed to higher female frequencies. Female AMTL rates were higher than males' for both series. AMTL was lower in PV. Differences in caries and AMTL between the sexes of both series can be attributed to differences in foodstuff consumption and to biological differences. The caries frequencies in PV are consistent with maize availability under Inca rule. Results show that socio-political change can impact on dental health over time. However, this impact can be variable between contemporaneous populations.

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Adaptive maintenance of ancient alleles: likelihood approaches for detecting balancing selection

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While much effort has focused on detecting positive and negative directional selection in the human genome, relatively little work has been devoted to balancing selection. This lack of attention is likely due to the paucity of sophisticated methods for identifying sites under balancing selection. We designed the first set of likelihood-based methods that explicitly model the genealogical process under ancient balancing selection using a coalescent framework. Simulation results show that our methods for detecting ancient balancing selection vastly outperform previous approaches based on summary statistics, and are robust to demography. We apply the new methods to whole-genome sequencing data from humans, and find a number of previously-identified loci with strong evidence of balancing selection, including various HLA genes. Not only are our methods for identifying signatures of ancient balancing selection the most powerful developed to date, but they can also be applied to any organism with polymorphism data and an outgroup sequence. As such, we expect that our methods will be widely used by the genomics community to uncover the potentially numerous genomic regions that are under ancient balancing selection in many non-human species.

Metric and nonmetric features of the *Homo naledi* dentition

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The hominin fossil assemblage from the Dinaledi Chamber, South Africa, provides a comprehensive picture of the dental anatomy of *Homo naledi*. Currently, there are more than 190 whole or fragmentary teeth recovered from the chamber. These teeth represent at least 15 individuals that range in age from neonate to older adult. Metrically, the *H. naledi* dentition is smaller than that typical of *Australopithecus* and *Paranthropus* and overlaps in size with early *Homo* species. Nonmetric features, such as the absence of prominent postcanine cingular features and supernumerary cusps, also distinguish the Dinaledi teeth from *Australopithecus* and *Paranthropus*. The dentition retains a number of features that are primitive for genus *Homo*, including a distally increasing mandibular molar size gradient, a mandibular canine accessory distal cuspule, a fully bicuspid mandibular P3, a multirooted mandibular P3, multirooted maxillary premolars, and relatively large distal cusps on the permanent and deciduous molars. These primitive features are also seen in some early *Homo*, but not Middle and Late Pleistocene *Homo*. The sample, however, differs from known early *Homo* in having occlusally simple molars that lack crenulation and a prominent cusp 7. This suite of characters is not otherwise represented in eastern African, Eurasian, or previously known South African samples of *Homo*. Along with the anatomy of other skeletal regions, the morphology of the Dinaledi teeth supports the identification of a novel *Homo* taxon and provides further evidence for speciosity in the genus and lineage diversity in southern Africa.

Bioarchaeological analysis of juvenile remains from a mass sacrifice at Huanchaquito-Las Llamas, Peru, circa AD 1400

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Multiple discoveries of human sacrifices have been made in northern coastal Peru over the past decade. These contexts show substantial variability in the demographic profile of victims, the ways in which they were killed, and the location and manner in which bodies were buried. Careful contextual and bioarchaeological examination of these assemblages is required if we are to properly interpret this growing corpus of data.

Here we report on the bioarchaeological analysis of a mass sacrifice of children and llamas discovered near the western periphery of the monumental city of Chan Chan, in the Moche river valley of northern coastal Peru. Archaeological evidence and radiocarbon dates suggest a single sacrificial event, circa AD 1400, involving at least 90 children and 150 llamas. Analysis of 86 complete juvenile remains from this sample focused on demography, mortuary context, and manner of death. The children were classified into one of three distinct age groups (5-8, 9-11, and 12-15 years) as estimated by dental calcification and eruption. Mortuary patterns suggest the children were buried in groups of three with purposeful regard to their age. Contrasting forms of cranial modification indicate that this is an ethnically diverse sample. Transverse sectioning of sternal elements was identified in 83.7% of individuals. Associated cut marks, displacement, plastic deformation, and perimortem fractures of the ribs consistent with forceful opening of the thoracic cavity were found in approximately 27% of the victims. This is evidence of a manner of sacrifice, transverse bilateral thoracotomy, not previously identified in Andean South America.

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Leprosy and plague interaction in Medieval Europe: revisiting the paradoxical cross-immunity hypothesis

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Leprosy and plague co-existed in Medieval Europe and two hypothetical and conflicting scenarios were proposed for the co-infection: a) individuals suffering leprosy presented a weak immune system not allowing them to mount a proper immune response to plague; and b) chronic leprosy infection could have generated a "hyper-immune" state conferring some immunity to plague. In this *in vitro* study, we tested if exposure to one microbial species (*Mycobacterium leprae* or *Yersinia pestis*) can shift the immune response when the same cells (or supernatants from stimulated cells) are exposed to other species. The experimental protocols involved a two-day experiment, where human peripheral blood mononuclear cells from healthy donors were exposed to the corresponding pathogen lysates. The expression of key immune proteins (TNFα and IFNγ) involved in the immune response against both pathogens was measured by enzyme-linked immunosorbent assay. Our preliminary results showed higher expression of IFNγ when cells were exposed first to leprosy lysates and sequentially (day 2) to plague lysates (LP/YP vs YP/YP). When cells were exposed to leprosy lysates (day 1) and then re-exposed to leprosy lysates (LP/LP) they expressed more IFNγ, partially supporting the hyper-immune hypothesis. Interestingly, supernatants from cells exposed to pathogen lysates induced higher expression of both cytokines when compared with corresponding controls (day 2). These results do not allow us yet to accept a "protective" hypothesis but show an immune activation induced by leprosy lysates. We propose to conduct experimental protocols that will consider the polarized immune status in leprosy and explore a bioarchaeological analysis.

The Biological Consequences of Social and Political-Economic Marginalization in Antebellum Warren County, North Carolina

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The historical record suggests that enslaved populations living in the antebellum southeast experienced severe social and political-economic exclusion, which precipitated stressors different than those affecting non-marginalized populations. Bioarchaeological analyses provide an important supplement to the record, as they allow us to examine beyond the population level to better understand individuals within a larger marginalized population and how/why their experiences and impacts of exclusion differed. This project employs bioarchaeology to examine differences in stress, diet, and nutrition among individuals of a burial ground population (n=17) associated with a North Carolina plantation. Data was collected on osteological and dental indicators of physical and physiological stress and synthesized with dietary information provided by stable isotope analysis of carbon and nitrogen. Results indicate a high degree of dental lesions (caries, antemortem tooth loss, linear enamel hypoplasias) across all individuals; however, there are notable interindividual differences in osteological indicators of stress (periosteal lesions, porosity, osteophytic lipping, Schmorl's nodes), as well as in dietary components. This raises important questions regarding how factors other than race and status influence different health impacts, and how marginalization may be operating at multiple levels.

This project was made possible by a grant from the Center for the Study of the American South at the University of North Carolina - Chapel Hill.

The foot of the last common ancestor of humans and chimpanzees

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There are very few pedal fossils from Miocene hominids and thus the foot morphology of the human-chimpanzee last common ancestor (LCA) remains unknown. Hypotheses have been proposed that model the LCA foot after gorillas (e.g. Morton) or chimpanzees (e.g. Susman). Others propose that extant hominoids are highly derived, and that the LCA foot was like that of a more generalized catarrhine (e.g. Straus; Lovejoy). Fortunately—despite the continued absence of fossils near the hypothesized human-chimp divergence date—the hominoid and hominin foot fossil records have increased quite dramatically in recent years, providing new evidence that bears on the question of what the LCA foot looked like. These finds include fossils from late Miocene hominoids (e.g. *Pierolapithecus*), and Pliocene hominins (*Ardipithecus*; Burtele; StW 573). Even the early Pleistocene hominin *Australopithecus sediba* may inform our understanding of the LCA foot given the ape-like form of the proximal calcaneus. Here, we will briefly examine the fossil foot evidence to better reconstruct what the heel, and ankle, subtalar, midtarsal, and metatarsophalangeal joint morphologies in the LCA may have been. These findings have important implications for understanding the form from which a bipedally adapted foot could evolve.

Cold exposure decreases trabecular bone mass in young mice: implications for human bone acquisition

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Humans exhibit significant ecogeographic variation in bone size and shape. However, the developmental plasticity of bone in response to temperature is not well understood, making it difficult to identify adaptation vs. acclimatization in past populations. Here we ask how temperature affects growing bones, using mice as a model for humans. We hypothesize that cold induces impaired cortical and trabecular bone acquisition via increased sympathetic tone. To test this hypothesis, we housed wildtype C57Bl/6J male mice (N=5-6/group) in pairs at 78°F (thermoneutrality for this species), 72°F (standard housing temperature, mild cold stress), and 66°F

(moderate cold stress) from 3-6 wks of age with access to food and water ad libitum. Microcomputed tomography of cortical and trabecular bone architecture at the midshaft and distal femur, respectively, showed that compared to mice housed at 78°F, mice housed at 66-72°F exhibit 4-9% lower cortical bone thickness and cortical bone area fraction in the midshaft femur, but no differences in total area. In the distal femur, mice housed at 66-72°F have 43-66% lower trabecular bone volume fraction and 35-46% lower trabecular thickness compared to mice housed at 78°F (all $p<0.05$). These data demonstrate that the growing skeleton has phenotypic plasticity in response to temperature and support the hypothesis that cold exposure is detrimental to bone mass acquisition. Further, cold-dwelling humans exhibit a similar pattern of low cortical thickness, suggesting mice are a reasonable model organism for this question. Future studies will include larger sample sizes, additional endpoints, and more skeletal sites.

Rethinking Massacres: Bioarchaeological and Forensic Investigation of Prehistoric Multiple Burials in the Tennessee Valley

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Conflict research on massacres tends to focus on large-scale episodes involving the systematic murder of a group of individuals. Small-scale massacres, represented by low minimum number of individual mass graves, are more common, and often overlooked in the bioarchaeological record of the Southeastern U.S. Given population and group sizes, these episodes can indicate events that would have had an equally significant impact on a group's overall success. Clear definitions, differences, and thresholds need to be established for mass graves, mass murders, and massacres. To understand the impact that small-scale massacres had, we examine osteological material from northern Alabama. Site 1Ct27 has evidence of the mass murder of individuals foreign to the site. Site 1Lu92 has evidence of the massacre of individuals from the site, and the likely capital punishment of individuals who committed a criminal act. Site 1Ms80 shows signs of capital punishment and ancestor veneration/trophy curation. Site 1Ms91 has multiple lines of mass grave evidence that present analytical issues. These cases are discussed in terms of their influences on the interpretation of what constitutes a massacre; on their affect of our understanding of conflict; on how they change over time; and on how they vary among the different forms of social organization. Large massacres show us the extreme level of violence that can be observed. Small massacres demonstrate an endemic nature to conflict and the social logic that embraced and perpetuated violence, both as a form of blood revenge, and as resources competition.

The effect of multiple stress events on risk of mortality during the medieval Black Death

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Numerous studies, in both contemporary populations and in skeletal samples from past populations, have shown the deleterious effects that physiological stress *in utero* or early in childhood can have on health and survival later in life. This study furthers our understanding of the effects of developmental stress by examining demographic outcomes in the context of a catastrophic infectious disease epidemic, the 14th-century Black Death. Using a sample of 130 individuals from the East Smithfield Black Death cemetery, London (MIN86, *c.* 1349-1350), the effects of multiple stress events during childhood (as indicated by linear enamel hypoplasia) on risks of mortality during the Black Death are assessed with a Cox proportional hazards model. Previous paleodemographic work found that the elderly faced higher risks of death than young adults during the Black Death; thus, any estimated negative effects of enamel hypoplasia on survival or risk of mortality would suggest there is a real effect given that younger adults are otherwise expected to be at reduced risks of mortality. The results of this study reveal that the presence of enamel hypoplasia is associated with an elevated risk of mortality. However, among those with enamel hypoplasia, the risk of mortality decreases with increasing number of defects. This suggests there is, at least in the context of the Black Death, considerable variation in frailty among those with skeletal evidence of physiological stress, and that the survival of multiple stressors might indicate relatively low frailty whereas evidence of survival of just a single stressor indicates higher frailty.

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Skeletal growth over the period of intensification of agriculture at the late prehistoric site of Ban Non Wat, Northeast Thailand

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The bioarchaeological model predicts deterioration in population health with the adoption and intensification of agriculture. Bioarchaeological research in mainland Southeast Asia challenges this model, showing no clear pattern of health deterioration over time. To further test the applicability of the model in SE Asia, the study investigates childhood growth from the late prehistoric site of Ban Non Wat in Northeast Thailand. Linear and appositional growth patterns of infants and children (n=65) were compared from the Neolithic to the Iron Age (1750 B.C- 430 A.D) for assessing variability between the periods which may indicate growth disturbances as a response to agricultural intensification over time. Comparative analyses of linear and appositional growth exhibited no significant differences in the growth of infants and children between the Neolithic, Bronze and Iron Age samples. These findings are consistent with other health research in prehistoric SE Asia. A gradual transition to intensified agriculture over time and retention of a broad-spectrum based diet in SE Asia may have buffered the population from the biological stress that is found in other prehistoric populations of the world during agricultural intensification.

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Ethoinformatics II: Developing Open-Source Digital Data Services for Behavioral Field Research

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One of the significant challenges for modern field researchers in the biological sciences involves collecting and managing large volumes of data of many distinct types, including systematic behavioral observations, digital photographs/audio/video, morphometrics, climatological records, voucher collections, and qualitative notes, all of which are usually associated with date, time, location, and other metainformation. Here, we describe the in-progress development of a framework of software tools and digital data services for addressing this challenge. This effort builds upon a core vocabulary (EthoCore) and data model (EthoGrammar) created with feedback from a large community of primate field biologists (the Ethoinformatics Working Group).

Central to this framework are two components. The first is a customizable open-source software application for collecting location-stamped data in real time using the EthoCore vocabulary. This application is capable of running on various mobile platforms and is designed to work in remote field conditions where researchers often have inconsistent access to the Internet. The application stores data in a

schema-agnostic, document-based "NoSQL" data archive, which is versatile enough to accommodate diverse existing data models. The second component is a web-based administrative panel that allows users to manage data exchange and synchronization across multiple handheld devices as well as local and remote servers. All of these data services are being developed to operate using the same fundamental technologies and information transfer protocols that underlie the functioning of the modern Internet (HTML5, CSS, JavaScript, HTTP/REST) and are being offered to the community as open-source tools for adoption and modification.

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Forensic Anthropology *Is* Anthropology: How Participant Observation, Cultural Relativism, and Interviews Inform International Casework

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Forensic anthropology has long been seen by non-practitioners as a non-anthropological pursuit, albeit one serving the public good, but non-anthropological nonetheless. Within anthropology, practitioners historically referred to it as sole use of the physical anthropology toolkit and therefore ancillary to scholarly anthropology. This stigma continues to the present day, with some forensic anthropologists unaware of how and why forensic anthropology has evolved into a discipline grounded by anthropological theory and practice. While it is obvious that forensic anthropology directly involves knowledge gained from biological anthropology and archaeology, it is less apparent that cultural anthropology plays a role. Evidence is presented of forensic anthropology's evolution and embracing of sociocultural anthropology, especially outside the United States. Two case studies are presented: the first, from Colombia, illustrates how practitioners have incorporated family interviews and greater family involvement with identification and repatriation. The model developed there followed the groundbreaking example set by the Argentinean Forensic Anthropology Team and others in Latin America, with the goal of involving families in the entire process. Cultural relativism is essential, as many families are from different backgrounds, ethnicities, or socioeconomic groups of the anthropologists'. The second case study focuses on Algeria, where civil society groups interested in human identification work underground, due to political and social issues stemming from the 1990s civil war. In both of these cases, cultural relativism informs every aspect of the forensic anthropologist's work, from understanding the complex reasons skeletal analysis is needed in the first place to family member consults and interviews.

The impact of illness behavior of patients and caregivers on the spread of an influenza epidemic

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Individual and group-level behavioral responses during epidemics, including heterogeneity in compliance with public health recommendations, psychological factors such as fear, and decisions to stay home from work or school, are likely to strongly influence the dynamics of disease spread within and between communities. However, computer simulation models of epidemics still frequently lack realistic behavior modifications beyond implementation of vaccination or quarantine measures. An agent-based model of a small fishing village in early 20th century Newfoundland and Labrador, parameterized to simulate the 1918 influenza pandemic, is used to test the effects of sick individuals, and in the case of young children, adult caretakers, staying home. Each infected agent has the same chance of staying home, with the probability systematically varied across different sets of simulations. If an agent chooses to stay home, the day of the infectious period which it does so is randomly determined. Results indicate that, as the chance of staying home increases from a probability of 0 to 1.0, the overall size of the epidemic decreases by approximately 15% of the population, and the peak of the epidemic occurs about 3 days earlier. Peak size is also smaller, and epidemics end almost a week earlier. These results demonstrate that epidemic outcomes are significantly influenced by illness-related behaviors; inclusion of these behaviors in models are therefore necessary for complete understanding of the dynamics of disease spread and for obtaining more refined predictions of possible outcomes during actual epidemics.

Maintaining and reinforcing commitment in the pair-bonded Bolivian gray titi monkey, *Callicebus donacophilus*

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Titi monkeys, *Callicebus*, are the only primates strictly conforming to the standard monogamous profile, being monomorphic and territorial with a high level of paternal investment. Tightly bonded male and female pairs are known to experience strong physiological and behavioral responses to separation. Titi pairs maintain and reinforce these bonds through a suite of affiliative behaviors (e.g. grooming) and conspicuous vocal and visual displays (e.g. duetting and tail-twinning). Little is known, however, of the relative contributions of the male and female to pair bond maintenance and whether investment varies with the reproductive cycle. Pair bond maintenance behavior (grooming, approach/follow interactions, contact and tail-twinning) was recorded for 4 habituated groups of wild Bolivian gray titi monkeys at Yvaga Guazu, Santa Cruz, Bolivia from February 2010 to December 2011. Pair bond maintenance behavior was found to be significantly higher and the male invested more in the relationship after the birth of an infant and the duration of its dependency. Affiliative behavior declined significantly during the mating season, March through May, and male and female investment was reciprocal with a marginally greater investment by the female.

Models for, and predictions about, the head, neck, pectoral and upper limb musculature of the last common ancestor of hominins, and notes on the myth of human morphological complexity

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Gross anatomical dissections were made of the muscles of the head, neck, pectoral region and upper limb of at least one individual from each major primate clade (N=55) and from outgroups. The morphological information obtained from these dissections was converted into characters and the states for each major primate clade were used as the raw data for a cladistic analysis. The resulting consensus cladogram was consistent with the pattern of relationships supported by DNA evidence. There were more unambiguous evolutionary steps [NS] from the base of the inferred tree to modern humans (N=75) than to any other taxon included in the study, including chimpanzees (N=70). However, modern humans have fewer head, neck, pectoral region and upper limb muscles (N=123) than most other mammals and fewer than most primates (e.g., chimpanzees have 126 muscles). So despite accumulating more evolutionary transitions than other primates, since the *Pan*/*Homo* split modern humans have actually secondarily lost muscles (e.g., levator claviculae and dorsoepitrochlearis) that are present in most other primates. The same data set was used to generate hypotheses about the head, neck, pectoral region and upper limb musculature of the hypothetical common ancestor of modern humans and chimpanzees/bonobos, and the hypothetical common ancestor of the clade that includes modern humans. Notably, modern humans accumulated more evolutionary transitions than other primates, but these transitions did not result in more muscles/bundles per muscle; in fact, since the *Pan*/*Homo* split humans have secondarily lost various muscles that are present in most other primates, including extant chimps.

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Forensic Taphonomy: Research Wanted!

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The foci, principles and practice of forensic anthropology have changed dramatically along the past decades. It evolved from a laboratory-based field targeting only victim identification, to a full-fledged scientific discipline with lab and field components, concerned with the understanding and interpretation of natural processes to reconstruct past events. Whether we consider methods or scope, virtually all elements of this transformation refer directly to the key questions in classic taphonomy. Modern forensic anthropology could be defined indeed as the combination of osteology and taphonomy to address forensic questions.

The initial development of forensic taphonomy has been based primarily on drawing from the existing body of knowledge of vertebrate taphonomy, with maybe the honorable exception of trauma analysis. Forensic archaeology has also drawn its main principles from taphonomy as applied in conventional archaeology.

However, forensic taphonomy departs from classic taphonomy in at least two key aspects demanding specific research: (1) the processes of degradation of soft tissues become relevant by themselves, instead of only for their potential role in the preservation of some structures; and (2) feature boundaries expand to encompass current environmental conditions, rather than just past ones recorded in the geological medium.

We propose that, for its success, future research in forensic taphonomy must also expand beyond the boundaries and scope of its classic parent disciplines to incorporate (1) field and functional ecology techniques and perspectives, (2) fully experimental designs, and (3) standardized field protocols allowing for scene-comparisons and actualistic research akin to multicenter clinical trials.

Determining Ancestry of Unprovenienced Human Remains from the Grenadines, Southern Caribbean: Dental Morphology and Craniometric Analyses

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The bioarchaeological record of the southern Caribbean reflects a diverse population history due to the replacement of founding indigenous groups by European and African populations as a result of colonial incursion and processes surrounding the Transatlantic Slave Trade that occurred over a period of centuries. This complex history can present problems for proper dispensation of archaeological material and human skeletal remains, particularly those recovered outside the strictures of controlled excavation. In this case study we examined a collection of unprovenienced skeletal material comprising four individuals of unknown ancestry deriving from a private collection on the island of Mustique in the southern Grenadines that supposedly originated on the smaller nearby island of Petite Mustique. Ancestry has been estimated using a combination of craniometrics and dental morphology, the latter assessed by scoring a suite of 23 Arizona State University Dental Anthropology System (ASUDAS) traits for comparison against existing population data from Africa, Europe, and the Americas. Standard craniometric measurements were also assessed using the FORDISC database. We find that these data do not support an Amerindian ancestry for these individuals, and instead suggest the remains are of European and/or African descent that date to the historic period. These and other ongoing analyses, including possible mtDNA extraction and stable isotope analyses, should help in efforts to repatriate the remains to the appropriate governing body and location.

Injury-Related Morbidity and Mortality in Neolithic Syria

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The injurious effects of the agricultural transition on health have been well documented. In addition to a general increase in indicators of illness, researchers have observed higher frequencies of skeletal trauma among early agricultural populations. This trend is often considered indicative of an increased level of interpersonal conflict, perhaps related to resource availability or the enforcement of social hierarchies. While much of this research is derived from New World contexts, contributions from the Near East are relatively uncommon. Excavations at the Pottery Neolithic cemetery at Tell el-Kerkh in northwest Syria provide an opportunity to study the frequency of skeletal trauma in this less examined region. The cemetery sample consists of 237 individuals. Of these, 127 individuals (male=48; female=41) were adults. Thirty-seven fractures were observed among thirteen individuals (male=11; female=3). Most individuals (54%) suffered multiple injuries. Fractures to the hands, feet, and thorax were most common. Four individuals exhibited cranial or facial fractures, including one young adult male with an unhealed, penetrating fracture of the frontal bone. In general, the observed frequency and pattern of fractures is similar to other sites within the Near East, with limited evidence for interpersonal violence. However, the divergent constellation of fractures among males and females suggests that, while interpersonal violence may have been uncommon, females were at greater risk of intentional injury. In contrast, males were primarily at risk of minor skeletal injuries, perhaps due to environmental dangers, or the hazards of manual labor.

Sealed osteons do not increase in the human femur with aging or in association with a total hip replacement

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Age-related degradation in cortical bone quality is detected histologically as empty osteocyte lacunae, increased porosity, and hyper-mineralization of osteocyte lacunae, osteon canals, and interstitial bone. Increased prevalence of sealed osteons (SO) might reflect age-related degradation. They might result from ischemia, as suggested by Congiu and Pazzaglia who showed that 4-5% of all secondary osteons from modern human tibiae were sealed (amputated legs;ages 25, 28, 52;all males). We performed microscopic analyses on transverse sections of proximal regions of bilateral femora (10 patients;52-94 years;mean 82) with non-cemented unilateral hip replacements (HRs) (implanted vs. contralateral non-implanted side). Hypotheses: SOs would increase with (1) patient age, (2) the presence of a femoral component, and (3) the amount of time since HR. We also re-evaluated images from normal human femora without HRs (ages 35-71;male:female=8:2) to measure areas of SOs vs. random non-SOs. Results: (1) SOs tend to decrease with age ($r = -0.234$; $p=0.04$) but do not increase with HR implant (3.4% SOs vs. 3.4% SOs; $p=0.9$) or with duration of HR implantation ($r=0.09$; $p=0.6$); (2) SOs occur in significantly smaller osteons when compared to normal osteons (mean diameters: 146 vs. 320 microns; $p<0.005$). The theory that SOs result from ischemia is not supported by the negative correlation of SOs with age or the lack of correlation of SOs with HR. Although we hypothesize that SOs represent the narrowed tip of osteon "closing cones", a reduction in prevalence of closing cones with age seems unlikely. Additional 3D studies are needed.

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Re-evaluating the co-occurrence and age of formation of Harris lines and linear enamel hypoplasia

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The use of indicators of systemic stresses, such as Harris lines (HL) and linear enamel hypoplasia (LEH), as a means of assessing past population health has been called into question in recent years. This study examines the ages of formation and co-occurrence of HL and LEH in a medieval British sample from the site of Poulton, which includes both adults and juveniles. A population-specific method of aging HL formation was developed for this study because our previous research revealed a different center of ossification estimation for all populations analyzed, and notable differences in growth rates among British populations across time and socioeconomic environments. As such, it is clear that standardized methods would not yield accurate ages of HL formation. The population-specific method is based on diaphyseal long bone lengths in the tibia, the element in which HL most commonly occur. Ninety Poulton individuals with dentition and complete tibiae were radiographed. Of these, 63 (70%) were found to have HL. The ages at which these lines formed were clustered into two ranges – between 2-3 and 7-11 years. LEH on the maxillary and mandibular canines was also recorded and 45 (50%) individuals presented both LEH and HL. The LEH formed mainly between the ages of 2-4 years. It is concluded that although the same stress factors may not result in the simultaneous occurrence of these two indicators, some individuals may be predisposed to both arrested growth and enamel disturbances.

Temporal variation in the neural canal among southern African foragers: implications for dynamic foraging strategies and social conditions in the later Holocene

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The terminal Later Stone Age on the southwestern African Cape features a short period of intense land use, more limited home ranges, and occasional lethal violence. Mean body sizes are smallest during this period, suggesting that some foragers experienced statural stunting. This study compares temporal variation in the size of the neural canal (NC) with that in body size (N=105; M=56; F=49). Z-transformed mediolateral (ML) and anteroposterior (AP) NC diameters, maximum femur lengths (FXL) and femur head diameters (FXH) are regressed on radiocarbon date using polynomial regression. Mean sizes are compared before, during, and after the intensification period with one-way ANOVA. FXL, FXH, and ML-NC exhibit similar quadratic curves with a nadir between 2000 and 3000bp. Mean values are greatest after the intensification period ($p<0.05$). However, regression models are markedly stronger for FXL and FXH than for NC (FXL β_1=-1.60, β_2=1.43, R^2=0.20, $p<0.05$; FXH β_1=-1.64, β_2=1.49, R^2=0.20, $p<0.05$; NC-ML β_1=-0.83, β_2=0.68, R^2 =0.06, $p<0.05$). The attenuated change in NC size, in contrast with the apparent decrease in body size suggests that the intensification period did not strongly affect early childhood growth among those who survived to adulthood. The terminal Holocene increase in average size coincides with a possible population contraction and with the earliest regional appearance of livestock. Subsistence and demographic changes, accompanied by the shift in average body and neuroskeletal size, may signal that social conditions were shifting away from an earlier Holocene status quo.

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Anthropological studies of past societies from the Hualfín valley in northern Argentina: A preliminary report

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The Hualfín valley is located in the province of Catamarca in northwestern Argentina. The valley has been characterized by a significant sequence of prehistoric occupation of different societies during Pre-Columbian times. The earliest agro-pastoralist societies in the area emerged in the valley between BC III and AD IV during the Formative Period. Unlike other Pre-Hispanic societies of northern Argentina, little information has been recorded about their funerary practices and the anthropological characteristics of the populations involved.

The aim of this paper is to present the preliminary results of the anthropological study of different burials recovered in the Hualfín valley corresponding to the earlier agro-pastoralist societies of the Formative Period. The skeletal sample consists of 19 individuals and was exhumed from burials in an archaeological site in the vicinities of Azampay, located in the western piedmont of the valley. The sample comprises 10 adults, including 6 females and 4 males, and 9 subadults. Dental and skeletal morphology and paleopathology are recorded, along with nonmetric and metric traits. Diverse patterns of burials are noted which may suggest social differences in these past societies. Individuals do not exhibit cranial modification as it was common in the area in later periods. The anthropological data collected in this study provide more information about the ancient peoples of the region and are a major contribution to the human biology of the area. Further studies in the Hualfín valley will allow increasing current knowledge about biocultural aspects of human populations of the Formative Period in northwestern Argentina.

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The mental eminence as a marker of sexual dimorphism in dentate and edentulous individuals: An analysis using geometric morphometry

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The mandible is often used for sex estimation as many mandibular studies have identified morphological differences among males and females. Sexual dimorphism of the mandible has also been shown to vary in relation to population samples. Specifically, the shape of the mental eminence is commonly utilized to estimate if an individual is male or female. However, mental eminence shape is not typically quantified and accuracy of traditional and often subjective non-metric methods can be poor.

Further confounding sex estimation from bony elements of the skull is the biomechanical implications of antemortem tooth loss. Several studies highlight changes in morphology of edentulous mandibles in comparison to dentate samples. Thus inquiry of quantification of the shape of the mental eminence in dentate and edentulous mandibles is warranted.

This study provides quantification of shape variables associated with the mental eminence in a sample of dentate and edentulous males and females. The degree of sexual dimorphism in the morphology is examined through the analysis of three-dimensional landmark data to ascertain whether shape differences are quantifiable even with tooth loss and alveolar resorption.

Results of this study show that changes occur in mandibular morphology due to tooth loss. However, overall shape of the mental eminence remains largely unaffected. Shape differences among males and females are significant, although estimation accuracy is higher among dentate samples. The retention of shape differences indicates that the mental eminence can be a useful region of the skull for sex estimation even when extreme tooth loss has occurred.

Leaf fracture toughness and foraging efficiency in Angola black and white colobus monkeys (*Colobus angolensis palliatus*) from the Diani Forest of Kenya

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Primate behavioral ecologists and functional morphologists are increasingly interested in how food mechanical properties relate to oral processing behaviors because such information provides context for understanding craniodental morphology. Colobine monkeys are renowned for their consumption of mechanically tough leaves and seeds; however, the relationships among fracture toughness, ingestion rates, and chewing efficiency of food items has been explored in only a handful of taxa. The purpose of this study was to test the hypotheses that leaf fracture toughness is negatively correlated with ingestion rate and positively correlated with masticatory frequency.

We collected diet and feeding data on three groups of Angola black and white colobus monkeys (*Colobus angolensis palliatus*) in the Diani Forest of Kenya from July 2014-December 2015. Ingestion rates were estimated by counting the number of items consumed during three minute feeding bouts and multiplying this value by the average weight of a given item. Chewing cycles were counted during three minute focal follows. Fracture toughness of commonly eaten leaves (N=30 species) was recorded with a single blade toughness tester designed by the authors. We used linear regressions to test our hypotheses and one-tailed t-tests to evaluate the correlations.

Our results show that average toughness of ingested leaves was 204.6 ±101.8 Jm^{-2} and ranged from 69.0-413.7 Jm^{-2}. As predicted, ingestion rates negatively correlated with toughness (r^2=0.68; $p<0.001$) while masticatory frequency positively correlated with toughness (r^2=0.77; $p<0.001$). We conclude that leaf toughness significantly influences foraging efficiency because more chewing cycles are required to sufficiently commute tougher leaves

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Interspecific variation in pubic bone morphology and its association with body size, locomotor classification, and phylogeny

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Variation in the anatomy of the pelvis is thought to be the product of locomotor function, body size, and obstetrics. Of its three components, the pubic bone is the least understood and studied, perhaps due to the assumption that variation in its morphology is largely due to variation in obstetrics. The present study evaluates a sample of 51 hominoid, ateline, and cercopithecine primates to quantify interspecific variation in pubic morphology. It also provides a preliminary assessment of interspecific variation as it relates to body size, locomotor classification, and phylogeny. Landmarks were placed on pelvic scans using Polyworks and shape analysis was conducted using Procrustes rotation and PCA in Morphologika. Results reveal that pubic shape effectively discriminates between taxonomic groups, suggesting a strong phylogenetic signal in pubic bone morphology. In addition, as the inferior ramus lengthens, the symphysis acquires a more superior position relative to the acetabulum. A superiorly-oriented symphysis is associated with a straight superior ramus, rather than a U-shaped one. Furthermore, symphyseal length is not influenced by changes in either length or orientation of the pubic rami, and may be better correlated with symphyseal thickness. Finally, results indicate that a decreased inter-acetabular distance may be compensated by a U-shaped superior ramus. While individual traits have been recognized before (ex: more cranially oriented symphysis in humans), this study is different in that it provides an understanding of concomitant shape changes in the pubis.

Observer error in digitizing endobasicranial coordinate landmarks

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The repeatability, precision, and validity of anthropometric landmarks has been assessed in the context of the ectocranium, but few studies have examined the reproducibility of endocranial landmarks. This is due, in part, to the difficulty in accessing these landmarks. To evaluate the repeatability of registering endocranial landmarks with a digitizer, nineteen homologous landmarks defining the endocranial base were selected for analysis (9 Type I, 10 Type II, 7 midline, 12 bilateral). Three observers digitized 15 anatomical specimens with a coordinate measuring machine over four measurement rounds with at least four days separating each round (180 configurations total). No significant effects on shape due to individual observer or digitization were found after a Procrustes fit of the coordinate data and subsequent Procrustes ANOVA ($p < 0.0001$). Observer error was 2.52 times greater than digitizing error and the smallest level of biological variation was 3.64 times greater than observer error. Patterns of variation in the levels of measurement error were explored with a principal components analysis of the covariance matrices for observer and digitization variables. The greatest shape changes were seen in anterior frontal, posterior frontal, and internal occipital protuberance landmarks, all Type II. This study is not a measure of individual landmark location; rather, it examines the effect of individual landmarks on mean shape. Thus, data collected from multiple observers of the endobasicranium may be combined into a single data set for further analyses and hypothesis testing of shape variation and covariance of landmark configurations.

Analyses of Morphological Variation among Hominin Proximal Femora

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Since evolution is defined as a change in allele frequency over time, it is important that we maintain a meaningful way of capturing this within the context of the fossil record. To do so, we must seek to uncover the pattern and magnitude of variability amongst temporospatially isolated groups of fossil hominins. While comparisons of variation are common for craniodental remains, similar studies are greatly lacking for post crania. Since the morphology of the femur is thought to vary to accommodate functional differences between hominin groups, a great deal of debate centers on interpretations of this element. This study features a suite of approaches for assessing morphological variation among femora from Koobi Fora, Rising Star, Swartkrans, and Sterkfontein. Specifically, this study tests the hypothesis that morphological variation of the proximal femur can discriminate hominin groups, and that such variation can be used to infer functional differences among hominins. Methods are employed for reconstructing missing portions of the femur, thus drastically increasing fossil sample size (n=45) and allowing more robust statistical comparisons. Advanced geometric morphometric techniques are used to capture morphological variation. Statistical comparisons are carried out among fossil groups and between fossils and extant hominids. Estimates of variation are iteratively compared using bootstrap resampling. Results reveal that while differences in morphology can discriminate hominin groups, inferences about functional differences are overstated. At the same time, there is a punctuated shift from the morphology of the fossils to that of modern *Homo*, which can be explained by significant differences in function.

Better with age: Diet and social identity of the elderly at Kellis, Egypt through stable isotope analysis

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Growing old is a process constituting profound biological and social changes which has received little attention in the bioarchaeological literature. Research examining the experiences of the elderly has been especially limited. Considering that consumption patterns

are determined by and serve to reinforce social position, stable carbon and nitrogen values, which reflect bulk consumption, should provide details about social identity, even among the oldest age cohorts. This approach has been applied to a population from the Kellis 2 cemetery in the Dakhleh Oasis, Egypt revealing a unique dietary trend among the oldest members of society. This group exhibited $\delta^{13}C$ values significantly depleted relative to other cohorts and also suffered from severe dental loss, which may have necessitated dietary changes. The increase in C_3 plant consumption contrasts with the common usage of millet as an illness and weaning food at Kellis and suggests that individuals greater than 60 years old were experiencing biological and social phenomenon related to age, health, status, and food preference. These findings highlight the unique identity of the elderly at Kellis and encourage further analysis. Furthermore, this study provides an incentive and framework with which to examine the experiences of this social group in different times and places.

Dinaledi Chamber hominins do not support hypothesis of early African *Homo* ancestry for "Homo floresiensis" taxon based on LB1 specimen

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Hominins from Dinaledi Chamber, South Africa, provide extensive data for tests of certain phylogenetic inferences. "Homo floresiensis" advocates originally derived that hypothetical taxon from H. erectus via island isolation but after our critical analysis many shifted to derivation from African early Homo taxa previously represented by relatively few, equivocal specimens. The rich Dinaledi Chamber hypodigm (>1500 bones, >15 fairly complete individuals) now facilitates comparative testing for African early Homo ancestry of "H. floresiensis." Much sparser Liang Bua evidence comprises ≤100 identified bones, of which 62 (including the only skull and femurs) belong to LB1 alone, most of the remaining ~14 individuals comprising 1 or 2 bones each. We have shown that supposedly diagnostic "H. floresiensis" features of 380 ml endocranial volume and 106 cm stature simply are those of the developmentally abnormal type specimen LB1, materially underestimated and with numerous marked craniofacial asymmetries discounted. Even with our more accurate endocranial volume and stature estimates (430 ml; 125-135 cm), confirmed independently by others, LB1 does not resemble Dinaledi early Homo (465 and 560, average =513 ml; 144.5-147.8 cm) any more than it did normal Rampasasa Homo sapiens on Flores (1270 ml; 146 cm), Australomelanesian near-contemporaries on Palau (900-1000+ ml; ~140 cm), or regional Homo erectus (various samples). With its modest supraorbital development anterior to an asymmetric vault having a cephalic index of 80.1 (brachycephalic), LB1 is an outlier against Dinaledi hominins with their pronounced supraorbital torus development and dolichocephalic proportions consistently resembling other genuine phylogenetically earlier hominins.

Rearing history and allostatic load in adult western lowland gorillas (*Gorilla gorilla gorilla*) in human care

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Altered rearing history is a well-documented stressor for nonhuman primates with long-lasting behavioral and physiological consequences. As a chronic soma-wide stressor, effects of disrupted rearing may be best assessed using a holistic measure. We explored rearing history among zoo-housed Western lowland gorillas (*Gorilla gorilla gorilla*) using an index of allostatic load. Allostatic load (AL) is assessed by multiple biomarkers that reflect physiological dysregulation secondary to stress-induced damage accumulated over the lifespan. While manipulating nonhuman primate rearing conditions is now rare, naturally-occurring maternal neglect provides conditions wherein we may examine effects of altered rearing. We predicted mother-reared (MR) Western lowland gorillas would have lower AL than nursery-reared (NR) and wild-caught (WC) conspecifics. We obtained rearing histories and calculated AL for 27 gorillas housed at the Columbus Zoo and Aquarium between 1956 and 2014. We then used ANOVA to determine if AL differed significantly by rearing history. WC gorillas had significantly higher AL than MR gorillas ($p=0.020$). NR gorillas showed an intermediate AL not significantly different from either WC or MR gorillas. When examined by sex, AL differed significantly by rearing history only among females. Males had equal AL regardless of rearing history, whereas WC females had significantly higher AL than MR females and neither differed significantly from NR females. Combined with previous work on AL in this sample, wherein females had two-fold higher AL than males, we suggest female gorillas may face substantially more stressors in captivity than males, generating increased AL. Disrupted rearing history may exacerbate effects of these stressors.

Can dental morphology contribute to the identification of undocumented border crossers?

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Forensic anthropologists are tasked with estimating the nationality of individuals who are found deceased along the U.S. border with Mexico. This presents a challenging task, as many American Hispanics derive from the same populations as undocumented border crossers. While cranial metrics and morphoscopic analyses have been attempted, little work has been done to investigate whether dental morphology, which is thought to have a higher component of expression genetically determined, could be of use in addressing this problem. We performed two exploratory tests using data from contemporary individuals to gauge this likelihood.

First, we considered a simplified version of inter-population variation, one Mexican sample from Tlaxcala (n=39) compared to Hispanics in the U.S. Southwest, from California and New Mexico (n=174). Logistic discriminant function analysis of 14 traits correctly classified 74.36% of Mexicans and 73.33% of Hispanics. Next, we considered a more realistic approximation of variation, comparing a combined Mexican sample from Tlaxcala, Hidalgo, and Yucatan (n=91) to a combined sample of U.S. Hispanics from California, New Mexico, Florida and New York (n=420). An analysis of 12 traits yielded correct classification of 69.23% of Mexicans and 64.29% of Hispanics. Including more variation within the two samples to be discriminated lowers the accuracy. Even with refinement, dental morph is unlikely to be useful as stand alone data for estimating nationality. However, these better than chance results indicate that they may be of use if combined with other data, such as form cranial measures and morphology.

Porotic hyperostosis and cribra orbitalia over the Mesolithic-Neolithic transition in the Danube Gorges, Serbia

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The most commonly reported pathologies in archaeological collections are porotic hyperostosis on the cranial vault surface and cribra orbitalia in the orbital roofs, both macroscopically visible as constrained areas of pitting and porosity, and both being manifestations of diploë expansion. Hemolytic and megaloblastic anemias are the most likely causes of porotic hyperostosis, while other pathological processes can also lead to orbital

roof lesions. Based on this proposed etiology, the aim of this study was to reconstruct health status and living conditions of the inhabitants of the Danube Gorges, Serbia over the Mesolithic-Neolithic transition by comparing the prevalence of these two conditions.

Here we present results of a gross anatomical study of porotic hyperostosis and cribra orbitalia spanning the farming transition in a sample size of 113 individuals from four archaeological sites in the Danube Gorges, Serbia (Vlasac, Lepenski Vir, Hajdučka Vodenica and Padina; c. 9500 - 5500 BC). The results show a high prevalence of porotic hyperostosis (89%) and a low prevalence of cribra orbitalia (13%). No major change in prevalence of these pathologies was observed through time.

In the light of this evidence we suggest that nutritional and sanitation factors are probable causes of porotic hyperstosis and cribra orbitalia in this region. Our findings have useful implications for other studies of chronic/episodic malnutrition and infectious disease spanning the farming transition elsewhere.

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Assessing the relationship between mandibular shape and endocranial volume

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We present a methodology with potential predictive capabilities of isolated mandibles with unknown cranial association. The shape of the mandible is affected by cranial size. One reason for the relationship between cranial size and mandibular shape is the correlation of mandibular and cranial size, while another reason is the configuration of the jaw musculature that attaches to the cranium. The direction of the pull of the temporalis muscle from its origin at the coronoid to its insertion on the cranium is impacted by the width of the braincase. A more medial pull is present when the attachment of the temporalis is closer to the midline (when the braincase is narrow superior to the cranial base) and a more lateral pull is present when the attachment is on the lateral aspect of the cranial vault (when the braincase is expanded superior to the cranial base).The direction of these forces potentially impacts the flare of the ramus in relation to the midline and depth of the mandible. We tested whether this mechanism produces a covariance between mandibular shape and endocranial volume. Using 3D geometric morphometrics, we analyzed the shape of mandibles and associated cranial vaults of several modern adult *Homo sapiens* populations. We applied geometric morphometric methods to compare mandibular shape variables with the centroid size (used as a proxy for endocranial volume) of associated calvariae. We found strong evidence for covariance between mandibular shape and centroid size.

Preliminary analysis of zygomaticotemporal sutural complexity in relation to diet in haplorhine primates

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Cranial suture complexity, defined as the degree of interdigitation, varies in relation to the mechanical demands of the skull. These sutures link cranial bones together, allowing movement between parts of the skull during growth, but also create areas of potential weakness in the presence of high loads. To combat this, increased interdigitation of the bones is thought to minimize and/or mitigate these loads. The zygomatic arch experiences considerable masticatory loading during feeding and the zygomaticotemporal suture, the single suture on the arch, is assumed to experience similar loads. Byron noted that increased sagittal sutural complexity tracked with mechanically resistant diets in *Cebus* but it has not been shown that this pattern extends to other cranial sutures. If greater loading promotes increased sutural complexity, then sutures in close proximity to the masticatory complex (e.g., zygomaticotemporal suture) are predicted to reflect differences in diet type.

This project tests if complex zygomaticotemporal sutures are consistently associated with primates eating more mechanically resistant foods compared with those eating less resistant foods.

Data on sutural complexity were collected from microCT scans of zygomatic arch cross-sections from 6 species of haplorhine primates (n=38). Primates were separated into two dietary groups (mechanically resistant and non-mechanically resistant) according to dietary material properties. Sutural complexity was measured using fractal analysis. Pairwise comparisons of midsuture cross-sectional measures between closely related taxa of differing dietary group revealed significant differences ($p<0.001$) between pairs. This suggests mechanically resistant feeders have relatively more complex sutural morphology.

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Energy expenditure and physical activity levels in captive tufted capuchins (*Cebus apella*)

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Previous research has shown a marked difference between the energy expenditure levels of primates as a group and other placental mammals, but little is known regarding interspecific variation within the primate order. In this study we investigated total energy expenditure, TEE (kcal/d) in captive tufted capuchins (*Cebus apella*, n=11, ages 8-36), a frugivorous and large-brained New World monkey, in order to compare their metabolic rates with other placental mammals and primates. For each subject, we used the doubly labeled water method to measure TEE over a 14-day period, during which we also recorded 20 hours of physical activity data via focal observation. These data were then compared to previously published TEE data collected from other primates and placental mammals. Capuchin TEE was similar ($p=0.67$) to other, less encephalized New World primates (*Callithrix* and *Alouatta*) in multiple regression controlling for body mass. Like other primates, capuchin TEE was 43% below that expected for a placental mammal of similar body mass. We discuss the effects of physical activity on daily energy requirements and the implications of these data for capuchin foraging, life history, and evolution.

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Investigating the Effects of Dental Wear on the Scoring of Morphological Traits

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As teeth wear throughout life, distinctive morphological features become obscured and sometimes entirely obliterated. Studies of dental morphology often rely on determining and comparing relative frequencies of these features within and between populations. Heavy wear can lead to mis-scoring of dental features yet the true extent to which wear affects the scoring of dental traits is difficult to investigate directly. Studying how a tooth wears through life would require decades of observations, or destructive methods to artificially wear specimens. Previous investigations have therefore drawn inferences from population frequencies without observing the effects of wear directly. This study presents a novel approach to investigating the effects of dental wear on tooth morphology by using destructive methods on 3D scans of human dental casts, rather than a physical sample, to directly observe the effects of wear.

Dental casts of ten maxillae were chosen and 3D models were processed to simulate progressive wear at three stages: light, moderate, and heavy. Three traits - incisor shoveling,

tuberculum dentale, and Carabelli's cusp - were scored at each stage according to the Arizona State Dental Anthropology System. While previous studies have found "downgrading" of trait scores to occur when observing heavily worn teeth, this study found both "downgrading" and "upgrading" to occur at similar rates. Such occurrences may indicate that observations of worn teeth are more prone to mis-scoring than previously thought, particularly in archaeological or paleontological contexts. Utilizing this method standards may be developed which characterize how dental features wear, thereby aiding in accurate scoring.

Paternal age at conception predicts offspring telomere length in chimpanzees to a greater degree than in humans

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Telomeres are repeating non-coding DNA sequences at chromosome ends. Telomere length (TL) is of growing interest to anthropologists because of its potential role in senescence, life history allocations, and intergenerational plasticity. TL declines with age in most human tissues, and shorter TL is thought to cause earlier senescence. Surprisingly, older men have sperm with longer TL; correspondingly, older paternal age at conception (PAC) predicts longer TL in offspring. The multi-generational effect of PAC on TL could contribute to a unique form of transgenerational genetic plasticity that modifies physiologic function in response to a relatively stable cue of recent ancestral experience and behavior.

The PAC-effect has not been examined in any mammals aside from humans. Here we examine the PAC-effect in captive chimpanzees (*Pan troglodytes*). The PAC-effect on TL is thought to be driven by the continual production of sperm—the same process that drives increased *de novo* mutations with PAC. Since chimpanzees have 3.4x larger testis than humans and a 50% greater sperm mutation rate with PAC than humans, we predict that the PAC-effect on TL will be greater in chimpanzees than it is in humans. Preliminary analyses of 40 chimpanzees and 144 humans showed increasing TL with PAC in chimpanzees ($p=0.007$) with a β -1.46x the chimpanzees age-related decline in TL. Consistent with our prediction, the PAC-effect on TL is an estimated 5.67x greater in chimpanzees than in humans ($p=0.003$). Examination of the influence of grandpaternal age at conception on chimpanzee TL is planned.

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Female power in a male-dominated society: Simulating how female kin reunite in hamadryas baboons

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In species with female dispersal, we typically assume that females live with unrelated individuals and thus have few opportunities to benefit from kin selection. This problem is particularly acute for hamadryas baboons, *Papio hamadryas hamadryas,* which have arguably the most male-dominated social system among primates. Males target individual females to aggressively take over from other males and add to their own one male unit, separating female kin in the process. Recent genetic research, however, suggests that adult females are often closely related within their one male unit. How female kin reunite is unclear. We created an agent-based model of hamadryas baboon demography and social dynamics to investigate whether this might happen by chance, via male choice, or through some female influence. We used data from the Filoha field site in Ethiopia to construct our model population and probabilistic events. The simulation also tracked the complete lineage of each individual to generate detailed kin relationships. We then ran separate simulations including male preference for closely related females and female preference to join kin upon dissolution of their one male unit. We compared the resulting kin biases to the genetic data available. Our findings lend support to the hypothesis that some behavioral mechanism leads to females rejoining their kin in one male units as adults, and that females themselves play a role in causing it. We plan to apply this simulation to investigations of male cooperation, the evolution of multi-level societies including hominin social evolution, and interspecies comparisons of social behavior.

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Getting the shaft?: investigating midshaft location in immature femora

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In immature femora, diaphyseal breadths have traditionally been measured at 50% of diaphyseal length. However, research on the Denver growth sample suggests that 45.5% of diaphyseal length in younger individuals best represents the most analogous position to the 50% midshaft location in adult femora with fused epiphyses. Currently, direct comparisons have not been made between measures at 45.5% and 50% diaphyseal length. Lack of methodological consistency could affect comparisons across studies of immature skeletal remains.

Here, we analyze immature (birth-13 years) femora from several archaeological skeletal assemblages (n=170) to determine whether significant differences are present in anterioposterior (AP) and mediolateral (ML) breadths between the two diaphyseal locations. A repeated measures ANOVA indicates significantly wider AP and ML breadths at 45.5% when compared with 50% in all archaeological populations. Additionally, age is positively correlated with increases in AP breadth at 45.5% diaphyseal length. Morphological differences in the two locations support current understanding of shaft development and biomechanical changes with age. Our preliminary data suggests that studies utilizing one location are not directly comparable to those utilizing the other. Future research will compare diaphyseal length and total bone length in radiographs of modern children to determine the more accurate midshaft location.

Biological affinities of Manasota Period populations in Southwestern Florida as derived from dental nonmetric traits

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Discrete dental traits are shown to be under strict genetic control. With heritability approaching 0.8-0.9 for h^2, the examination of such traits can be useful for discerning biological affinities. Biological relationships among Pre-Columbian southwestern Floridian populations are unknown, mostly due to a lack of modern descendants in the region and an unclear archaeological record. This study measured biodistance of Manasota Period (500 B.C. to A.D. 500) populations through dental nonmetrics, as scored with the Arizona State University Dental Anthropology System (ASUDAS). One hundred seven individuals from seven sites in four southwestern Florida counties were scored for 38 traits. Sample choice was limited due to poor preservation and extensive dental wear (abrasion). Raw ordinal scores were subject to a Kendall's tau-b

correlation analysis to reduce the number of traits to 15 that were uncorrelated. Features were dichotomized into present or absent. Results demonstrate a high frequency (>40%) of a hypocone on UM1, a fifth cusp on LM1, presence of shoveling on the upper incisors, and a Y groove pattern on LM1 in all sites. Individuals at two sites, Manasota Key and Palmer Burial Mound, possess talon cusps, which are rare dental anomalies. Both talon cusps are found on the maxillary left lateral incisor. Population affinities were compared using C.A.B. Smith's Mean Measure of Divergence (MMD). This study demonstrates that geographic distance does not equate to genetic difference in these populations as well as the usefulness of utilizing dental nonmetric traits in the examination of biological affinities.

Geological and taphonomic context of excavations within the Rising Star cave system

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To date, over 1550 fossil specimens have been recovered from the Dinaledi Chamber within the Rising Star cave, South Africa. Cranial and postcranial remains of at least 15 individuals have been recovered and have been attributed to a novel species, *Homo naledi*. Only a small portion of the remains in the chamber have been collected, but all macro-vertebrate fossils are exclusively hominin. The fossil material occurs within clay-rich sediments derived from in situ weathering, and exogenous clay/silt which entered the chamber through fractures that prevented coarser-grained material from entering. Geological investigations suggest that the chamber was always in the dark zone, and inaccessible to other large mammals. Taphonomic analyses indicate that at least some of the individuals reached the chamber intact, with disarticulation occurring during/after deposition. Although dates are still pending, the hominin remains appear to have accumulated over a period of time as older mudstone units and sediment along the cave floor eroded out. This presentation introduces the geological setting of the Dinaledi Chamber within the Rising Star cave system, our excavation work, and reports on our ongoing efforts to understand the context of the fossil material.

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Identifying Scurvy on Infant Remains on the Southern Plains

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Little has been published regarding the presence of scurvy in Late Prehistoric Southern Plains groups. This deficiency stems from a lack of excavated, sizeable skeletal collections from the region. Additionally, many collections were examined prior to the development of modern differential diagnosis techniques for scurvy from other diseases with similar lesions.

This study re-analyzed the skeletal remains from the McLemore site (34WA5), a Late Prehistoric Plains Village site (1300-1400 A.D.), located in Washita County, Oklahoma, in order to pinpoint paleopathological indicators that help explain the high subadult mortality. The collection consists of 65 complete and partial individuals, 65% of which were subadults. Previous analyses completed in 1989 focused on the adults, and only subadult paleodemography was reported. Initial hypotheses proposed that the high subadult mortality was irregular, likely due to widespread infection. Further paleopathological inspection found morphological indicators of scurvy in the subadults including endocranial vascular lesions, sphenoidal, and mandibular lesions, affecting forty percent (40%) of the subadults (n=17). Of the 17 individuals with evidence of scurvy, six were newborn infants less than six months, one was a fetus approximately 37 gestational weeks, and ten cases were observed on infants between six months and two years of age (n=5), and children between the ages of three to twelve (n=5). No adult cases of scurvy were observed. These results suggest scurvy did affect Late Prehistoric Southern Plains groups, probably more frequently than is understood currently. Further research is needed on existing collections to investigate the commonality of scurvy in the region.

Reproductive seasonality in two sympatric primates (*Ateles belzebuth* and *Lagothrix poeppigii*) from Amazonian Ecuador

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Utilizing a long-term data set, we investigated seasonality in mating behavior and births in two sympatric ateline primates (*Ateles belzebuth* and *Lagothrix poeppigii*) at the Tiputini Biodiversity Station (TBS) in Amazonian Ecuador. In both species, an overwhelming majority of observed copulations took place between August and February (>90% of 61 copulations for *Ateles* and >85 % of 56 copulations for *Lagothrix*), with November being the month in which the largest number of copulations were seen for both species. Gestation length for these two primates lasts 7 to 7.5 months. Accordingly, most infants were born between April and October. In fact, in *Ateles*, all but two of 32 known births occurred during this time period. The seasonality of births may be even more constrained in *Lagothrix* for which all known births (n = 23) occurred between May and September. At TBS, May historically marks a time period when fruit, a preferred food source, becomes scarce. A trend towards giving birth when preferred foods are scarce is seen across the ateline clade (*Ateles, Lagothrix,* and *Brachyteles*), while conception often occurs when preferred food sources are more abundant. Given females' role in initiating sexual behavior in many atelines – and given the marked seasonality of mating behavior and births – it is plausible that body condition must exceed a minimum threshold before females show proceptive behavior or are able to conceive. Combined behavioral and endocrine studies are needed to evaluate seasonal changes in ovarian cyclicity and female sexual motivation.

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Population genetic evaluation of tooth size reduction in Late Pleistocene and Holocene Europe: A reappraisal of Brace's hypothesis using modern human teeth

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This project uses a population genetics models to determine if genetic drift or natural selection produced reduction in human molar size for the last 30,000 years in Europe. The data were collected from the Anthropological Data Free website. The database includes tooth measurements spanning the Aurignacian to Medieval periods. Bucco-lingual and mesio-distal measurements were converted to crown areas. Population genetic models that estimate the effective population size necessary to reject genetic drift based on differences between average tooth measurements across a specified time span were calculated (N*). Effective population sizes were too large to reject genetic drift as an explanation for tooth reduction between the Aurignacian and Medieval periods and vast majority of cultural transitions between these two time periods. However, genetic drift was rejected as an explanation for tooth size reduction during several isolated cultural transitions: Mesolithic-Linear Pottery transition (N*M1 = 4762, N*M2 = 4354), Late Upper Paleolithic-Early Mesolithic (N*M2 = 1584), Early Mesolithic-Mesolithic (N*M2 = 5280), and Early Mesolithic-Mesolithic (N*M3 = 5280). These results argue that neutral mutation and isolation were the likely drivers of tooth size reduction in Europe between the Aurignacian and Medieval periods. That said, it remains important to point out that natural selection for tooth size reduction characterizes several important cultural transitions. The study argues that genetic drift interspersed with periods of natural selection during crucial cultural transitions were the likely drivers of tooth size reduction in Europe and that bioarchaeological research should incorporate population genetic models in evaluating morphological change over time.

Cadaver Decomposition and the Persistence of Human DNA in the Underlying Soil

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Cadaver decomposition frequently occurs in close contact with a diverse soil environment that is drastically altered as decomposition progresses. Despite this, there is still much to be learned involving the impact human decomposition imposes on associated soil, including the fate of important cadaveric materials (i.e., human DNA).

DNA can serve as a source of carbon, nitrogen, and phosphorous for microbial consumption; therefore, understanding its fate ameliorates our understanding of soil processes and dynamics. This study evaluated the persistence of human DNA in soil during different stages of human decomposition. End-point PCR was used to assess the presence or absence of human nuclear and mitochondrial DNA, while qPCR was used to evaluate the quantity of human DNA recovered from the soil beneath four cadavers placed at the University of Tennessee's Anthropological Research Facility (ARF).

Human nuclear DNA from the soil was largely unrecoverable throughout decomposition, while cadaver mtDNA was detectable in the soil throughout all decomposition stages. Though there was a clear trend in mtDNA copy number, copy number was not significant between decomposition stages following Mann-Whitney U pairwise comparisons with an adjusted significance (p>0.05). Moreover, when tested against additional variables including soil chemistry and *Bacteroides* quantities using a repeated measures ANCOVA, only *Bacteroides,* a human-associated bacteria, was a significant predictor of mtDNA copy number (F= 12.81, d.f.= 1, 13, p= 0.0034).

This study supplements the growing body of literature in forensic soil taphonomy; it has potential to inform and improve current and future post-mortem interval estimation (PMI) models.

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Bioarchaeological profile of three ancient high altitude sites in Mustang and Manang districts, Nepal

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The Himalayas provided a challenging environment for early human settlers. Despite the high altitude risks of hypoxia and cold stress, difficult terrain, and limited resources, populations persisted and established complex polities, including those in western Nepal. This study examines three archaeological sites from this region for a comparative analysis of the bioarchaeological profile among populations that shared both the constraints of high altitude living (average elevation 3850m) and the mortuary practice of above ground burials in shaft tombs and/or caves. The variables considered include markers of dental disease, non-specific stress, and trauma. Two sites are located in the Mustang district: Mebrak (400 cal BCE-50 cal CE), with 42 individuals (10 subadults, 32 adults); and Samdzong (400-650 cal CE), with 105 individuals (38 subadults, 67 adults). Kyang, located in the neighboring Manang district, is roughly contemporaneous with Mebrak, with 23 individuals (3 subadults, 20 adults). Results show no significant difference in the total adult sample comparisons of markers of dental disease and non-specific stress; the only significant difference is in the comparison of the males among sites, with the highest rate of carious lesions in Mebrak males (χ^2(2, N=35)=8.203, p=0.017). Both Mustang sites also have notable cases of interpersonal violence. It was expected that shared environmental challenges of high altitude living would result in similar bioarchaeological profiles, although it may be that local variation in environment, cultural buffers, and/or historically contingent factors may have led to differential exposure to stress in these populations, contributing to varied rates of these markers.

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Integration of contextual information with bioanthropological data from skeletal collections

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Physical anthropologists examine human remains from various contexts, including historical research collections, archaeological excavations and forensic investigations. As a consequence, analyses rely on a broad range of contextual information, varying between institutions, sites, campaigns and cases. We propose solutions how to formally express such connections within our recently presented digital framework for managing research data in skeletal collections, which is formulated as an ontology complying with the resource description framework (RDF).

Seven skeletal collections with different profiles were surveyed to assess what contextual information is available with reference to the human remains they are holding. Possible relations to materials, processes and agents in bioanthropological studies were recorded or inferred. These findings were complemented by contextual information that might occur in research that was not represented by the collections under study.

Building on the existing framework, mechanisms were developed to represent the types of reference identified in the survey. This process was guided by the principle of parsimony, introducing as few RDF classes and properties as possible, while keeping the ontology complex enough to identify analogous and compatible entities across different contexts.

The resulting ontology provides simple mechanisms for expressing a wide range of references to provenance, geographical and spatial origin, association with structures, documents, people and organizations as well as inventory and classification systems. It is ready for implementatin in semantic web applications and will be part of a software that is currently being developed. Queries on such systems can draw on semantic inferences provided by the RDF.

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Determinants of terrestrial feeding in an arboreal primate: the case of *Hapalemur meridionalis*

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The proximate and ultimate determinants that may have prompted the shift from an arboreal to terrestrial feeding niche, whether due to environmental change, seasonality, and/or predation pressure, are poorly understood. Within a fragmented littoral forest in southeast Madagascar, a strepsirrhine population of the typically arboreal genus *Hapalemur* spends a large proportion of time on the ground. We therefore aim to identify the costs and benefits imposed on feeding terrestrially by an arboreal primate. From January to December 2013, we observed three social groups of southern bamboo lemurs *H. meridionalis* for 1,762 h, recording continuous feeding time on all food items separated by strata (arboreal or terrestrial), and biochemical analyses on each item for dietary quality comparisons. Considering only full-day focal follows (n=106), our model predicted increased terrestrial feeding by both seasonal factors (cooler temperature and decreased precipitation) as well as metabolizable energy in the diet, but not by protein/fiber ratio or by canopy exposure. Despite the lack of difference in canopy exposure between the two feeding strata, however, focal subjects fed more closely to a conspecific when on the ground, suggesting increased vigilance. Our study provides empirical evidence for an ultimate origin of terrestriality, suggesting a seasonal alternative to increasing metabolizable energy intake. Coupled with the disturbance of the habitat, our results suggest that the initial expansion to a terrestrial dietary niche occurred when the nutritional pay-off was greater in the new strata and predation risk was even (or less) compared to the original arboreal stratum.

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Simple gifts aid others to learn to use tools: a platyrrhine example

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How do social partners provide scaffolding for novices mastering the use of a hand tool in the absence of language and established human culture? We address this question with findings from observations of sixteen immature wild bearded capuchin monkeys (*Sapajus libidinosus*) learning to use stone hammers and anvils to crack palm nuts, and concurrent observation of their companions. The nut-cracking activity of others dramatically impacts immature monkeys' behavior during the several years when they cannot open nuts themselves. Immatures are strongly attracted to sites where others are cracking. Rates of immatures' nut-related actions are elevated when others are cracking, and subside to baseline levels in an exponential manner after others cease cracking. Elevation of presence near an anvil and manipulation of nut debris both last several minutes after cessation of cracking. The enduring presence of stone hammers and nut debris (artefacts) at anvil sites provides an opportunity for immature monkeys to engage in persistent practice of actions related to nut-cracking regardless of others' current activity, and to practice these activities outside of the competitive context of feeding. This example illustrates how animals can make tool use more likely to be learned by novices through the immediate influence of their own tool-using behavior and through enduring alteration of the physical environment consequent to their use of tools. The two influences work synergistically in bearded capuchins. Traditions of tool use can be maintained by simple gifts of behavior and artefacts in these monkeys. Research approved by CNPq, Brazil, n° 002547/2011.

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Hybrid speciation in amphibians: synergy, conflict, and sex chromosomes of allopolyploid genomes

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Hybridization can lead to gene flow between species, and also the formation of new species, including "allopolyploids" whose chimerical genome is derived from two ancestral species. Allopolyploid speciation was particularly common in the evolution of African clawed frogs (genus *Xenopus*), raising the question of whether there are advantages to speciation via genome duplication associated with hybridization. Our work suggests that sex chromosomes may be an important factor, and in particular that species with young sex chromosomes may more readily undergo allopolyploidization. Our findings shed light on factors that influenced evolution of early vertebrates after whole genome duplication, and also the role of hybridization, gene duplication, and sex chromosomes in more recently evolved lineages, including primates.

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Can fossil hominin pelves be sexed using standards developed for modern humans?

JENNIFER EYRE. Anthropology, New York University, Anthropology, The New York Consortium in Evolutionary Primatology..

The modern human bony pelvis is sexually dimorphic because the female pelvis must function in birth and locomotion while the male pelvis is only subject to the latter pressure. Although the pelvis is a reliable indicator of sex in modern humans, it is unclear if the same standards can be applied to fossil hominins. There is little sexual dimorphism in the pelves of humans' closest living relatives, chimpanzees. It is unclear when in the hominin lineage the modern pattern of sexual dimorphism arose.

This study tests if standards based on modern humans can be applied to South African fossil hominins by using the Phenice (1969) method to score sexually dimorphic traits. Original fossils were examined and each trait (when preserved) was scored. Pelves belonging to *Australopithecus africanus, Australopithecus sediba* and *Paranthropus robustus* lack variation in these character states. Thus it may be inappropriate to rely on modern human standards when using the pelvis to sex individuals from these species. For example, based on the width of the sciatic notch, all the pelves included in this study would be sexed as female, suggesting that a wide sciatic notch is a primitive feature in the hominin lineage. Caveats include the fact that there is a paucity of pelvic remains, and many are fragmentary, thus not preserving the appropriate morphology. Potentially if a larger sample was available more variation would be observed. Additionally, there can be dimorphism in traits not included in the Phenice method, such as the shape of the birth canal.

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Action Grammars - Extraction, recognition and prediction of movement primitives in tool-making

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Understanding and predicting human motion and behaviour is of importance to a variety of fields. Motion Capture recordings of the human hand and body provide accurate body position information with high spacial and

temporal resolution. Applications that benefit from this technology range from robotics and assistive technologies, to clinical measures and basic neuroscience. Here, we focussed on tool-making, an activity closely linked to human brain evolution, which to date, has been difficult to analyse using standard anthropological methods. We took a computational approach to overcome this hurdle have combined our latest generation Motion Capture technology with novel quantitative algorithms that decomposes the continous kinematics of the body and hands into a symbolic structure, we termed motion primitives. We applied this method to quantify data we obtained from daily-life behaviour in a "studio flat" and contrasted this with Oldowan and Acheulean tool making by expert modern-day subjects using computational models of grammars. Among other things, we found that tool-making behaviour is variaiable at the level of individual actions, but highly predictable in its hierarchical sequence of actions. We found that to a surprising degree the manipulative complexity of tool-making activity is larger than most modern daily-life activities and characteristic markers of different complexity across tasks. While our quantitative behavioural analysis using modern-day tool-makers cannot directly the cognitive capacities or strategies used by extinct hominine species, our technologies and methods help to clarify the complexities of evolutionarily significant behaviours.

The Anthropology of Forensic Identification in Texas

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The rise in migrant deaths at the South Texas Border has created a humanitarian crisis. The dead have been buried as “unknown” without proper analyses or DNA collection, leaving no hope of identification. In response to this situation, Baylor University and University of Indianapolis faculty and students performed voluntary exhumations of these burials for the purpose of skeletal analysis and DNA sampling in hopes of completing identifications. Because the Forensic Anthropology Center at Texas State (FACTS) has large scale storage, processing, and analysis capabilities, many exhumed remains were brought to FACTS. FACTS faculty and students are helping to identify and repatriate these individuals to their families. As little is known about this group of migrants and their reasons for migrating, a full suite of data is collected including osteometrics, markers of developmental stress, age and sex, bone histology, dental pathology, DNA samples, and complete dental charting and radiographs for each individual. All data collected is used to aid in positive identification and repatriation, to better understand this population group, to further research and develop identification methods, and to explore and understand the human variation of modern population groups.

Our findings suggest that the individuals exhumed from Brooks County likely represent migrants with differing levels of SES that may have different reasons for migrating from other, traditional migrant groups. This group requires population-specific methods for metric sex estimation and contains multiple individuals that fall outside the range of variation of the forensic reference groups used to estimate ancestry.

Opportunistic Blitz Research: “What can you tell me about these bones?”

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Biological anthropologists often receive calls requesting that we examine human osteological materials in private collections, in a relatively short time period with limited resources. In this paper we suggest that such cases provide unique research opportunities, despite limitations, and parallel some field situations. We were contacted about two privately-owned skulls (A, B) and had only an afternoon to assess them. We gathered photographic, qualitative, and quantitative data on 37 variables to assess osteometric dimensions of sex, age, and ancestry for both. Our results show that Skull A, a young female (18-25 years) of Asian ancestry, was clearly a commercially-prepared, hemisected teaching specimen, with modern side hinges and retaining springs on the mandible. Skull B appeared to be exhumed, based on its overall condition, and prepared for exhibit, as evidenced by mandible hardware. Analyses suggest the skull was an older male (35-45 years) with Oceanic ancestral affinities. Skull B presented evidence of a surgical procedure, similar to trephination, with healing in progress. A blunt trauma fracture on the left side of skull may have necessitated the procedure. Our application of basic osteological assessment methods benefited the owner and the anthropologists. The former is better informed and, on the basis of our interaction, has agreed to further analyses of Skull B. We gained access to material which can provide insights into Oceanic culture, and which would not otherwise be available to us. We argue that such material constitutes a novel research resource with significant potential for yielding valuable data.

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Maternal environment, prenatal stress, and offspring cortisol reactivity: A meta-analysis

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During pregnancy, placental enzymes buffer the fetus from maternal cortisol. Maternal stress, from undernutrition, disease, or psychosocial pressures, causes a rise in endogenous cortisol. This excess can overwhelm the placental barrier, influence fetal development, and cause long-lasting changes in infant responsivity to stressors, increasing their risk of developing behavioral and mood disorders. To investigate the influence of maternal stressors on infant cortisol responsiveness we conducted a literature search in PubMed combining terms: *maternal*, *prenatal*, *stress*, *infant*, and *cortisol*. We excluded 81 of 99 papers returned because they focused on substance abuse, which introduces several confounding factors, or failed to characterize maternal stress. We extracted data on stressors, infant age, and pre-/post-stressor change in infant delta cortisol. After standardizing units of measurement, we ran iterative models to evaluate the predictive significance of stressor categories on delta cortisol. The best fit model (R^2=0.89) included: maternal stressor (infants whose mothers were depressed or had elevated cortisol had significantly higher delta cortisol than low socioeconomic status, early life stress and control categories: $p<0.0001$); infant stressor (pain and frustration were associated with higher delta cortisol than separation, fear and physical stressors; $p<0.0001$); and interaction between maternal and infant stressor ($p<0.0001$). Without adequate characterization of maternal stressors studies exploring variation in infant cortisol response may miss important influences in fetal development. These results suggest that future studies should consider maternal affective state, nutrition, and measures of psychosocial stress together as these appear to explain a significant portion of variation in infant cortisol response to stressors.

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Alternative reproductive tactics among male chimpanzees in Gombe National Park, Tanzania

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Male chimpanzees sometimes employ sexual coercion to constrain female choice and increase their reproductive success. Alternatively, they may sometimes obtain increased reproductive success by trading grooming for mating opportunities. The efficacy of these strategies likely varies between both individuals and communities according to demography and male dominance structure. In Gombe National Park, sexual coercion, in the form of long-term patterns of aggression, is associated with increased reproductive success primarily for high-ranking males. However, many males manage to sire offspring without being high ranking or highly aggressive towards females. We analyzed a 17-year sample of behavioral and genetic data from Gombe to test the hypothesis that affiliative behavior increases male reproductive success. In a preliminary analysis, we found that *high-ranking* males were more likely to sire offspring with females who they groomed frequently (GLMM, $p = 0.04$), controlling for female age, dyadic relatedness, and dyadic rates of long-term aggression. In a separate analysis, we found that *all* males were more likely to sire offspring with females with whom they associated at high rates (GLMM, $p < 0.01$), controlling for female age, dyadic relatedness, dyadic rates of long-term aggression, and male rank. Thus preliminary results suggest that male-female grooming and affiliation are positively associated with male reproductive success, independent of coercive aggression, and may represent a viable alternative to sexual coercion. Future work will add additional reproductive events to increase sample size and employ an information-theoretic approach to determine best predictors of paternity.

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Shape analysis of the proximal phalangeal articular surface of pedal phalanges in extant anthropoids and fossil hominins

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Dorsal canting of the pedal proximal phalangeal base has been proposed as diagnostic of bipedalism in the fossil record, and has been used sometimes in isolation to reconstruct hominin locomotor behavior. When quantified using angular metrics, however, human-like dorsal canting overlaps with *Gorilla* and *Pan*, and even with terrestrial cercopithecoids in the non-hallucal proximal phalanges, thereby complicating functional interpretation of hominin fossils. Here we explore shape variation in the proximal phalangeal base of the first, third, and fifth rays using three-dimensional geometric morphometrics (3DGM) among shod and unshod humans, a diverse sample of anthropoids, and fossil hominins. Major shape differences among species in proximal phalangeal base morphology were captured by the first two principal components, and MANOVAs and post-hoc tests revealed significant differences among clades and serve to separate humans from other species. In the hallucal phalanx PC1 is driven by dorsal canting, which separates humans from all other extant taxa sampled, and this is probably related to its specialized biomechanical role in human "toe-off". PC2 was the discriminating axis for human-like canting in PP3 and PP5. *Homo sp.* from Ileret (KNM-ER 64062) and *Homo naledi* most closely resemble modern humans in dorsal canting morphology, whereas *Ardipithecus kadabba, Australopithecus afarensis* and *Homo floresiensis* fall intermediate between humans and great apes in morphospace. These results suggest that phalangeal base morphology is less derived than metatarsal head morphology in some fossil hominins, perhaps due to the dual functional roles that the pedal phalanges play in arboreal pedal grasping and terrestrial bipedalism.

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The shoulder and upper limb of *Homo naledi*

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The recently announced species, *Homo naledi* (Rising Star Cave, Cradle of Humankind, South Africa), combines an australopith-like cranial capacity with dental characteristics more akin to early *Homo*. Its postcranium is similarly mosaic; although the hand, foot, and lower limb share many derived characteristics, the *H. naledi* shoulder girdle and upper limb is strikingly primitive. Here, we describe the *H. naledi* upper extremity (exclusive of the hand) in greater detail and place it in comparative context with extant hominoids, *Australopithecus*, and key specimens attributed to early *Homo*.

Homo naledi is characterised by a short clavicle and humerus with extremely low torsion. This suggests that the scapula – with a markedly cranially-oriented glenoid – was situated superiorly and laterally about the thorax. This configuration is similar to that of *Australopithecus* and distinct from the modern human shoulder girdle, which is positioned low and dorsally about the thorax. Early African *Homo erectus* is derived in scapular morphology, but also maintains primitive clavicle and humeral features.

The evolution of the hominin shoulder girdle appears to have occurred in concert with a behavioural shift from an upper limb involved predominantly in locomotion to one adapted for manipulation. Throwing adaptations may have also influenced more recent transitions, especially with regards to features that characterize the modern human shoulder girdle. However, the overall picture evinced by the *H. naledi* upper limb is one that is markedly primitive, retaining morphology conducive to climbing, and lacking many of the derived features purported to characterize other members of *Homo*.

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Patterns of Morphological and Genomic Variation Among Different Regional Groups in Mexico

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Mexico's vast historical and cultural characteristics are due in part to the legacy of indigenous groups residing in the country and the prior arrival of Spaniards. This diversity has been supported by genetic studies revealing a significant amount of genomic diversity within Mexico. The present study attempts to analyze the relationship between neutral genetic variation and morphological traits in Mexican populations by examining an anthropological data set collected by Marcus Goldstein in 1943 from the northern and central regions of Mexico, as well as data from two modern skeletal collections located in the central and southern regions of Mexico. Previously published microsatellite data

from indigenous groups in Mexico, Spaniards and Afro-indigenous groups was analyzed with the STRUCTURE software to identify correlations between genetic ancestry and morphological traits. A positive correlation was found between stature and intralimb proportions for groups in the central region of Mexico and Native American ancestry, while a negative correlation was found in groups from the northern and southern regions when examined against the Afro-indigenous groups. In addition, unsupervised model-based clustering methods revealed a K=3 cluster-model for stature and intralimb proportions within Mexico. Further analysis suggests a clinal distribution on male stature from north to south, with groups becoming shorter. Results from this study suggest that morphological trends within Mexican populations provide similar clustering trends from previous genomic work. The examination of multiple biological datasets, as hereby proposed, can provide new insights as to how to proceed when selecting an appropriate identification technique in a forensic context.

Keeping Up with the Kids: Mobility patterns of young individuals from the St. Mary Magdalen Leprosy Hospital (Winchester)

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Leprosy is one of the few specific infectious diseases that can be studied in bioarchaeology due to its characteristic debilitating and disfiguring skeletal changes. Leprosy has been, and continues to be, one of the most socially stigmatising diseases in history, over-riding all other aspects of social identity for the sufferers and frequently resulting in social exclusion. This study examines the stable isotopic evidence of mobility patterns of children, adolescents, and young adult individuals with the lepromatous form of leprosy in Medieval England (10^{th} – 12^{th} centuries AD) to assess whether the individuals buried with the disease were non-locals, possibly from further afield. Enamel samples from 19 individuals from the St. Mary Magdalen Leprosy Hospital, Winchester (UK) were selected for strontium ($^{87}Sr/^{86}Sr$) and oxygen ($\delta^{18}O$) stable isotope analysis based on age at death (<30 years), the presence of bone changes associated with lepromatous leprosy, and the underlying geology of their burial locations. The results from these data indicate that the St. Mary Magdalen Leprosy Hospital received an almost equal mixture of local and non-local individuals from further afield, including early pilgrims. At present, the St. Mary Magdalen Leprosy Hospital is the earliest dedicated leprosaria found within Britain and mobility studies such as these can help elucidate and test some of the broader historical notions and identities associated with the movements of those infected with the disease in Medieval England.

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Videographic analysis of kinematics in great apes: To what extent are gait and posture conserved?

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The great apes provide a point of reference for understanding the evolution of locomotion in hominoids and early hominins. Great apes habitually walk quadrupedally, but kinematic variation among great apes is largely unstudied. We used high-speed digital video trials (300 frames/second) to test whether quadrupedal locomotion varied among zoo-housed subjects (*Gorilla gorilla*=13, *Pan troglodytes*=13, *Pan paniscus*=8, *Pongo pygmaeus*=6) and differed from patterns of footfall sequence, timing, and joint angles observed in other primates. Contrary to most other primates, great apes did not favor diagonal sequence gaits, but exhibited variable gait patterns and employed lateral sequence in 47.8% of trials. Footfall pattern tended to vary according to species (ANOVA: $F(3,31)= 2.55$, $p= 0.074$), but the effect did not achieve statistical significance. In analyses controlling for size-adjusted speed (tibia/second), measures of contact time, duty factor, stride frequency, limb excursion, and trunk orientation exhibited a great deal of overlap among species. These similarities among great apes suggest a coupling of kinematics and anatomy, such that the large bodied, long forelimb, orthograde body plan typical of extant apes is associated with a similar suite of gait parameters across species. We also found that *Pan* wrist posture at forelimb touch-down and mid-stance was significantly more flexed than that of *Gorilla* (ANOVA: $F(1,17)=5.92$, $p=0.03$; ANOVA: $F(1,15)=12.51$, $p<0.01$), contrary to predictions based on bony morphology. Our results suggest that postural and kinematic variation among *Pan*, *Gorilla*, and *Pongo* can be attributed to differences in limb proportions and body size, rather than differences in ecology.

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Morphometric Assessment of Sexual Dimorphism and Asymmetry in the Human Scapula

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This study presents pilot research utilizing a morphometric approach to assess shape differences in human scapulae between sexes and to evaluate directional asymmetry within each sex. Bilateral scapulae from 14 modern individuals (F=6, M=8) of European descent, housed at the C.A. Pound Human Identification Laboratory at the University of Florida, were available for this study. Eight homologous landmarks and 18 semilandmarks capturing three-dimensional coordinate data representing the overall shape of the scapular body, including curvature and thickness of the lateral border, were digitized for each scapula. Coordinate data were translated, rotated, and scaled using a Procrustes analysis. Procrustes ANOVA tested directional asymmetry within each sex. Principal component analysis was conducted to visualize shape variation within and between individuals. Discriminant function analysis (DFA) was also performed to assess reliability of sex discrimination based on shape. Wilcoxon rank-sum tests were used to compare scapular centroid size within and between sexes. Results identified significant directional asymmetry only in males, and indicated that females possess broader, shorter scapular bodies with less complex lateral curvature relative to males. DFA correctly classified 66.7% of female scapulae and 87.5% of male scapulae, with poor cross-validation results due to limited sample sizes. Male centroid sizes were significantly larger than females for comparisons of left ($p<0.001$) and right scapulae ($p=0.001$). Results of these tests suggest that scapular shape is sexually dimorphic. Additional study, including larger sample sizes and the addition of other ancestral groups, is needed to determine the utility of this approach for sex estimation.

Social network analysis of Barbary macaque (*Macaca sylvanus*) dominance structure

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Social network topology provides insight to the structure of a group, but deciding which networks represent important components of group dynamics is a challenge. Dominance

relationships can be represented by aggressive interactions or formal status signaling which may consist of signals of subordination or dominance. We investigated the structure of these networks in two groups of Barbary macaques from the Upper Rock Nature Reserve in Gibraltar. Focal sampling was used to record all occurrences of aggression and signaling of 35 adult individuals over two months. A Beta Random Field Percolation and Conductance method was used to calculate dominance probability of dyads using direct and indirect pathways in an aggression network. In addition, directional transitivity of aggression, unidirectional chatter (a bared teeth display associated with submission and affiliation), and round-mouth threat (RMT; associated with dominance) networks were calculated. Dominance probabilities show that rank was not completely linear, but rather consisted of tiers in the rank order such that individuals within the same tier had more ambiguity. Further, both groups' RMT networks had perfect or near perfect transitivity (100% and 97.14%), greater than a network of unidirectional chattering (78.67% and 71.62%) and aggression (62.84% and 58.44%). The transitivity of RMT networks supports its previous classification as a status signal and its potential to represent dominance structure. Together, sections of uncertainty in a rank ordering of individuals and sparse hierarchical organization of signaling networks provide quantitative and qualitative evidence of non-linear dominance structure in these groups, supporting previous claims about this species' hierarchies.

Human pelvis shape, stature, and head size covary in a way that alleviates the obstetric dilemma

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Compared with other primates, childbirth is remarkably difficult in humans because the head of a human neonate is large relative to the birth-relevant dimensions of the maternal pelvis. It seems puzzling that females have not evolved wider pelvises despite the high maternal mortality and morbidity risk connected to childbirth. Despite this seeming lack of change in average pelvic morphology, we show that humans have evolved a complex link between pelvis shape, stature, and head circumference that was not recognized before. The identified covariance patterns contribute to ameliorate the "obstetric dilemma." Females with a large head, who are likely to give birth to neonates with a large head, possess birth canals that are shaped to better accommodate large-headed neonates. Short females with an increased risk of cephalopelvic mismatch possess a rounder inlet, which is beneficial for obstetrics. We suggest that these covariances have evolved by the strong correlational selection resulting from childbirth. Although males are not subject to obstetric selection, they also show part of these association patterns, indicating a genetic–developmental origin of integration.

Ancient Celts: Myth, invention or reality? Dental affinities between continental and non-continental Celtic groups

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The present study presents preliminary results of the biological relationships between the continental proto-Celts, Celts and non-continental Celts, as well as establishing whether the Celts represent a biologically distinct population. Although the social and political changes accompanying the transition from the Hallstatt (1200-475BC) to the La Tene period (450BC-1st century BCE) in continental Europe are reasonably well understood, much less is known about whether population movements accompanied these changes, whether the proto-Celts show any biological affinity to the fully Celtic populations in continental Europe, whether the continental Celts show any biological affinity to the non-continental Celts and whether the Celts represent a biologically distinct population. To address these questions, human dental remains from the Hallstatt (Hallstatt D:650-475BC) site in Austria, the Munsingen-Rain (420-240BC) site in Switzerland, the Pontecagnano (650-300BC) site in Italy and a composite sample of six La Tene (400-100BC) period sites in Britain were analyzed. The Arizona State University Dental Anthropological System was used to record key crown, root, and intraoral osseous nonmetric traits. Based on these data, phenetic affinities and identification of traits driving intersample variation were determined using principal components analysis and the mean measure of divergence statistic. Comparative results indicate the continental proto-Celts and the continental and non-continental Celtic populations represent biologically distinct populations, which indicates that the transition from proto-Celtic to Celtic culture in these regions and the subsequent spread of Celtic culture to Britain during the La Tene period may have been primarily a cultural transition.

Developmental age and size variation in mouse embryos from embryonic days 12-16 as a window to heterochronic processes

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The anatomically modern human skull is commonly characterized as evolving through heterochrony, with human cranial development being decelerated relative to other apes. This produces neotenous morphology, where humans retain cranial features characteristic of juvenile apes such as midfacial retrusion However, there has been little quantitative research into the developmental basis for heterochronic change in evolution, especially throughout the prenatal period during which the human craniofacial development trajectory is established. Research into developmental rate variation in human embryos presents both ethical and practical problems. However, laboratory mice provide an experimental system for evaluating variation in the rate of embryological development in mammals and for proposing inferences regarding the processes that underlie evolution by heterochrony.

Here, we characterize the variation present in inbred mouse embryos harvested at 24 hour intervals from embryonic day 12 through 16 (E12-E16) (total N=150, N=30 in each age group), using both discrete measures (digit separation, appearance of whisker barrels, ear pinna morphology) and continuous measures (crown-rump length, limb bud shape) of developmental age. Digit separation accurately segregate mice into developmental age groups based on embryonic days (i.e. all E14 mice grouped together apart from other ages), but crown-rump length showed substantial overlap between mice harvested up to 48 hours apart. This suggests that the developmental mechanisms that govern overall body size operate somewhat independently from those involved with the morphogenesis of specific developmental milestones. These findings illustrate the need to avoid body size as a proxy for age in heterochronic research.

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Khmer Rouge massacres: Skeletal evidence of violent trauma in Cambodia

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This presentation will discuss the preliminary analysis of human skeletal remains from the Khmer Rouge genocide (1975 – 1979). The remains used in this study are located at The Choeung Ek Genocidal Center (Choeung Ek), colloquially known as the "Killing Fields", a mass gravesite just outside of Phnom Penh, Cambodia. Today the remains of 8,985 individuals are sheltered within a memorial at Choeung Ek.

Based upon historical accounts of Khmer Rouge executions, blunt force injuries were expected to be the most common mechanism of skeletal trauma in this sample. To test this hypothesis, the remains—exclusively crania—were assessed to determine age-at-death, sex, and traumatic injuries. A total of 50 adult individuals were analyzed.

The results indicate that the majority of the individuals were male and all were young to middle-aged adults. Perimortem trauma was

present on nearly every individual in the sample; blunt force injuries were the most common, followed by sharp force. When examined by region, the occipital was the most frequent location for injuries, although all cranial regions were affected by trauma in this sample. Although the sample is small, this is the first systematic analysis of the human skeletal remains at Choeung Ek which is a significant contribution to the scientific documentation of Khmer Rouge mass violence.

In addition to skeletal analysis, this study also sought to understand the broader socio-cultural context in which human remains stand as evidence of mass violence. By integrating socio-cultural and biological approaches, this study provides a more comprehensive conception of massacres.

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Genetic diversity of A2 and C1 haplotypes in Puerto Rico: Implications for initial migration and settlement patterns of the Caribbean

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The initial colonization of the Caribbean has been debated for many decades. Although recent archaeological findings have provided valuable clues to the distribution of ancient peoples in the Caribbean, we are only beginning to understand the migration and settlement patterns in relation to present-day population diversity. Insights into patterns of native mitochondrial genetic diversity in the island of Puerto Rico by Vilar et al. suggested that native haplotypes A2 and C1 diversified before initially being brought to the island by ancestral Taíno populations. We attempted to clarify the population history of Puerto Rico and the settlement of the Caribbean by sequencing the mitochondrial DNA control region of an additional 34 Puerto Rican individuals belonging to the A2 and C1 haplotypes. Due to the nature of genetic diversity in native haplotypes on the island, we hypothesize that multiple migrations took place during the initial colonization of Puerto Rico. We test this hypothesis by conducting network and statistical analysis of the 34 Puerto Rican individuals, in combination with 169 native haplotype Puerto Ricans previously published by Vilar et al. in 2014. In addition, we specifically assessed intra- and inter-island gene flow by comparing haplotype distributions across Puerto Rico and neighboring Vieques Island, and between Puerto Rico and Cuba. This study provides new insights into the initial settlement of Puerto Rico, and the migration history of the Caribbean.

Facial Expressions and Pair-Bonds in Hylobatids

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Among primates, humans have the largest and most complex facial repertoires, followed not by their closest living hominid relatives but by hylobatids. Facial behavior is an important component of primate communication that transfers and modulates intentions and motivations. However, why great variation in primate facial expressions evolved and why hylobatid facial repertoires seem to be more similar to humans than other apes is unclear. The current study compared 206 hours of video and 103 hours of focal animal data of facial expression repertoires, measures of pair bond strength, and behavioral synchrony of ten hylobatid pairs from three genera (*Nomascus*, *Hoolock*, and *Hylobates*) living at the Gibbon Conservation Center, Santa Clarita, CA. We tested if facial repertoire breath or frequency were linked to social parameters of pair-bonds, how facial expressions related to behavioral synchrony, and if facial feedback (i.e., the transfer of behaviors and intentions by mimicking observed facial expressions) were important between pair-partners. Intra-pair facial repertoires correlated strongly with repertoire composition and rate of use, suggesting that facial feedback was important, while behavioral synchrony showed no correlation with facial behavior. We suggest that larger facial repertoires contribute to strengthening pair bonds, because richer facial repertoires provide more opportunities for facial feedback which effectively creates a better 'understanding' between partners through smoother and better coordinated interaction patterns.

Parasite infections reveal costs and benefits of social behavior in a community of wild chimpanzees

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Increased risk of pathogen transmission through close proximity and physical contact is a well-documented cost of sociality. For highly social animals like primates, however, affiliative social contact is an integral part of group life and can have beneficial effects on health through its role in ameliorating stress. The tradeoff between costs and benefits of social contact has implications for the evolution of social structures and relationships within social groups, yet remains poorly understood. Here, we test whether variation in social behavior among wild chimpanzees (*Pan troglodytes*) is associated with intestinal parasite infections, which recent studies suggest can be transmitted through social contact. Using a dataset of 385 fecal samples from 43 adult males and females of the Kasakela community in Gombe National Park, we modelled individual mean parasite richness over a three-year period with a generalized estimating equations approach. As potential predictors of parasite richness we considered number of social partners, mean party size, strength of social connections, party association and grooming network centrality, time spent grooming, age, and dominance rank. We found that, all else being equal, more gregarious individuals had more parasites, and individuals with stronger grooming bonds had fewer parasites. Effect sizes varied by sex. Our results suggest a negligible risk of exposure to infective parasite stages through grooming, contrasting to conclusions reached by recent studies in other primates. Instead, strong grooming bonds came with tangible health benefits, particularly for females, while gregariousness carried health costs, particularly for males. We discuss potential mechanisms behind these patterns.

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Physiological stress in the Middle Cumberland Region of Tennessee: Mortality and survivorship differences during the Mississippian Period

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Epidemiological research demonstrates that individuals possess varying levels of frailty and respond to physiological stressors differently. Because of enamel's inability to remodel, teeth serve as a valuable indicator of stress episodes experienced during childhood. Skeletal remains from 12 sites dating to the Mississippian Period (ca. AD 1000-1450) in the Middle Cumberland Region of Tennessee were analyzed. It was hypothesized that individuals with enamel hypoplasias (LEH) have a greater age-specific risk of death than similarly-aged individuals without LEH, having been predisposed to

physiological stressors during childhood. Sex-specific mortality was also examined.

Age-at-death was estimated using Transition Analysis, a maximum likelihood method of adult age estimation. Permanent incisor and canine crowns were observed macroscopically and scored for enamel hypoplasias. The MLE point estimate of age-at-death from Transition Analysis was calculated for each adult skeleton (n=550) and used in the survival analyses.

The survival curves generated by Gompertz hazard model parameters suggest a substantial number of individuals living into old age. The Gompertz survival curves reveal a higher age-specific risk of death of females compared to males. Kaplan-Meier analysis indicates no statistical differences in survivorship among males with LEH compared to those without LEH (p=0.269). Similarly, no statistical differences were found in the survivorship of females with LEH compared to those without LEH (p=0.242). However, females with LEH were considerably frailer than males who also experienced early childhood stressors (p=0.00911). These results elucidate how the process of selective mortality acts upon the heterogeneous frailty of individuals.

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The relationship between hindlimb loading and cross-sectional morphology in bipedal rats

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The evolution of bipedalism in the human lineage involved significant changes in musculoskeletal morphology to accommodate the locomotor shift from quadrupedalism to upright walking. One relevant feature involves changes in long bone cross-sectional morphology. Previous studies suggest that differences in variables such as polar section modulus (Z_p) are related to locomotor behavior. Because bone adapts to the predominant forces placed upon it, experimentally altering mechanical loading regimes in an animal model allows for a natural test of the relationships between form and function. In this study, a novel method was used to experimentally induce a locomotor shift during ontogeny in a rat model. Rats (n=14) were placed in a custom harness system mounted on a treadmill which allowed for bipedal locomotion over 60 minute periods, 5 days a week, for three months, starting at 4 weeks of age. The harness imparts an adjustable upward force on the torso which alters the load experienced by the hindlimbs. In this study, this group was compared to a quadrupedal control group that was exercised for the same period and a no activity control. At the end of the experiment, µCT scans were to taken to measure Z_p at mid-shaft (50% ± 5%) for both the femur and tibia. Using a linear mixed-effect model, no significant differences were found between the bipedal and control groups (femur: p=0.7588; tibia: p=0.3896). These findings suggest that adopting a bipedal locomotor gait during ontogeny isn't enough to alter cross-sectional geometry often linked with locomotor behavior.

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Reconstructing knee posture in humans, chimpanzees and gorillas: subchondral and trabecular signals

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Studies attempting to discriminate activity patterns via subchondral and trabecular bone in primates have exhibited varying levels of success. Many of these studies examined trabecular bone properties in one or multiple VOIs deep to the joint surface, with some displaying promising signals. This study aims to examine subchondral and trabecular bone across the entirety of the distal femoral joint surface in order to discern differences in habitual posture. Inter- and intra-species comparisons will examine variation in these characteristics as well as across locomotor modes.

MicroCT scans of distal femora were obtained for 18 human, 8 gorillas, and 8 chimpanzees at a resolution of 50µm and processed in ImageJ. Contour lines were drawn along the joint surface of each specimen's medial femoral condyle and scaled to distances of 0.25, 1, and 3mm inside the joint surface. Profile plots were created at each distance to examine subchondral and trabecular radiodensity across the entirety of the joint surface. Results suggest that humans have denser trabecular and subchondral bone anteriorly, as expected from their relatively extended knee postures. Gorillas have the densest subchondral and trabecular bone of the three species examined, but the densest region in gorillas and chimpanzees is posterior to that of humans, suggesting use of more flexed habitual knee postures. While a great deal of variation is present among the individuals examined, it appears that a clear positional signal can still be discerned using this new method and may offer opportunities for examining posture and activity in fossil hominins.

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Could male *Colobus vellerosus* be using behavioural cues to estimate paternity?

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In polyandrous mating species, male traits that enhance their ability to distinguish offspring from non-offspring should be selected for if paternal care is advantageous for males. Males could use behavioral cues that relate to the probability of siring an offspring to estimate paternity certainty and bias positive behavior accordingly.

We investigated these ideas in a population of wild *Colobus vellerosus*, where females mate with multiple males; males sometimes commit infanticide; and some resident males protect and interact affiliatively with infants. We used 6 months of focal data on 8 immigrant males in 4 social groups, where paternity data was available for 12 of 16 infants. Using three generalized linear mixed models, we asked if male dominance status, tenure length, or presence in a group at the time of an infant's conception were good predictors of male-infant affiliation. To evaluate the accuracy of these potential behavioral cues, we used a fourth model to ask if paternity predicted male-infant affiliation.

Dominance was the only significant predictor: dominant males interacted with infants more than subordinate males (GLMM: F(1, 35) p=0.012). Paternity was not a significant predictor (GLMM: F(1, 35) p=0.012). In two of our study groups, reproductive skew was low, which contrasts with previous reports in this species. In these groups, the alpha males were recently established, potentially leading to an uncoupling of paternity and dominance. Thus, dominance rank might be an imperfect cue for males to estimate paternity during periods of rank instability, but an effective cue during times of rank stability.

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Fetal and infant health in prehistoric and colonial Ifugao

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Infant death in prehistoric Ifugao villages has only been viewed through a lens of modern ethnography. Ifugao culture and subsistence practices in the Philippines Cordillera have been subject to periods of environmental change and two episodes of direct and indirect Western colonization. Recent excavations at the Old Kiyyangan Village site have revealed new information on the resource base, trade networks and impact of outside groups on the prehistoric and early historic Ifugao. This work has produced a small sample (19) of sub-adult individuals. The age-at-death estimates for these individuals range from 26 weeks in utero to 1.5 years. Fetal and infant remains are subjected to either jar or open interment in a pattern that may reflect ritualized beliefs, health status or both. Skeletal lesions were recorded from five of the neonate and infant skeletons. Nutrition-related diseases are most likely the cause these lesions. One individual exhibits clear signs of infection in a femur. The location suggests this is likely due to a fall. New bone growth and the bowing of long bones are both most common in the tibia, humerus, and ulna. Fragmentation and poor preservation prevent the identification of porotic hyperostosis in the crania. This study establishes new information for Cordillera prehistoric and colonial period burial practices and fits into the larger Southeast Asian sample of high mortality in the late period of gestation and early infancy.

Parentage complexity in socially monogamous wild lemurs (*Eulemur rubriventer*)

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Genetic analyses of parentage often reveal that socially monogamous species are not reproductively monogamous (i.e., offspring result from extra-pair copulations). Thus, without genetic confirmation, pair-living species can be incorrectly or prematurely categorized as monogamous, which in turn can confuse behavioral studies and comparative analyses of social structure. Red-bellied lemurs (*Eulemur rubriventer*) live in groups generally comprising an adult male-female pair plus immatures. Adult males occasionally participate in infant care, and while mating behavior in this taxon is rarely observed, an earlier genetic analysis of parentage in a relatively small sample found no evidence of extra-pair matings (i.e., the resident pair could not be excluded as likely parents of immatures). Expanding on this, we combined behavioral observations of wild red-bellied lemurs in Ranomafana National Park with genetic parentage analysis of immatures from 10 groups (N_{adults}= 57, $N_{immatures}$= 20). Our panel of microsatellite loci has a low parentage non-exclusion probability ($p < 0.03$), and the majority of immatures ($N = 16$) were likely offspring of the resident adult pair. However, the resident adult male was excluded as the likely father of four immatures ($N_{groups} = 3$), although causes other than extra-pair copulations might explain these results. Moreover, both our genetic data and behavioral observations indicate that multiple females reproduced in at least two groups. These results suggest that social behavior in red-bellied lemurs may be more complex than previously thought, and multiple lines of evidence are important for inferring parent-offspring relationships within pair-living groups.

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Tracing the geographic origin of the Indian Ocean slave trade: Genomic ancient DNA data from the historical cemetery of Le Morne (Mauritius)

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During the period of slavery, millions of people were forcibly displaced from Africa. Recent studies have attempted to shed light on the origin of slaves, mostly on the trans-Atlantic trade. In contrast, the Indian Ocean slave trade has received much less attention. A clear example of the extensive manpower trade across the Indian Ocean is Mauritius, where at least 100,000 slaves were imported during colonial times. In this study, we used next-generation sequencing of ancient DNA to estimate the genome-wide ancestries of individuals sampled in the historical cemetery of Le Morne (n=26), which is thought to contain the remains of runaway slaves.

Damage patterns and length distributions are consistent with ancient DNA molecules. Endogenous DNA accounted for 0.14–45.1% of the total. WISC capture allowed us to increase endogenous DNA content 4.5-27.6X, demonstrating the importance of capture methods for paleogenomics projects in tropical regions. MtDNA genome depth ranged from 29.3 to 228.0-fold. MtDNA lineages have a clear sub-Saharan African and Malagasy origin, although some South Asian types are also observed. Although the genome coverage was low, for 18 samples, at least 2,000 SNPs intersected with a reference panel. Principal component analysis and admixture estimates indicate that slaves from Le Morne came from mainland Africa and Madagascar, although European admixture and a South Asian component are also confirmed. Our results represent the first genomic project to recover data from African individuals involved in the Indian Ocean slave trade and provide insight into the complex demographic history of Mauritius.

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Ontogeny of modern human longitudinal body and transverse shoulder proportions: implications for the Upper Paleolithic Sunghir children

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Variation of modern human body size and shape has been widely studied in the context of ecogeographical clines. However the proportions of the adult human body derive from the differential growth of body segments and little is known on the relationship between the shoulder and longitudinal dimensions during ontogeny. The aim of this paper is to document the ontogenetic variation of the shoulder and longitudinal body (clavicular and long bone) proportions in recent humans in order to evaluate body proportions in the immature fossil record, and in particular in the Upper Paleolithic Sunghir children.

We studied postnatal ontogenetic development of the transverse and longitudinal proportions in cross-sectional ontogenetic samples of African, Amerindian and European human populations (n=148) and computed average population-specific ontogenetic trajectories from traditional growth curves, bivariate plots, and multidimensional phenotypic space. The Sunghir children and a sample of immature fossil specimens from the Late Pleistocene were then compared to the recent human variability.

The longitudinal dimensions of both Sunghir children are within recent human variation and have a relatively normal vertical growth, despite the foreshortened femora of Sunghir 3. By her clavicular dimensions, Sunghir 3 falls among the highest recent human values. Her transverse growth is advanced for her age but her transverse dimensions are isometric. We thus suggest that either an advanced growth spurt or an elevated rate of growth of the transverse dimensions in the Sunghir sample may be responsible for the exceptionally long clavicles observed in Sunghir 3.

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Assessing the Precision and Accuracy of Craniometric Measurements: Geomorph versus Caliper Data Collection Methods

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The use of modern human skeletal remains as reference data is critically important to the practice and research of skeletal biologists, however, these collections have limited access. The use of 3-D digital scans offers a feasible solution to this issue, but the accuracy of virtual measurements compared to standard caliper measurements must be fully ascertained. Then, both media can be used to augment sample sizes and make skeletal collections more easily accessible. This study tests the accuracy and precision of collecting standard craniometric measurements from 3-D laser scans versus physical caliper measurements.

The study sample includes nine human crania archived at the C.A. Pound Human Identification Laboratory. Eighteen standard cranial measurements were collected onsite using calipers. All crania were laser scanned using a NextEngine 3-D scanner and twenty-two landmarks were digitized using the Geomorph package in R. Equivalent interlandmark distances were computed, which were then compared with their directly measured counterparts using intraclass correlation coefficients (ICCs).

Total margin of error for individual measurements ranged from 1-35 mm, with average inter-observer errors across all 18 measurements of 1.1 and 2.2 mm, for caliper measurements and digital measurements respectively. Intra-observer errors across modalities averaged 2.1 and 1.6 mm (ANF and MKS, respectively). Average ICC across modalities was .996 (95% confidence interval: .994 - .998). These results indicate that caliper measurements may be more reliable; however, high agreement between measurement modalities, even for different observers, suggests that craniometric measurements gathered by physical and virtual means are appropriate for pooling and statistical comparison.

"Enamel Hypoplasia and Longevity as seen in the Antelope Creek and Wolf Creek skeletal sample at the Panhandle-Plains Historical Museum"

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The purpose of this study is to observe the health and longevity of two prehistoric communities from the Texas and Oklahoma Panhandles. The samples include burials from the Antelope Creek and Wolf Creek sites. These are prehistoric Plains Native Americans who lived as hunter-gatherer-horticulturalists during the time period of 1200 A.D. to 1500 A.D. Data specific to the frequency of linear enamel hypoplasias was collected. This data is then matched to longevity and life expectancy from birth as indicated by a life table specific to this group of burials. A total of 103 individuals are available for assessment, 71 individuals have teeth for enamel hypoplasias analysis. Forty-three of them (60.56%) had one or more linear enamel hypoplasias. A burial sample with such a high frequency of dental defects suggest that there was considerable childhood stress among these individuals and that this had an effect on their morbidly rates. Linear enamel hypoplasias were measured using gross measuring techniques. Measurements were assessed using the distance of the linear enamel hypoplasia from the occlusal surface of the tooth. The defects were measured to determine the approximate age at which an individual acquired the defect. Age at defect is important in understanding potential cultural and/or environmental factors that might be linked to health stressors. The demographics of these samples were determined using skeletal age and sex techniques. The demographics were then verified using Owsley's assessments (Panhandle-Plains Historical Museum, NAGPRA files, Archeology Department, Canyon, Texas, 1995) for the burials in this sample.

Estimating fetal-pelvic disproportion in Australopithecines, with special reference to the MH2 (*Australopithecus sediba*) pelvis

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Paleoanthropological reconstruction of childbirth is crucial in the study of human evolution but is difficult because of the lack of complete pelves and neonate crania in the fossil record and the complex relationship between them during the birth process. To partly compensate this, we propose to assess labor outcome in australopithecines, with a special focus on a new reconstruction of the MH2 pelvis (*Australopithecus sediba*). We explore multiple combinations of the pelvis and estimated neonatal crania based on a partial least squares discriminant analysis (PLSDA) of a modern obstetrical sample of 131 births with known pelvis and neonatal dimensions. The PLSDA analysis includes 61 fetal and pelvic variables. It enables to determine the association of fetal-pelvic configuration with caesarean section, operative vaginal, spontaneous vaginal delivery, and rotational and non-rotational birth. Neonatal cranial dimensions of australopithecines are estimated based on chimpanzee cranial growth curves that we reversely applied on Taung and Dikika. Then, we combine these estimates with all available reconstructions of australopithecine pelves, including Sts 14 (*A. africanus*), A.L. 288-1 (*A. afarensis*) and MH2. This yields 14 possible combinations and provides an initial assessment of fetal-pelvic constraint. When these fossil combinations are added to the PLSDA, MH2 and all others australopithecines are found to belong to eutocic configurations. Rotational birth is not clearly identified because australopithecine dyads belong both to the rotational and the non-rotational group. This most likely suggests that australopithecines had a non-rotational birth with a sagittal head orientation due to their small fetal-pelvic constraint.

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Modeling the impact of coping through animal milk rationing on dietary quality of Ariaal agro-pastoral mothers facing food insecurity and poverty in drought-prone northern Kenya

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Food insecure households utilize coping strategies, including the rationing of micronutrient-rich foods to divert resources toward cheaper, calorie-dense foods for survival. Poverty increases the risk for food insecurity and the urgency for food rationing. Food insecurity and poverty are therefore closely intertwined and can simultaneously influence food choice. Modeling the impact of strategic food rationing on dietary quality is challenging because forfeiting high-quality foods can be forced by low accessibility and poverty instead.

Here, we examine the pathways from food insecurity to dietary quality via rationing of animal milk while accounting for the correlation between food insecurity and poverty. Cross-sectional data from 222 breastfeeding Ariaal mothers were used. The absence of milk, a preferred staple, in a 24-hr dietary recall was identified as milk rationing. A food insecurity index was derived using food accessibility interview data. Dietary quality was assessed through confirmatory factor analysis to construct a latent variable with a micronutrient content focus. Structural equation modeling was applied to test the hypotheses: 1) both food insecurity

and poverty will predict diminished dietary quality and 2) these effects will be mediated by milk rationing.

Both food insecurity and poverty predicted lower levels of dietary quality. These effects were respectively fully and partially mediated by milk rationing. Our findings indicate that operationalizing forfeited consumption as food rationing can offer insights into how poverty and food insecurity together may diminish the quality of diet and also catalyze a context-specific behavioral pathway leading to even more compromised dietary quality.

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Signal trees: testing a theoretical framework and model for the evolution of primate vocal repertoires

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Research has provided substantial insight into how animals produce, perceive, and use signals, yet understanding communication in terms of entire signaling systems remains incomplete and underexplored. Of particular interest is how "new" signals emerge and evolve, both within and among species. In primates, evidence that most vocal repertoires are species-stereotyped and genetically determined suggests signals are subject to – and thus reflecting of – evolutionary forces (e.g. selection, drift) in the same manner as other heritable traits. Inter- and intraspecific comparative analyses of signals, therefore, should illuminate the evolutionary trajectories of repertoires, including the origins of individual call types.

Here, I propose an extensible model for the evolution of vocal repertoires, and describe comparative methods that can allow inference about timing of and socioecological factors relating to changes in vocal signals among taxa. To illustrate the proposed model, I examined the complete male vocal repertoires of four *Cercopithecus* species (*C. mitis*, *C. nictitans*, *C. cephus*, and *C. ascanius*), and applied ordination analyses to signals' acoustic structures. Results indicated that signals cluster more closely between species than within species (i.e. each call type was more similar to that of another species than to other call types within the same species). I discuss these findings' in relation to the potential merit and hazards of interpreting acoustic similarity as indicative of descent with modification (i.e. the hypothesis that call types of related species are homologous).

Association of *ACE*, *TPA*, and *WNK1 Alu* polymorphisms, perceptions of unfair treatment, and personal networks with hypertension in African Americans

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African Americans are at greater risk of heart disease than other racial or ethnic groups. In this study, we combine genetic and sociocultural data to investigate risk of hypertension in our sample of 137 African Americans living in Tallahassee, Fl. Saliva samples, anthropometric data, blood pressure readings, and a wealth of sociocultural data were collected from study participants. To investigate potential genetic risk factors for hypertension, *Alu* insertion/deletion polymorphisms at three candidate genes (*ACE*, *TPA*,*WNK1*) were assayed. We also investigated the impact of discrimination on hypertension. Specifically, we collected data on perceptions of unfair treatment, including a novel measure of unfair treatment that was experienced by individuals close to the study participant. We also constructed personal networks of 30 alters for each study participant in order to examine the social environment of each participant.

Multiple linear regression and AIC modeling were used to identify the factors that account for variation in blood pressure in our sample. As found previously, *ACE* correlated with blood pressure in all analyses. Unfair treatment to others, in an interaction with *ACE*, was also correlated with systolic and diastolic blood pressure. Mean between-ness, representing the extent to which a network is dominated by brokering nodes (nodes that are in a position to influence or control the flow of information or resources), correlated with higher systolic and diastolic blood pressure. Combining genetic and sociocultural data allows for a more nuanced and accurate understanding of the prevalence of hypertension in African Americans.

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Investigating dietary evolution in crown strepsirrhines using dental topography metrics and ancestral state reconstruction

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Crown strepsirrhines, although diverse today, are rare in the fossil record and absent from their apparent center of diversification on the island of Madagascar before the Pleistocene. Phylogenetic methods may offer the best opportunity to investigate morphological history in this group. We examine the evolution of dietary adaptation among strepsirrhines using a novel combination of a dental topography metric, Dirichlet normal energy (DNE), and phylogenetic ancestral state reconstruction. DNE values from the second lower molar of 30 strepsirrhine species are assigned as tip values to a block of 1,000 trees. Using the distribution of tree topologies and the data, we tested the fit of several evolutionary parameters, and then estimated posterior distributions of DNE scores at the most recent common ancestry of all well-represented clades as inclusive as families. Default parameters of gradual evolution along branches were favored. The most recent common ancestors of lorisiforms and lemuriforms were reconstructed with significantly different DNE scores (means of 178.5 and 107.5, respectively, *t*-test $p < 0.001$), with the lemuriform MRCA overlapping extant frugivores (Tukey's HSD $p = 0.71$) and the lorisiform MRCA extant omnivores ($p = 1$). The lepilemurid MRCA overlaps the range of insectivores ($p = 0.17$), which may reflect similarity between folivorous and insectivorous dental adaptations at small body sizes. All other families overlap the ranges of omnivores. These results suggest contrasting adaptive strategies near the base of the lemuriform and lorisiform radiations as well as a tendency toward dietary specialization among the tip taxa of strepsirrhine families.

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Anthropology is Elemental: Observations from the first four years of an outreach initiative

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Current theoretical frameworks within anthropology increasingly emphasize engagement in applied, practicing, and public endeavors, such as complementing STEM curricula at K-12 levels. Anthropologists are able to convey what the Next Generation Science Standards (NGSS) term "cross-cutting concepts" because of our discipline's basis in the sciences and humanities. Specifically, providing anthropology education at the primary school level exposes a more diverse demographic of students to concepts including evolution, race as a cultural construct, and the impact of culture on humans. In 2011, the University of Alabama Department of Anthropology began offering semester-long courses in four-field Anthropology. We are in our fifth year and have expanded, offering a similar course at a second elementary school and more specialized curriculum in Biological Anthropology at a local middle school. Our program has facilitated outreach and training to more than 200 elementary schoolers, 12 undergraduates, and 13 graduate students. Quality instruction is provided through the construction, by undergraduates, of

student-centered activity-based lessons. Observational data on concept retention by students suggest that the synergistic engagement of faculty instructing graduate students who, in turn, educate undergraduates on how to teach primary schoolers is a successful model for integrative training. Our program has led to an increase in cooperative research among undergraduates and has provided a platform for graduate students to learn and practice effective communication and teaching skills. Students that experience the humanistic and scientific study of anthropology at an early age are uniquely positioned to be able to excel in both as they continue their education.

An Investigation of the Relationship Between Cranial Porosity and Cranial Modification Intensity in Late Intermediate Period (AD 1000-AD 1400) Andahuaylas, Peru

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Artificial cranial modification is an irreversible and highly visible form of body alteration that has been employed throughout prehistory and around the world to convey social information such as ethnic and/or kin group affiliation. Many studies have focused on methods of classification, typology, and social implications of artificial cranial modification however, few studies have investigated the extrinsic pathological consequences of the cranial vault in response to cranial reshaping practices. The aim of this study is to elucidate whether porotic cranial lesions are a consequence of the modification process or a product of health related stress by examining the absence, presence, and intensity of cranial porosity and cranial modification in Andahuaylas, Peru. This study investigates the relationship between porotic lesions found on the external table of the cranial vault and the intensity of cranial modification in 34 individuals affiliated with two polities that coalesced during the Late Intermediate Period (AD 1000 – AD 1400) in Andahuaylas. Results indicate that as cranial modification intensity increased, the amount of cranial porosity increased within the Chanka group. However, in contrast, there was no significant association within the Quichua group. These findings suggest that the presence and amount of cranial porosity is not a consequence of cranial modification and therefore, there is no relationship between the two variables within the Andahuaylas region. This study further contributes to our current interpretations of porotic cranial lesions and their etiologies in the Andes.

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The New World settlement as seen from different craniofacial morphospaces: An Evo-Devo approach

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The arrival and dispersal of human populations in the Americas remains a very controversial issue especially regarding the number of migration waves. Craniofacial variation between ancient and recent Amerindians has been attributed to the effects of multiple founder events or alternatively, as the result of a single population carrying high levels of internal heterogeneity and effects of local differentiation plus recurrent gene flow. Here we investigated craniofacial shape variation of a large sample (978 specimens) of past and modern groups from America and Australasia applying 3D geometric morphometrics methods and the Factor Model. This approach enables to separate shape features that covary because of common factors from those only explained by local factors. We analyzed separately the full skull shape as well as neurocranium and face modules in both integrated and modular shape spaces. All analyses underlined a high variability among ancient specimens and show that regional factors explain most of the variance observed. These results give more support to the hypothesis of a relatively fluid and continuous variation than the presence of two distinct biological populations.

Hierarchical variation of bone hardness in the colobine femoral midshaft

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Understanding spatial variation in bone material properties is integral to the development of biomechanical models of skeletal function. Numerous investigations suggest that bone may be modeled as either orthotropic or transversely isotropic. Regarding the latter, in transverse planes taken roughly orthogonal to the long axis of Haversian systems, the arrangement of osteons can be described as structurally analogous to cross-sections of a fiber-reinforced composite, with in-plane stiffness characterized as isotropic.

We used Knoop indentation to sample bone hardness (under an assumption that hardness is proportional to elastic modulus and yield strength) in the femoral midshaft of a specimen of *Colobus polykomos*. Under a 50g load with 10s dwell time, we examined three serial 1mm transverse sections, sampling hardness in four quadrants (anterolateral, anteromedial, posterolateral, posteromedial) with three replications each at four different orientations (0, 30, 60, and 90 degrees relative to an anteroposterior axis). The hardness data were analyzed via hierarchical ANOVA to assess the directional dependence and within- and between-section variation.

The angle of indentation represents a significant source of variation ($P < 0.01$), but variance is random among quadrants and sections. Hardness variation in midshaft is thus homogeneous on a local scale, with the caveat that there does appear to be directional dependence, with the bone being stiffest in the mediolateral direction. In this case, the femoral bone does not conform to an expectation of transverse isotropy. This conceivably mitigates locomotor stress if bounding – idiosyncratic to black and white colobus – involves bending about an anteroposterior axis.

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Exploring stress thresholds through dental enamel defects and skeletal evidence for life history trade-offs in adults

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It is clear that patterns in developmental plasticity shape later life experiences and that the timing of non-specific stress in relation to growth and development is critical to these impacts. Dental enamel provides detailed information on the timing of non-specific stress experiences, which may be considered in relation to growth in other systems to elucidate the impact of one on the other. This research investigates these patterns through the consideration of accentuated striae of Retzius (AS) in relation to stature and long bone lengths in a medieval Danish sample.

The results demonstrate that while stature had a significant positive correlation with total crown AS, femoral length was negatively correlated. Subdivision of the crown into deciles representing different developmental periods showed a continued positive trend in overall stature at significant levels in the 6th, 7th, and 10th deciles. The consideration of long bones showed variable positive and negative trends. Femoral length showed a negative correlation in most deciles, with significant correlation in the 6th decile ($p = 0.025$). While sample sizes for tibial lengths were prohibitively small, significant positive correlations were apparent for humeral length, with the 10th decile being significant when considered using a Bonferroni-style correction ($p = 0.02$).

These results seem to indicate differential impacts on growth based on stress timing, possibly pointing to patterns in catch-up versus cumulative growth. The period of later developing enamel seemed to be the most critical, but future investigation using population-specific growth curves and larger sample sizes should be employed for further insight.

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Understanding developmental factors in the ontogeny of 3D rib curvature and its importance for human thorax growth

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Individual rib development is essential to understand human thorax morphogenesis because rib orientation relative to the spine (axial and sagittal planes) modifies thorax morphology during ontogeny. It has been proposed that rib orientation does not change in the same way at the upper (ribs 1-5) and lower thorax (ribs 6-10) during postnatal growth. However, it is unknown if these developmental modifications are produced by changes of rib morphology (intrinsic rib factors) or by mechanical changes at the costal joints (extrinsic rib factors). To clarify how intrinsic rib factors contribute to thorax development, we apply 3D geometrics morphometrics of landmarks (N=7 per rib) and sliding semilandmarks (N=13 per rib) to 280 individual ribs (1-10) of *Homo sapiens* comprising from newborns to adults. Form space PCA shows that rib torsion and axial rib curvature are intrinsic rib factors which act during ontogeny, contributing in this way to adult thorax form. Moreover, growth simulations and regression slopes suggest that the upper thorax unit would comprise ribs 1-7 while the lower unit would comprise (at least) ribs 8-10. This suggests anatomical constraints for ontogenetic rib variation because only ribs 1-7 (true ribs) are usually directly linked to the sternum. These results are also supported by functional anatomy since upper and lower thorax development could be influenced by pulmonary and diaphragmatic kinematics respectively. Our findings are relevant not only to understanding how changes at individual ribs contribute to the adult thorax morphology, but also to the development and evolution of modern thorax.

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Dominance and intelligence: Testing two sexual selection theories of leadership against the ethnographic record

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There are two sexual selection theories of leadership. The dominance model, inspired by primate dominance hierarchies, posits that leaders are physically stronger and have superior fighting ability. The intelligence model is based on the reproductive skew evident in many small-scale subsistence societies: headmen and other leaders often have more wives and children than other men. If this pattern characterized ancestral human populations, then there would have been strong selection on traits that predisposed to leadership roles. Neel proposed that intelligence was the most important such trait and that selection for intelligence among leaders contributed to encephalization in *Homo.*

We tested these models in 1,213 ethnographic texts from the HRAF Probability Sample. At the text level, we found evidence for both the dominance model (13% of texts) and the intelligence model (15% of texts). However, there was also substantial evidence against the dominance model (6.6%) but virtually no evidence against the intelligence model (0.1%). At the cultural level, leaders were dominant over followers in 28% of cultures, used aggression in 22%, and were described as physically stronger than followers in 20%. However, dominant leaders were resisted in 72% of cultures. Intelligence, in contrast, characterized leaders in 60% of cultures, and leaders were polygynous in 40% of cultures.

Hunter-gatherers provided higher support for the intelligence model, pastoralists provide lower support, with other subsistence regimes intermediate. Support for or against the dominance model did not show differences across subsistence regimes. Results provided more support for the intelligence model than the dominance model.

Early Life Stress in Colonial Peru: Internal Enamel Micro-Defects and their Influence on Life History Trajectories

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Recent research investigating the Developmental Origins of Health and Disease (DOHaD) Hypothesis has incorporated analyses of enamel macro- and microdefects to examine the role of early-life stress episodes on life history trajectories. The present study centers on examining the DOHaD in the context of Spanish colonization of Andean South America. More specifically, it examines associations between early-life stress, represented here by internal enamel micro-defects called Wilson bands, and age-at-death. Permanent first molars were thin-sectioned and examined microscopically from individuals (n=30) interred at two sites in northern coastal Peru dated to the Spanish Colonial period (AD 1533-1760); previous research by the authors has documented skeletal signs of stress and disease across these cemetery samples linked to low socioeconomic status.

Stress chronologies were developed based on the constant periodicity of internal incremental enamel growth, and frequencies of enamel defects were estimated for each individual. Results show that, overall, individuals at CNS and CSMME with Wilson bands died at an earlier age in comparison to those whose molars exhibited no Wilson bands. Furthermore, at both sites, results reveal a negative relationship between age-at-death relative to enamel defect frequencies, and a positive relationship between age-at-death relative to age at first defect formation. This suggests that individuals with early-forming defects or multiple early life stress events experienced a greater risk for early mortality. This study underscores the importance of understanding how energy allocated towards the survival of early stress may result in trade-offs in future growth and maintenance, thus resulting in earlier mortality.

Variation in ontogenetic growth patterns with shifts in a small town economy: Intra-population assessment of body size and bone strength (Barton-upon-Humber, Lincolnshire UK)

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Patterns of endochondral and appositional skeletal growth may alter in a population experiencing decreased prosperity and shifts in subsistence economy due to diminishing nutritional health, living conditions, and labor practices. However, there are few bioarchaeological studies specifically addressing ontogentic skeletal response to economic and temporal changes within a single, temporally deep non-urban population.

In a large British cemetery assemblage, Barton-upon-Humber (950 AD-1849 AD), growth in body size (stature, femoral length, body mass), appositional growth (percent cortical area [%CA]), and femoral polar section modulus (overall bone strength [Zp]) was evaluated. A large sample (perinatal to young adult; n=279) was subdivided into age cohorts and two burial periods comparing the effect of subsistence economy and prosperity (Early, AD 950 to 1500; Post-medieval, 1500 to 1855) on ontogenetic trajectories. It was expected that decreased ontogenetic body size and exaggerated endosteal resorption (%CA) would be most evident in Post-medieval infants, reflecting the

greater impact of decreased prosperity during infancy. Evidence of less vigorous mechanical loading accompanying modernized labor practices was expected throughout growth.

Results show no statistical effect of temporal period on growth in body size or endosteal resorption from birth to adulthood. However, there is evidence of shifts in mechanical loading activities by age. Post-medieval children (5-10 years) exhibit less bone strength for size (p<0.007). This is suggestive that there was a change to labor practices among children in the community and that non-urban environments may buffer negative effects of economic downfalls on growth.

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Effects of sociality on the evolution of olfactory systems in mammals

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Mammals rely heavily on smell, however this varies across and within taxa. Genomic comparisons reveal substantial variation in genes encoding main olfactory receptor proteins (OR genes) and vomeronasal proteins (VR genes). While both olfactory systems have overlapping functions, evidence supports the vomeronasal system's role mediating innate responses to chemosignals, with the main olfactory system mediating conditioned responses. Given the importance of olfaction in intraspecific signaling, we hypothesize that the vomeronasal system and main olfactory system are partly shaped by grouping and sociality. Solitary mammals with little regular conspecific contact may rely heavily on innate olfactory responses mediated by the vomeronasal system, while group living social mammals may mediate these cues via main olfaction. We collected data on OR and V1R genes from the literature on 80 mammal species, including 55 primates. Data on home range size and social group size were collected from the PanTheria database as proxies for proximity and sociality. We ran phylogenetically corrected regressions on log-transformed values of intact OR and V1R genes against home range size and social group size. We found no statistical relationship between measures of home range or sociality and OR genes; but a significant relationship between all predictor variables and V1R genes. Particularly, mammals with larger home ranges and social groups have fewer intact V1R genes. These results support the hypothesis that solitary mammals rely more on vomeronasal-mediated olfaction. The implication for primate evolution is that increased gregariousness in haplorhines, especially anthropoids, may have contributed to relaxed selection on their vomeronasal system.

Body size and sexual dimorphism in *H. naledi*

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The discovery of 1550 *Homo naledi* fossil specimens from the Dinaledi Chamber of the South African Rising Star cave system provides a rare opportunity to study intra-specific body size variation and sexual dimorphism in a geographically and temporally constrained sample of hominin fossils. Using linear measurements and equations derived from a variety of modern human reference samples, we estimated body mass and evaluated sexual size dimorphism from 20 adult postcranial specimens. Because the sample may represent any single individual multiple times, a subsample of eight non-antimeric proximal femora was also analyzed. Stature was estimated from a mostly complete adult humerus (U.W.101-283) and tibia (U.W.101-484). *H. naledi* canine (n = 6) and molar (n = 9) size dimorphism was evaluated using coefficients of variation and were compared to modern humans and extant apes using bootstrap analyses.

Results indicate that body mass estimates for the 20 specimens range from 35 to 56 kg. *H. naledi* had an average body size most consistent with early *Homo* species (~147 cm and 45 kg). *H. naledi* males weighed approximately 20 percent more than females, which is consistent with other reports of sexual size dimorphism in *Homo*. Canine and molar size dimorphism is minimal and more similar to modern humans than extant apes. Endocranial volumes (465 – 560 cm^3) and encephalization quotients (~2.5), however, are most similar to *Australopithecus*. *H. naledi*'s relatively small brain paired with *Homo*-like body size and levels of sexual dimorphism may have important implications for behavioral and ecological interpretations of fossil hominins.

Relationship between macrowear and dentin hardness in *Macaca fascicularis* molars

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While dental wear has been studied extensively in nonhuman primates, little is known about how dentin responds to wear. Dentin is known to react to wear and irritation through different pathways, such as occlusal sclerotic lesions, which may induce hardening of dentin local to the occlusal surface. These events may, therefore, slow or alter the process of occlusal wear. In this study we test the null hypothesis that dentin hardness is unassociated with degrees of occlusal wear.

We sampled dentin hardness from crown dentin of coronal sections of ten *Macaca fascicularis* M2s after scoring each for degree of macrowear (none, light, pronounced). Each section was sampled utilizing a Knoop indenter at four different angles: parallel to a buccal-lingual axis, parallel to an occlusal-apical axis, and at two 30 degree angles in between. Knoop indenter tips are highly asymmetrical, allowing testing for directionality when obtaining hardness data.

ANOVA did not reveal a significant difference between indentation length and angle (P = 0.075); however, there is a statistically significant relationship between macrowear and hardness in an apical to occlusal direction (P = 0.033). Hardness values generally decrease in an apical to occlusal direction and the largest range of indent size was found in the most worn teeth.

These results indicate that teeth with significant dentin exposure have markedly softer dentin in closer proximity to the crown and, therefore, no layer of harder occlusal dentin could be detected. Consequently, tooth wear appears to be able to progress virtually unhindered in the sampled teeth.

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Refugee presence is positively correlated with host community energetic status in Turkana County, Kenya

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Refugee camps are frequently assumed to negatively impact their host communities through resource competition and conflict. We ask instead whether host communities might benefit from refugees' presence through economic exchange. To assess the impact, we compare anthropometric measures of physical wellbeing between communities in the Turkana region of northwest Kenya. Specifically, our aim was to test whether Kakuma Refugee Camp affects Turkana host community energetic status [body mass index (BMI) and summed skinfold thickness; (n=599)]. For comparison, we sampled four locations across Turkana County: Kakuma Town, adjacent to the refugee camp; Lorugum (170km from Kakuma), an area of sustained development investment; Lokichoggio (96 km from Kakuma), formerly a host to UNHCR and NGOs, and now an underdeveloped community; and Lorengo (50 km from Kakuma), an undeveloped, rural community. Using Lorengo as a baseline for comparison between

locations, and controlling for subjects' ages, we found that BMI did not vary by location among men, and differences in female BMI were significant only between Lorengo and Lorugum (p=0.04). Men had thicker skinfolds, on average, in Kakuma Town (p=0.01) and Lorugum (p=0.06), compared to Lorengo. Women residing in both Kakuma Town and Lorugum had thicker skinfolds, on average, than females living in Lorengo (both p<0.001). Based on these body composition analyses as well as ethnographic and economic data, we suggest that access to resources and trade networks associated with refugees has a positive impact on host community health in this area.

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Predicting language ability from cortical surface morphology

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Language was a key influence in the evolution of the human brain. This behavior was likely associated with gross morphological changes and novel neural networks. As endocasts of hominin skulls only preserve surface features of the brain, we must devise alternative methods to predict underlying connectivity in fossil hominins. Our previous research demonstrated a strong correlation of language and verbal working memory function with overall network connectivity in the language-specific cerebrocerebellar network (LSCN) in humans. In this study we take the next step and test the hypothesis that the complexity of the cerebral surface overlying Broca's area, an important area for language production, is directly proportional to connectivity in the underlying white matter in the LSCN. We quantify the correlation between measures of connectivity in the LSCN and morphology of the cortex in Broca's area using *in vivo* MRI and diffusion tensor imaging (DTI) in young adult males (N=59).

Results indicate that white matter connectivity can be approximated from cortical surface measurements. Specifically, the LSCN is strongly correlated with gray matter surface area and volume of a subdivision of Broca's area, left Brodmann's Area 44. Given the association of Broca's area with language production, these results show that we can predict language behavior from cortical surface morphology when white matter connectivity is included. This novel approach combining surface and sub-surface morphology allows us to make predictions about subcortical connectivity in hominins from analyses of endocasts. This step is crucial for determining when unique behaviors, such as language, evolved in humans.

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Tracing the Origins of Dental Non-Metric Traits in New Mexican Hispanics

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The genetic make-up of Hispanic groups in the U.S. involves a mix of European, Native American, and African genotypes. The relative contribution of these ancestral groups varies across geographic locations throughout the country, however, creating different prevalence patterns of nonmetric dental traits. By estimating the proportionate mix of ancestral populations to modern Hispanic populations, it may be possible to distinguish regional groups in the U.S. As an initial test of this hypothesis, crown trait frequencies from a sample of Albuquerque Hispanics are compared to those of a European sample (Basques) and two Native American samples (Cuicuilco and Tlatelolco). An African contribution is excluded because there is little to no African genetic contribution to this group of Albuquerque Hispanics. A comparison of frequencies for eight dental traits demonstrates there is more similarity between European and Albuquerque Hispanic samples than with Native Americans. Six traits that are markedly different between Europeans and Native Americans show the intermediacy expected of an admixed group, indicating this Hispanic sample is comprised of approximately 75% European and 25% Native American genes. Future research will focus on data from known ancestral groups, rather than potentially related groups, to better trace the origin of these traits in selected Hispanic samples. This research has the potential to be useful in the process of undocumented border crosser identifications by helping to narrow the region-of-origin for decedents.

Prenatal androgen exposure (2D:4D) and its relationship to early growth and adult reproductive effort in men from Cebu, The Philippines

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Prenatal androgen exposure has important organizational effects on growth and development with potential long-term implications for adult male reproductive strategy. Higher prenatal androgen exposure is predicted to lead to more masculinized somatic, behavioral and physiological phenotypes. Using low second-to-fourth digit ratio (2D:4D) of the hand as a proxy of high in-utero androgen exposure, multiple studies have tested this prediction with inconsistent results. Previous work from the Cebu Longitudinal Health and Nutrition Survey, located in the Philippines, revealed that growth velocity in the first 6 months of life, during a temporary period of high testosterone secretion, predicts accelerated maturation, and increased young adult musculature, testosterone and mating effort. Here we report 2D:4D ratios in a large sample of men (N=700-806) from this study and test the prediction that individuals with low 2D:4D exhibit more rapid birth-6 month weight gain and have increased adult mating effort. Men with low 2D:4D (<1.0) had greater birth-to-6-month weight velocity (P=0.03) and reported a greater number of sexual partners during the previous year when surveyed at age 30-31 (P=0.02). Men with low 2D:4D also tended to report earlier age of first intercourse (P=0.07). In contrast, digit ratio did not predict adult testosterone, muscle development, or number of biological children. These findings provide mixed support for a link between digit ratio and adult reproductive phenotype among Cebu males, and point to possible links between prenatal androgen exposure and growth rate during the postnatal period of high T secretion in humans.

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Communication for conservation: reducing disease transmission to mountain gorillas (*Gorilla beringei*) through better message framing to tourists

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Mountain gorillas (*Gorilla beringei)* are a flagship species for biodiversity and as a consequence there is worldwide interest in gorilla ecotourism through exclusive gorilla tracking safaris. This tourism provides substantial revenue for their protection, but puts them in danger of zoonotic diseases. To minimize disease transmission, healthy guidelines such as remaining 7 m from the apes and staying in a cohesive group were instituted. Unfortunately tourists often do not follow these rules putting gorillas at risk. The pre-tracking messages presented to tourists in Bwindi Impenetrable National Park, Uganda were changed to determine if the way messages are framed affects visitor adherence to rules. Tourists (N=389) either received positive, negative, or neutral messages in relation to expectations to follow specific rules that adhere to health guidelines. Tourist behavior was then measured, such as the nearest distance they were

to gorillas, and their cohesiveness. Using a series of generalized linear mixed models, it was found that framing messages differently had a large influence on tourist behavior. Tourists read a negatively framed message had a higher adherence to rules than the positive and control messages. They were 75% further from the gorillas (7.26 vs. 4.52 m), more cohesive (0.40 vs. 0.81 m to each other) and approached the gorillas less (0.34 vs. 1.32 times) than the neutral message ($p<0.01$). The findings provide empirical evidence that communicating in different ways effectively and simply promotes changes in behavior by tourists which reduces disease risk, and illustrates that better communication should be considered during conservation planning.

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Androgen receptor gene CAG repeats, testosterone, and male life history

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Drawing on a large study in the Philippines, we have previously reported that men's testosterone declines as they transition to partnering and fatherhood. These changes in testosterone relate to social behavior, such as paternal care. At this site, newly partnered new fathers experience large testosterone declines, on average, but these testosterone responses are also variable. Little is known about genetic variation that might explain psychobiological variability of this kind. The CAG (polyglutamine) repeat in the androgen receptor (AR) gene is a genetic polymorphism that could have moderation effects for testosterone-related male life history dynamics. Within-populations, the number of AR CAG repeats (CAGn) is typically between eight and thirty-seven, following a normal distribution. Humans with higher CAGn experience lower transcriptional activity of the AR gene after testosterone binds AR, decreasing testosterone's physical effects in these men. Here, we test whether CAGn moderates longitudinal relationships between testosterone and men's life history patterns and childcare. Among men who were single non-fathers at baseline (mean age 21.5 years; n=544), those with shorter CAGn and high testosterone were not more likely to be partnered fathers at age 26.1 years ($p>0.3$). Men's testosterone responses to becoming newly partnered new fathers did not differ based on CAGn ($p>0.1$). New fathers' change in testosteroneXCAGn was not significantly predictive of caregiving involvement ($p\geq0.1$). However, men with high pre-fatherhood testosterone and short CAGn were more likely to become uninvolved parents as new fathers ($p<0.05$), and men with low testosterone and short CAGn were more likely to be highly involved dads.

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Predation by female chimpanzees at Gombe and Kibale: toward an understanding of sex differences in meat acquisition among early hominins

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Since women often hunt, acquiring more meat than men in some contexts, it is surprising that hunting by females is rarely considered in human evolutionary scenarios. Chimpanzees are often used as referential models of early hominins. We use 55 years of data from two chimpanzee communities to test the hypothesis that due to constraints associated with raising offspring, females primarily target less dangerous and less risky prey than males do. Preliminary analysis of data from Kasekela (Gombe National Park, Tanzania) supports this hypothesis. There, females captured only 10% of the red colobus monkeys, 11% of the baboon infants, 21% of the bushpig infants, and 32% of the guenons killed during the study. Capturing these species involves considerable energy expenditure and/or confrontations with dangerous defenders. By contrast, females acquired 68% of the birds (mostly nestlings), 83% of the eggs, and 43% of the bushbuck fawns. These prey items are generally less costly to obtain, although on several occasions, females stole carcasses from adult male baboons. Overall predation was less frequent at Kanyawara (Kibale National Park, Uganda), and was almost entirely limited to arboreal monkeys, which were typically killed by males – females caught only 8% of the red colobus and 20% of the black and white colobus that were killed during the study. These results suggest that female hominins may have concentrated their efforts on low-cost hunts of concealed prey. We test the hypothesis further by examining individual variation in hunting proclivity and the circumstances under which females capture high-risk prey.

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Diurnal testosterone variation among indigenous Shuar men from Amazonian Ecuador

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Male circadian rhythms in testosterone, with higher morning than evening levels, have been well documented in Western populations. Previous research indicates that testosterone levels are lower in traditional subsistence groups than in industrialized populations. Additionally, male testosterone levels often decline with age. However, the extent of testosterone diurnal variation and decline with age varies across ecological contexts. Thus, it would be useful to examine these patterns in non-Western populations to understand the range of human variation and identify ecological factors responsible for these differences. The present study uses preliminary data to examine male diurnal testosterone patterns among the Shuar, an indigenous Ecuadorian population. One morning and one evening saliva sample were collected over three consecutive days; these samples were averaged to provide mean morning and evening levels (N = 28; ages 15-57). Paired t-tests examining within-individual variation suggest that morning testosterone levels are significantly higher than evening levels ($t(27) = 7.93$, $p < 0.001$). Linear regressions indicate that body mass index (BMI), but not age, significantly contributes to variation in afternoon testosterone levels only; higher BMI was associated with lower afternoon testosterone levels (B = -23.70, $p = 0.009$). Peak testosterone levels were compared between Shuar and US men using NHANES data, controlling for age. ANCOVA results suggest US men have significantly higher overall testosterone levels than Shuar men ($p < 0.001$). It appears that Shuar testosterone diurnal patterns are similar to those previously documented, with higher morning than evening

levels, yet are generally lower than levels in industrialized populations.

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The Monkeybar Project: Population Density of Long-Tailed Macaques (*Macaca fascicularis*) in Two Different Forest Types in Kudat District, Sabah, Malaysia

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Non-human primates and humans interact in a number of different capacities that allow for cross-species disease transmission. Research on the pathogen sharing between humans and primates has focused mainly on diseases such as influenza, *Cercopithecine Herpsevirus* 1 (herpes B), measles, simian immunodeficiency virus, and Ebola. Although a body of research exists on non-human primates and malaria, little work has been done on the most recent strain of malaria to be discovered, *Plasmodium knowlesi,* for which long-tailed and pig-tailed macaques are a natural host. Largely limited to Malaysia, *P. knowlesi* has the shortest life cycle of all of the malaria parasites known to affect humans, and is therefore capable of becoming fatal in the event of delayed or inadequate treatment. As a component of a large, multidisciplinary project exploring the environmental, biomedical, and social risk factors for transmission of *P. knowlesi,* we assessed the population density of long-tailed macaques (*Macaca fasicularis*) in two different forest types, intact and fragmented. We used line transect and Distance sampling techniques to assess macaque density over a period of 12 months from November 2013 to October 2014. Our preliminary results reveal that macaque density was higher in the intact forest compared fragmented forest that contained oil palm, rubber, acacia, and coconut plantations. These results will be combined with radio collar data to further map the macaques' movement in relation to nearby human settlements in order to better understand the potential for malaria transmission between species.

Predicting platyrrhine locomotor behaviors using principal component regression

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This study utilized Principal Component Regression (PCR) to create predictive models of common platyrrhine locomotor behaviors: leaping, suspending and climbing. Regressing known locomotor profiles onto principal component scores of 3D geometric morphometric shape data lead to predictive models for four different bones (distal humerus, proximal ulna, astragalus, calcaneus), and combinations of these bones (elbow, ankle, all bones). Regressions used to predict suspending behaviors were strong, while leaping and climbing regressions were only moderately effective. Predictive models, each with $N \geq 20$ species, consistently estimated behaviors of an extant test sample to within 5-10% of an appropriate intrageneric comparison. Platyrrhines with little published behavioral data, such as *Aotus*, are now predicted with PCR. These predictions can be used as working hypotheses to be tested in the field.

Extinct taxa were also predicted here using both a full and minimal landmark coverage in order to include fragmentary fossils in the 3DGM shape analysis. Predictions from several fossil platyrrhines were compared to behavioral reconstructions drawn from traditional functional analyses. *Dolichocebus gaimanensis*, for example, represented by a single astragalus, has previously been depicted as a leaper based on morphology of the trochlear and ectal facets, but was predicted by PCR to exhibit relatively little leaping and more suspending. Results for other taxa, such as the Caribbean subfossil, *Antillothrix bernensis*, supported previous reconstructions of this taxon as a climber with some suspending behaviors, and with little predicted leaping. These predictive models will improve with additional behavioral data, including postural behavior profiles and substrate preference data.

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Patterns of Mandibular Molar Expansion in Megadont Primates

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Australopithecines share an unusual molar relationship among primates in which the distal molars get progressively larger. The "robust australopithecines" (a.k.a. *Paranthropus robustus* and *P. boisei*) take this trend to an extreme with M3s that can be up to 21% larger than M1. Few Catarrhines share this pattern. Among them are species in *Papio, Macaca, Nasalis* and *Cercopithecus*. This study investigates whether molars under pressure to grow larger will do so in the same way across closely related genera. The results show this is not the case. *P. robustus* and *P. boisei* both exhibit molars that expand more bucco-lingually, while the catarrhines examined expand more mesio-distally. The similarities between *P. robustus* and *P. boisei* may be due to both taxa having more orthognathic faces and shorter jaws than the catarrhines in this study. It remains unclear whether the dental similarities in increased crown area of these hominin species are the result of recent shared ancestry or whether they both resemble what would be expected of any short faced hominin experiencing pressure to increase molar occlusal area.

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Variation in the trabecular structure of the proximal tibia between obese and non-obese females

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Obesity can add a biomechanical burden to the human knee joint. Since mechanical usage influences trabecular architecture, differences between obese and normal weight individuals should be reflected in the trabecular structure of the knee joint. In this study, we conduct a preliminary assessment of the differences in trabecular architecture of the proximal tibia in obese and non-obese females. High-resolution computed tomography was used to scan the left tibia of five obese and five non-obese, age-matched females. A cubic volume of interest (VOI) was extracted from below the center of the medial and lateral condyles of each tibia. Bone volume fraction, connectivity density, degree of anisotropy, structure model index, and trabecular thickness and separation were calculated for each VOI. Two-tailed t-tests show that obese individuals have significantly greater bone volume fraction and lower trabecular separation in both condyles. Connectivity density, a proxy for trabecular number, was also significantly greater in obese females, but only on the medial side. There is a nearly significant difference in anisotropy in the medial condyle, with obese females having less oriented trabecular structures than non-obese females.

Trabecular thickness was not significantly different for either condyle. The results of this preliminary study suggest that the biomechanical burden of obesity is reflected in the proximal tibia trabecular structure of females. The differences between obese and non-obese females are more pronounced in the medial condyle and are due to the addition of trabeculae in obese females rather than an increase in the trabecular thickness.

Developmental coordination of the masticatory system constrains molar emergence across primates

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Paleoanthropologists use the relationship between life history and molar emergence age to probe the antiquity of the unique human life history profile. Knowledge is lacking about how variation in molar emergence age arises and why it is closely associated with key aspects of life history. This study examines molar emergence as part of a developing, functionally integrated chewing system. Developmental coordination among parts of the masticatory system is critical for food ingestion throughout life. One important biomechanical relationship established across adult primates is the position of the molars relative to the adductor muscle resultant (MR): in adults, molars lie anterior to the MR thereby avoiding damage to the temporomandibular joint during chewing. The relative position of molars and cranial musculature changes throughout ontogeny, suggesting that a shifting masticatory configuration throughout growth may provide a fundamental constraint modulating molar emergence times. We used 3D coordinate data from cross-sectional ontogenetic samples of primate skulls (n = 12 species) to quantify the position of emerging molars within a growing masticatory configuration. For all taxa examined, all permanent molars emerge significantly anterior to the MR, suggesting that the position of molar emergence is constrained by the biomechanics of mastication. Identifying this developmental constraint across taxa that vary in craniofacial configuration and timing of molar emergence suggests that ontogenetic changes in masticatory configuration regulate variation in molar emergence schedules among primates.

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Multivariate ordinal probit analysis of the McKern and Stewart pubic symphysis scoring system

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McKern and Stewart proposed a component based approach to scoring age related changes in the pubic symphysis. While their system has largely been abandoned, other systems have been proposed that break the morphology of a small region, such as the pubic symphysis, into a number of individual ordinal traits. Because of increasing interest in such approaches, we have conducted a multivariate ordinal probit analysis of the pubic symphysis.

The data consist of McKern and Stewart and Todd scores on 412 males from the Terry Anatomical Collection and 350 casts of individuals from McKern and Stewart's Korean War Dead study. As the six stages within the three components of McKern and Stewart's scoring system and the ten stages within Todd's scoring system had very low goodness-of-fit p-values against log-normal transitions, we collapse the scorings so that there were four stages within each of McKern and Stewart's components and six stages within Todd's system. McKern and Stewart's third component was eliminated from further consideration because it was invariant across all but the last stages of components two and three. We then fit bivariate ordinal probit models with age on the log scale and found significant positive residual correlations of 0.853, 0.800, and 0.677 between Todd and MS-1, Todd and MS-2, and MS-1 and MS-2 scores, respectively. Given that high positive residual correlations among age "indicators" is probably the rule rather than the exception, multivariate age estimation methods must account for this lack of independence after conditioning on age.

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Spatial Patterning (or lack thereof) in Osteon Population Density in the Human Rib

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Previous research has demonstrated the density of secondary osteons in cortical bone to be a useful variable in addressing many questions of anthropological importance. Osteon population density (OPD) demonstrates a significant relationship with human chronological age and has been suggested useful in interpreting biomechanical loading on bone. However, when quantifying OPD most research has focused on small regions of interest, rather than examining the entirety of a bone cross section. Our recent work demonstrates there is significant patterned spatial heterogeneity in cortical remodeling density at the femoral midshaft, likely the result of biomechanical loading. This research sought to examine if such spatial patterning extends to the axial skeletal, specifically the rib. It was hypothesized the cutaneous cortex of human ribs, more subject to tensile forces during respiration, would have higher OPD than the more compressively loaded pleural cortex.

Fifteen complete cross sections were taken from the midshaft of mid-level ribs of modern male cadavers (aged 15–64), microscopically imaged, and digitally subdivided into pleural and cutaneous cortices. All remodeling events from each cross section were manually notated using geographic information systems software (ArcGIS 10.1), and OPD calculated for each rib cortex. Density maps of remodeling events failed to demonstrate any distinguishable pattern, and a paired t-test confirmed that OPD does not differ significantly between pleural and cutaneous cortices ($p=0.418$). The lack of difference in rib cortices suggests that cyclic respiratory loading is not sufficient to yield an observable pattern in remodeling density, as is possible in dynamically loaded bones.

New evidence of widespread hunting of giant lemurs on Madagascar

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The importance of hunting as a trigger for megafaunal extinction in Madagascar has been questioned on the grounds that direct evidence of human butchery of giant lemurs and other megafauna is rare and human settlement sites show little if any evidence of megafaunal exploitation. We surveyed 522 humeri and femora of giant lemurs *Pachylemur*, *Archaeolemur*, and *Palaeopropithecus* from four subfossil sites, Tsirave, Manombo Toliara, Beloha Anavoha, and Ampasambazimba, looking for evidence of cut marks made by humans. Thirty-three of these bones show positive signs of human butchery (including 12.9% of the sample at Tsirave), as confirmed by microscopic examination of molds of the cuts. We selected eight *Pachylemur insignis* specimens with newly identified cut marks from one of these sites (Tsirave) for radiocarbon and isotope (carbon and nitrogen) analysis. We also identified 186 humeri and femora of these genera from these sites with diagnostic signs of nonhuman (avian, carnivoran, or crocodilian) predation. We show that: 1) direct evidence of butchery (all taxa and all sites examined) is widespread in Madagascar; 2) cut marks are distributed on bones in a patterned fashion; 3) there is predictable site bias: i.e., floodplain sites with strong terrestrial predator presence are more

likely to yield bones with human-made cut marks than are lakes or marshes with strong crocodilian predation; 4) giant lemurs were butchered as recently as 1000 years ago; and 5) without recognizing them as such, paleontological explorers in the early 1900s apparently dug through stratigraphic units bearing concentrated evidence of early human occupation.

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Evaluating minimally invasive methods of telomere length measurement: A sub-study of the WHO Study on Global AGEing and Adult Health (SAGE)

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Telomere length (TL) has been proposed as a biomarker of aging and disease in anthropological research. However, it has yet to be determined if biological samples commonly collected in field-based studies will yield TL estimates that are comparable to those obtained from whole blood collected by venipuncture. Because telomere length is cell-type specific, we predicted the relationship between TL and chronological age would vary between samples (e.g., blood and saliva) and collection protocols. To test this, we extracted DNA from buffy coat collected from venous blood, saliva collected using Oragene collection kits (passive drool), and saliva collected using the Oasis salivary collection kit (includes buccal abrasion) from 40 women divided into two age groups, 18-22 years (n=20) and 47-77 years (n=20). The quantity of extracted DNA was assessed using the Qubit 2.0 Fluorometer and the quality using a Nanodrop 2000 spectrophotometer. TL was then measured using Cawthon's monochrome multiplex qPCR assay on a Bio-Rad CFX96. Our preliminary analyses found that TL displayed the expected inverse relationship with participant age in the buffy coat DNA only (R^2=0.23, p=0.008). In addition, there was a significant correlation between Oragene TL and buffy coat TL (R^2=0.25, p=0.03) but no correlation between TL values from Oragene-collected and Oasis-collected saliva, or between Oasis-collected saliva and buffy coat. We are currently adding capillary blood (dried blood spot cards) to our dataset. The results of this study will help assess the costs and benefits of measuring TL using less expensive and/or minimally invasive field-friendly techniques.

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Skeletal indicators of lower limb flexibility in australopithecines and extant primates

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Diversity in the lower limb anatomy of fossil hominins suggests functional-mechanical differences across taxa. This study seeks to test the hypothesis that australopithecines exhibit a mechanically different form of bipedality than modern humans by examining lower limb flexibility. In order to test this hypothesis, nine skeletal indicators of lower limb flexibility were quantified in *Australopithecus afarensis, Au. africanus, Au. sediba*, *Homo habilis*, *H. erectus, H. sapiens, Gorilla, Pan, Pongo, Hylobates, Ateles,* and *Cercopithecus.* Taxa were scored on a leg flexibility gradient to estimate its arboreal/bipedal tendency. Each trait was scored from 1-0 for its lower limb flexibility: a score of 1 indicates maximum flexibility, and a score of 0 indicates stiffness. I summed these scores for all traits measured for a given taxa to calculate its mean flexibility score. Results show that australopithecines possess greater lower limb flexibility (mean score 0.36) as compared to humans (mean score 0.07); and that older australopithecines such as *Au. afarensis* retained a greater amount of foot flexibility (mean score 0.42) than younger specimens such as *Au. africanus* (mean score 0.3). These results suggest that australopithecines retained a significant amount of arboreal lower leg use and consequently utilized a mechanically different form of bipedalism than modern humans. Understanding whether australopithecines retained a significant amount of arboreal lower leg use while practicing bipedality has implications for inferring the selective pressures involved in the initial evolution of bipedality.

Patterns in ontogeny of epiphyseal and metaphyseal trabecular bone microstructure in the human proximal tibia

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During growth, metaphyseal trabecular bone architecture is gradually altered due to development of new trabeculae from the growth plate, while epiphyseal trabeculae are formed from the secondary growth center. This leads to differential patterns of development and load adaptation. The purpose of this study is to quantify and compare these ontogenetic patterns in the metaphysis and epiphysis of the proximal tibia using six morphological parameters: bone volume fraction (BV/TV), mean trabecular thickness (Tb.Th), mean trabecular spacing, structure model index, connectivity density, and degree of anisotropy. High-resolution CT scans were collected for 29 tibiae from the Norris Farms #36 skeletal collection, with individuals ranging in age from 8 to 35 years old. Morphometric analysis was performed for 11 volumes of interest (VOIs) using ImageJ. VOIs were positioned below and between tibial condyles within the epiphyseal and metaphyseal regions. General linear model analysis was performed to test the association between region and parameters. With age, trabecular microstructure is defined by an increase in Tb.Th, in both regions, with a higher average in the epiphysis ($p < 0.01$). Additionally, an increase in BV/TV is observed, with higher values in the epiphysis. These results indicate that age-related changes in loading have varied effects on trabecular bone morphology within the proximal tibia. More specifically, trabeculae in the epiphyseal region are likely more directly influenced by loading than trabeculae in the metaphyseal region during growth. Understanding the spatial specifics of ontogenetic processes during bone development can offer insights into adult morphological variation in health and disease.

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The influence of brain size on canal radius of curvature

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Semicircular canal radius of curvature (CR) is correlated, albeit weakly, with locomotor agility when body mass is controlled for. But relative brain size also may play a role in CR. If so, one would predict that once body size is accounted for, just as with locomotor variation, brain size also should explain a significant amount of residual variation in CR.

We compiled body and brain mass and CR values for six orders of extant mammals. In PGLS regressions, larger brained species have relatively large canals compared with smaller-brained species. In contrast, when CR is regressed against brain size neither large-brained nor small-brained taxa are conspicuous positive and negative outliers, respectively. Thus, brain size has an important effect on CR size independent of locomotor differences.

As a second step, we included **six** Paleogene stem primates and euprimates, known to have relatively small brains compared with extant primates. As with the extant mammalian taxa, when CR is regressed against body size, the

small-brained fossil taxa resemble extant small brained mammals in having relatively small CRs. But when CR is regressed against brain size, the fossil taxa are not outliers.

The findings for Paleogene taxa reinforce the conclusion from the extant sample: relative brain size is an important correlative of relative CR size. Relatively small CRs in Paleogene primates may be a consequence of having smaller brains, not having slow locomotor movements, a finding more compatible with locomotor abilities inferred from postcranial anatomy.

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Thoracic Fracture Patterning as a Result of Blast Trauma

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Previous studies indicate the biomechanical response of bone to a blast event differs from that of blunt or ballistic trauma. Bending and tensile strength of the ribs and vertebrae have been tested using high-grade explosives. However, it is unclear how the thoracic region experiences and mitigates forces as result of positive and negative wave pressure, particularly when fragmentation is present.

While these studies demonstrate the utility in using thoracic fracturing as a unique indicator of military blast trauma, the existence of these patterns has yet to be tested using explosive devices typical of domestic terrorism. This study tests the effects of the blast wave, shrapnel material, and victim distance to an explosive device on skeletal fracture patterning in a sample of wild pig (*Sus scrofa*) specimens (n = 8). Pig carcasses were placed at set distances from the device in front of a wall to magnify negative blast wave pressure.

Results demonstrate clear patterns of costal butterfly fracturing in all specimens, regardless of distance. Tensile indicators were observed on the dorsal (visceral) surface of the body of the rib, likely as a result of compressive force experienced ventrally. Vertebral fracturing is consistent with hyperextension of the thorax. Secondary trauma from fragmentation was also evident in the thoracic region, however its presentation differed with distance from the device. These trends provide a more detailed picture of skeletal trauma associated with blast events and the biomechanical reaction of affected bone.

Cranial base height as an indicator of developmental stress in native Mexican and American-born Mexican populations

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Cranial base height, much like stature, has been used as an indicator of developmental stress in human populations since J. Lawrence Angel first proposed the idea in 1982. Previous research on the cranial base has involved the study of secular change in historic populations, but it has not often been used to explore differences in developmental stress in modern populations. Current views of Mexican migrants often hold that this population is impoverished, malnourished, and under a high disease load during growth and development. The present research allows for an empirical analysis of this viewpoint by comparing the height of the cranial base in a Mexican-born population (n=137) from the Pima County Office of the Medical Examiner and Xoclan and Zimapán documented collections, and an American-born population of Mexican descent (n=13) from the Texas State University Donated Skeletal Collection and the University of New Mexico Documented Skeletal Collection.

Landmark data were collected using a Microscribe® G2 3D digitizer and 3Skull software. Data were analyzed with an ANOVA in Excel, using the Real Statistics Add-in. Males and females were analyzed separately in order to control for size differences associated with sex. Cranial base height was not significantly different in females ($p=0.3646$), and only slightly significant when rounding down in males ($p=0.05647$). These findings indicate that the levels of developmental stress in American-born Mexicans and native Mexicans are not drastically different, which has broader social implications for understanding the environments from which migrants leave and those to which they migrate.

Intersexual Affiliation in a Troop of Ring-Tailed Lemurs (*Lemur catta*)

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The occurrence of female dominance among the Lemuriformes has prompted extensive research into the mating strategies and mate choice of several species, particularly ring-tailed lemurs. Female mate choice has been suggested to be particularly significant when understanding these complex mating strategies. The focus on female dominance, however, may obscure the complexities of intersexual affiliations that can have consequences for later mating opportunities. While males may use short-term strategies to increase their chances of breeding with females, continuous residence with females provides the opportunity for the use of long-term reproductive strategies. We studied intersexual relationships among adult individuals using grooming and proximity as measures of affiliation. Subjects were a group of semi-free-ranging ring-tailed lemurs (N=17) on St. Catherines Island, Georgia. Data was collected on social behavior using all occurrence sampling. Focal animal sampling was also used to collect behavioral and proximity data. When excluding related individuals, male-female grooming occurred less frequently than male-male and female-female dyads. However, social grooming was not equally distributed across all male-female dyads. The lowest ranking females were groomed by every adult male whereas the high ranking females were only groomed by certain males. Low ranking females were also observed to be in closer proximity to males more often than high ranking females; 20% and 6% of proximity scans, respectively. These data highlight asymmetries in intersexual relationships among these lemurs. These relationships should be considered when studying reproductive strategies and mate choice.

Sex diagnosis of the human dentition after heat exposure: the potential of cementum-enamel junction and root dimensions

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Teeth are often the only elements preserved from human skeletons after cremations, intentional or accidental burning. Thus, the potential of odontometry for sample-specific sex diagnosis was investigated. A sample of permanent lower second pre-molars, donated by 40 patients (20 males and 20 women) extracted in dental medicine clinics were experimentally burned at 900°Cto assess heat-induced changes in seven dimensions of the cementum-enamel junction and the root. Four of them, cementum-enamel junction perimeter, mesiodistal, buccolingual and perimeter at the mid-root level, were investigated for the first time. Also, five measurements combining some of the isolated standard measurements were investigated. Additionally, 10 permanent upper central incisors and 10 permanent lower first molars were experimentally burned at 400°C and 700°Cto document heat-induced dimensional changes and serve as comparison with the 900°Csample. Results showed that most of the standard measurements, although presenting significant sex differences, were not reliable enough to allow for correct sex classifications above 80% both before and after the burning. Nonetheless, the perimeter at the cementum-enamel junction and the combined measurement

of the mesiodistal and buccolingual diameters, at the same level, were quite promising before and after burning, with correct sex classifications above 80%. At 900°C, in average, females were slightly more affected by shrinkage in the perimeter at the cementum-enamel junction than males thus artificially increasing sexual dimorphism after burning. Although additional research is needed, these measures apparently have good potential for sample-specific sex diagnosis in individuals recovered from archaeological and forensic contexts.

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The strategy of cognitive buffering to deal with environmental seasonality is unique to higher primates

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Explaining interspecific variation in brain size requires taking two perspectives: On one hand, maintaining a large brain is energetically very expensive and requires a continuous supply of energy throughout the year. On the other hand, a large brain entails enhanced cognitive abilities, allowing for behavioral flexibility to meet challenges. From the first perspective, energy deficits in lean periods predict a negative correlation between experienced seasonality and brain size (Expensive Brain hypothesis). From the other perspective, finding hidden food sources in seasonal habitats may be cognitively challenging, predicting a positive correlation between brain size and the degree of buffering habitat seasonality (Cognitive Buffer hypothesis). We test the two non-exclusive hypotheses in a broad sample of Carnivora and Rodentia and compare the results to recent findings in primates. Our results confirm the predictions of the Expensive brain hypothesis in all mammalian clades – primates, rodents and carnivores, whereas cognitive buffering was found to be unique to higher primates, i.e. platyrrhines and catarrhines, probably due to a lack of alternative strategies. Lemurs, on the other hand, show a similar pattern as rodents and Carnivora, which do not exhibit cognitive buffering, but use alternative buffering strategies such as hibernation or a switch in diet towards more meat-eating to deal with seasonally lean periods.

These findings suggest that we humans as a carnivorous primate use a combination of two strategies, a switch in diet and cognitive buffering, which enables us to live in a great variety of different habitats with varying degrees of environmental seasonality.

Birth since the LCA: Reconstructing the twisted evolution of human parturition

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The pelvis is at the center of two distinctly human traits: efficient habitual bipedalism and a birth canal that allows for passage of a relatively large-brained neonate. Previous research on hominin obstetric evolution has focused on differences between fossil species and modern humans in pelvic morphologies related to birth. A number of hypotheses have been proposed for the role these differences played in parturition and for the selective forces that produced these changes, but whether the morphological changes seen in the birth canal were actually the result of selection for this behavior is unknown. Here we use evolutionary quantitative genetic models to test the hypothesis that strong directional selection was responsible for the differences observed in the birth canal across a sample of fossil hominin hips spanning the Plio-Pleistocene. Our approach uses covariance among traits and the differences between relatively complete fossils to estimate the net selection pressures that drove the major transitions in hominin obstetric evolution. Our findings show that a number of morphological changes in the birth canal were driven by selection on other traits, including those fundamentally important for parturition. Specifically, our results suggest that pelvic inlet and outlet dimensions have changed independently and in different directions due to apparent disparate selection pressures, complicating the story of human birth and may suggest rotational birth was restricted to our own species.

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Reconstructing the Origins of the Perrins Ledge Cremains

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Perrins Ledge is a Late Woodland period (A.D. 600-850) crematory located in the lower Illinois River valley that exhibits in situ burning and burial, a combination that is rare among Late Woodland period mortuary sites of this region. The group(s) that utilized the crematorium to dispose of their dead has remained unknown. Typological characteristics of the artifacts recovered from Perrins Ledge are similar to artifacts recovered from a number of different sites from the surrounding and more distant areas. In this study the origins of the 13 individuals cremated at Perrins Ledge were reconstructed using strontium isotope analysis via thermal ionization mass spectrometry. It was expected that strontium isotope signatures ($^{87}Sr/^{86}Sr$) derived from the Perrins Ledge cremains would mirror those derived from neighboring contemporary habitation sites. Regional baseline signatures from five faunal specimens of species known to have small foraging ranges from each of three contemporary sites (Newbridge, Carlin, and Apple Creek) (n=15), located within 10 miles of Perrins Ledge, were compared with strontium signatures derived from bone (n=13) and enamel (n=5) samples procured from the Perrins Ledge cremains. Results indicate that signatures from 4 of the 18 samples representing the Perrins Ledge individuals fall within two standard deviations of the mean strontium ratio for at least one of the three baseline sites and thus classify as local. Given that the majority (n=14) of the Perrins Ledge cremains classify as non-local other hypotheses aiming to identify the group(s) that used the crematory need further exploration.

Functional differentiation of the propulsive and braking roles of the forelimbs and hindlimbs during quadrupedal locomotion

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In primate and non-primate quadrupeds, the forelimb has been described as 'net braking' while the hindlimb is 'net propulsive.' However, the mechanism underlying this functional differentiation of the limbs is unknown. Identifying the functional role of each limb is essential to understanding primate locomotor adaptations. The model presented here predicts that when the hand or foot is placed cranial to the center of mass (COM), the associated limb will produce a braking force, and will transition to a propulsive force as the hand or foot pass behind the COM, which may not necessarily occur at mid-stance. Therefore, since the hand is usually positioned cranial to the COM throughout support phase, the forelimb is in a more effective position to produce a net braking force while the hindlimb is better equipped to produce a net propulsive force because of foot position. To test this, we collected single limb forces from twelve primate species, and from these data determined net impulse, timing of mid-stance, and the braking to propulsive transition (B/P) for each limb. As predicted, the forelimb was on average net braking (-2.57 bws) while the hindlimb was net propulsive (2.38 bws). The B/P occurred on average 22.05% later than mid-stance in the forelimb, and 15.07% earlier than mid-stance in the hindlimb. This finding likely represents biomechanical rule for all quadrupeds. Primates, which are noted for increased protraction and retraction, may display amplified functional differentiation of the

braking and propulsive roles of the limbs when compared to non-primate quadrupeds.

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Consequences of hybridization in Darwin's finches

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On the island of Isla Daphne Major in the Galápagos rare hybridization occurs between two resident species. Following a major El Niño event in 1983 that altered the ecological conditions on the island, hybrids survived and backcrossed to their parental species. The evolutionary consequences of this rare gene exchange are examined. The genetic and phenotypic variation of both species was enhanced, and in each species new genetic variants were acquired that contributed to phenotypes that were better adapted to the new environmental condition. Admixed individuals with their novel genetic and phenotypic structure can, in a different environment, lead to the development of a new species. Such a situation was observed on Daphne and was followed from its inception for six generations. An immigrant hybrid from an adjacent island was the starting point of an evolutionary trajectory leading to a new lineage. Members of the lineage bred amongst themselves and with no other species. These observations on genetic exchange in contemporary time match genetic evidence of extensive interspecies gene flow throughout the phylogeny. Thus Darwin's finches, although apparently far removed from human evolution, may in fact be a guide as to what happens generally in the biological world when relatively young species encounter each other after a period of separation and divergent evolution.

Hybridization in Darwin's Finches

PETER R. GRANT. Ecology & Evolutionary Biology, Princeton University.

There are 10,000 species of birds and at least one in six species is now known to hybridize with another. Many hybridization events are evolutionarily doomed by inviability or infertility, but a significant number lead to an exchange of genes. The most detailed investigation of introgressive hybridization has been carried out with Darwin's finches in the Galápagos. At least 14 species have evolved from a common ancestor in the last one to two million years. Perhaps because the group is young, intrinsic barriers to gene exchange appear to be lacking, and indirect evidence suggests that introgressive hybridization occurs widely in the archipelago yet never commonly. On the small island of Daphne Major the medium ground finch hybridizes rarely with the small ground finch and the cactus finch. A study on this island extending for 40 years has shown why hybridization occurs and why hybrids backcross to a particular parental species. Hybridization occurs when young finches learn the song of another species, and as adults choose heterospecific mates that are not much larger or smaller than themselves. In the early part of the study hybrids did not survive well, but after a strong El Niño event in 1983 altered the composition of the vegetation hybrids survived as well as the parental species. The direction of backcrossing, as in conspecific mate choice, is strongly influenced by paternal song. Inasmuch as song is learned in the majority of terrestrial bird species these results are likely to be generalizable.

Experimental water switch in sheep improves models for seasonal climate reconstruction

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Seasonal climate patterns impact ecosystem productivity and human subsistence, and are hypothesized to have influenced early human technological development. Rainfall patterns are reflected by oxygen isotope ratios in mammalian tooth enamel, which records environmental chemistry during mineralization. Herbivore molars, abundant in fossil and archaeological assemblages, are commonly used for seasonal climate reconstruction through repeated isotope sampling. However, this approach has been hampered by incomplete knowledge of tooth mineralization. Here, we test the relationship between seasonal hydrology and tooth isotopes experimentally, using fine-scaled phosphate $\delta^{18}O$ measurements in the enamel of sheep subjected to controlled water switches (n=6). We compare these measurements to high-resolution isomap predictions, based upon tooth growth models developed from synchrotron-based quantitative mineral density mapping. We furthermore measure feed, drinking water, and sheep blood $\delta^{18}O$ repeatedly throughout the experiment. Tooth mineralization, blood oxygen turnover and isotope measurements demonstrate that enamel secretion and maturation occur in two waves that are distinct in timing and geometry. Previous mineralization models fail to account for isotope shifts during enamel maturation from amorphous precursors; however, new discoveries in the field of biomineralization are crucial for accurate reconstructions of past climates from isotope values. Our proposed model of herbivore tooth mineralization addresses these shortcomings, relates tooth isotope measurements to seasonal rainfall patterns, and will aide in further explorations of the relationships between climate, behavior and human evolution.

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A re-evaluation of the Health Index of Southern Brazil shellmound populations

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The shellmounds located in Southern Brazil coast show archaeological evidence of prolonged human activity from ~6000 to 1000 BP. The fisher-hunters-gatherer groups that dwelt on these sites were well adapted to the local environment, and the shellmounds show clear traces of habitation practices, including feasting, accumulation of material waste, and human burials. As such, the human remains recovered from these sites are an important source of information on health and overall lifestyle of these Mid-Holocene populations, and as such were included in the comparative analyses of the Western Hemisphere World Health project. Using the Health Index, which considers the prevalence of seven health and lifestyle skeletal markers, the Brazilian shellmounds show the highest index value in the entire continent. However, this result is based on collections that lacked postcranial remains, and therefore they may be misrepresenting the relative health of these local populations. Here, we calculated the Health Index for a shellmound sample of 22 complete skeletons recovered from the site Porto do Rio Vermelho 02 (Santa Catarina, Brazil). The Health Index for the complete skeletons is 65.6%, which is lower than the average reported for American series in the project (72.6%) and considerably lower than the index reported for the incomplete shellmound series (91.8%). The difference is due to a large prevalence of infectious disease and low stature observed in the postcranial skeleton, which characterize shellmounds groups in general. Therefore, while a useful comparative statistic, caution should be used when applying the Health Index to incomplete skeletal series.

Deviant burials and social identity in a post-medieval Polish cemetery as interpreted using stable oxygen and carbon isotopes

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Deviant burials can reveal important information about both social and individual identity, particularly when the mortuary record is supplemented by an examination of skeletal remains. At the post-medieval (17^{th}-18^{th} c. AD) cemetery of Drawsko, Poland, six individuals (of n=285) received deviant, anti-vampiristic mortuary treatment. A previous study using strontium isotopes (x= 0.7112 ± 0.0006, 1σ, n=60) found that these "vampires" were in fact locals, not migrants to the region targeted for deviant burial due to their status as immigrant outsiders. However, considerable geologic overlap in strontium isotope values across the North European Plain may have prevented the identification of at least some non-local individuals. This study further contextualizes strontium isotope data by examining stable oxygen and carbon isotopes from the dental enamel of the same individuals in order to test the hypothesis that additional non-locals were present in the Drawsko cemetery.

Both $\delta^{18}O_{c(VSMOW)}$ (x= 26.3 ± 0.7‰) and $\delta^{13}C_{ap}$ ratios (x= -13.6 ± 0.8‰) displayed little variability and were not significantly different between vampire and normative burials for either oxygen (p=0.38) or carbon (p=0.11), supporting the prior strontium results. Nevertheless, two adult males exhibited depleted oxygen and carbon ratios indicative of a non-local origin, one of which was also identified as a migrant using strontium. Subsequently, those interred as vampires appear local to the region and must have had deviant mortuary treatment due to a disruption of some other social construct in life or because of a specific type of death.

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A Matter of Perspective: The Influence of Anatomical Reference Frame Construction on Cross-Species Biomechanical Comparisons

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Comparative evolutionary biomechanics applies information from living forms as a basis for interpreting functions within extinct species. When applied to human evolution, this field represents an intersection of anthropology, paleontology, biology and engineering. Each of these fields is associated with unique interpretive assumptions. These assumptions will sometimes conflict. As users of these types of data, it is necessary that we be aware of these conflicts and how they might influence our interpretation of fossil functional morphology. One example of a common biomechanical conflict can be found in the construction of the anatomical reference frame. This presentation will use an example from the foot to show how common assumptions on constructing the anatomical position will influence the appearance of kinematic data.

Sample data are derived from foot kinematics of six humans, five chimpanzees and six baboons. Anatomical reference frames are constructed from bony landmarks. These landmarks follow conventions used in most human biomechanical investigations (ISB standards). However, examination shows that morphology, and therefore landmark positions, vary in ways that are unrelated to joint biomechanics. Hence, analyses may illustrate differences that are due more to morphology than to function. Until the reference frame can be constructed in a way that is biologically meaningful and functionally identical among these many difference species, fully meaningful biomechanical comparisons may not be possible. By implication, some interpretations of the evolution of hominine musculoskeletal functions may be drawn from misguided applications of comparative biomechanical analyses.

Fracture patterns of early first Millennium B.C. mounted Pastoralists in the Kunlun Mountains, China

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The burial site of Liushui in Xinjiang, West China, dates to the early first millennium B.C. The mounted pastoralists living in this area suffered from various diseases, with entheseal changes and fractures being particularly common. Paleopathological examination was carried out on 100 individuals. The skeletons were examined with macroscopic and optical-microscopic techniques.

Age and sex distribution of the fracture patterns will be discussed as well as their probable connection to the way of life of these people. The frequencies of fractures of different body parts will be compared to those in other populations. For example, when compared to people engaged in animal husbandry from the Bronze Age in Southern Russia, the fracture pattern is quite different: In Liushui the highest frequency of fractures occurred in the skull, followed by the upper and lower extremity. Fractures of the ribs and spine are less common whereas they are the most common fractures in the Bronze Age people from Southern Russia. In Liushui, perimortem fractures, particularly of the skull and mainly produced by blunt force trauma, indicate the presence of interpersonal violence.

The effects of posture on neck and trunk musculature in *Hylobates lar* and *Macaca fuscata*

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Variation in muscular size and arrangement are central to understanding how head and neck posture are maintained during locomotion and how mechanical forces influence vertebral form. A comparative framework can define how postural differences affect the muscles of the axial skeleton. *Hylobates lar* and *Macaca fuscata* have similar head and neck postures but possess different trunk postures during locomotion. This study aims to understand how the difference in trunk posture affects the muscular anatomy of the neck. The macaque has a semi-pronograde neck and a pronograde trunk. These orientations allow the neck muscles to extend into the thorax, thereby increasing mechanical advantage. Gibbons, however, possess a semi-pronograde neck but an orthograde trunk. The angle between the neck and trunk exceeds 180°, creating a mechanical environment where neck muscular force cannot extend beyond the cervicothoracic junction. This shortening should cause an increase in muscle mass to maintain a similar degree of muscular force.

Two specimens of each species were dissected. Muscles were removed and wet-massed. In *M. fuscata*, splenius capitis and semispinalis capitis extended to the sixth thoracic vertebra but in *H. lar* these muscles terminated at the first thoracic vertebra. No differences were found in relative muscle mass, despite the noticeable change in length. This research elucidates the manners in which head and neck posture are maintained and the effects of postural behaviors on muscular anatomy. Further studies linking nuchal muscle differences to skeletal features will prove useful for understanding postural function and the evolution of trunk orthogrady in hominoids.

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Primate cranial shape evolution: combining geometric morphometrics and phylogenetic comparative methods

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Interspecific variation in primate cranial shape is the result of complex interactions between numerous selection pressures, constraints, and phylogenetic history. In this study, we integrate 3-dimensional geometric morphometrics and phylogenetic comparative methods to investigate the major factors driving the direction and rate of cranial shape evolution across primates. Our cranial shape data include 18 landmarks for a single representative male and female specimen of nearly all primate genera. In support of well-known allometric patterns in primates, we found that increased cranial size is associated with relatively smaller orbits and increased basicranial flexion. Sexual dimorphism in body mass is associated with an overall lengthening of the face in both males and females, explaining twice as much variation in males compared to females. By contrast, activity pattern, diet, and locomotion style were not significant predictors of cranial shape when phylogeny and allometry were controlled for (although activity pattern was highly significant in non-phylogenetic analyses). We also estimated overall rates of evolution and the strength of modularity between the face and neurocranium for different primate groups. We found that rates of cranial evolution were higher in haplorhines than strepsirrhines, and we found preliminary evidence that modularity is also stronger in haplorhines than strepsirrhines. Taken together, our results indicate that allometry and agonistic competition for mates are more potent drivers of primate cranial shape evolution than any other variables considered in this study. Additionally, modularity between components of the primate cranium may facilitate higher rates of cranial shape evolution in haplorhines than strepsirrhines.

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Ring-tailed lemurs use olfactory signals to differentiate the MHC quality of potential mates

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Because the Major Histocompatibility Complex (MHC) plays a critical role in health and survival, individuals may increase their reproductive success by selecting mates with particular MHC genotypes. Although many taxa show evidence of MHC-assortative mating, the mechanism they use for assessing the MHC of potential mates remains poorly understood. We tested a potential olfactory mechanism in ring-tailed lemurs (*Lemur catta*) by (1) analyzing the chemical composition of their genital secretions (n=17 F:19 M), (2) relating these condition-dependent signals to their MHC genotypes, and (3) assessing, via behavioral tests, if conspecifics (n=11 F:19 M) could differentiate their scent according to "good genes" or "good fit" criteria. Despite a lack of association between volatile chemical complexity and MHC diversity, in either sex, ring-tailed lemurs differentiated between the scents of opposite-sex conspecifics (i.e. potential mates) based on the conspecific's absolute MHC diversity and relative MHC compatibility. By more frequently sniffing and licking the scent of females that had MHC genotypes least dissimilar from their own (p=0.026*), males either showed MHC-assortative preferences or perhaps biased their efforts towards determining the relatedness and quality of those females. Conversely, females deposited more genital marks near the scent of males that were more MHC-dissimilar from themselves (p=0.022*), potentially to attract the most MHC-compatible males. Although we lack information about the non-volatile component of olfactory signals, or about the relationship between parental MHC and offspring survival, we have shown that lemurs can discriminate different MHC genotypes via olfaction, a potential mechanism for understanding MHC-associated mate choice across taxa.

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Two-way gene-flow and ancestry-related assortative mating in African American populations

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Previous studies of African American admixture assumed models of one-time admixture between Africans and Europeans or continuous gene-flow from Europeans. However, historical records document continuous African immigration over the past several hundred years. Our goal is to model the admixture process in African Americans and identify the model parameters that best recover the observed individual ancestry (IA) distribution.

The data are genetic ancestry estimates for 82 individuals from HapMap-Phase III, and 98 individuals from Tishkoff et al. We began with a one-time admixture model, then created increasingly complex models by adding continuous gene-flow from Europeans, continuous gene-flow from Africans, and assortative mating by ancestry. We used a log-likelihood ratio test to assess the fit of each model-based distribution to the observed distributions and to compare the fit of the model-based distributions to each other.

The two predominant features of the observed IA distributions are a skew toward low African ancestry, and a high proportion of individuals with high African ancestry. For both datasets, two-way gene-flow models fit better than one-time and one-way gene-flow models. For the Tishkoff dataset, including assortative mating further improved the fit of the two-way model. The two-way gene-flow models captured the two predominant features of the observed distributions, and required higher per-generation European contribution than the one-way gene-flow models. We conclude that models that take into account African American history fit better than those that do not, and that European-African American matings were more frequent than reported in previous admixture studies.

Ultrasonic vocalizations by montane pygmy tarsiers (*Tarsius pumilus*) in Sulawesi, Indonesia

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Ultrasonic vocalizations (greater than 20 kHz) have been reported in lowland Philippine and Sulawesian tarsier species, but have not yet been studied in the only highland Sulawesian species, *Tarsius pumilus* (pygmy tarsiers). Communication among pygmy tarsiers is unusual in that they have rarely been documented to vocalize audibly. Pygmy tarsiers also have not been observed to engage in the audible duet calls characteristic of lowland species. We report the use of ultrasonic communication between male and female pygmy tarsiers. Calls were recorded in Lore Lindu National Park, Sulawesi, Indonesia in February 2012 using a recorder with ultrasonic capability and omnidirectional microphones. Multiple vocalizations of at least four individuals were recorded, including one lactating female, an infant, one male, and one individual of unknown sex. Our analyses of spectrograms reveal that pygmy tarsiers emit calls at 10-80 kHz, and that they exhibit sexual differentiation of calls. These results indicate that highland, smaller-bodied pygmy tarsiers habitually communicate at high frequencies in contexts where lowland tarsiers use lower frequencies, such as when they leave and return to their sleeping sites. The use of higher frequency calls appears to be part of a cryptic communication strategy found in association with internal ear morphology that is less attuned to low frequency sounds.

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Prenatal supplementation, breast milk composition, and infant growth in rural Gambia

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Infants in low-income countries experience intense growth faltering within the first two years of life. Prenatal supplementation can positively impact the nutritional milieu of the mother and fetus and may provide continuing benefits into postnatal life. Here, we address the effect prenatal supplementation has on maternal breast milk composition in early infancy. We measured milk macronutrients in samples collected at 4 weeks postpartum from women in rural Gambia who were given iron-folate (FeFol, N=13) as standard of care, or randomized to one of three interventional prenatal supplement arms (ISRCTN49285450): protein energy (PE, N=12),multiple micronutrient (MMN, N=14), or protein energy plus multiple micronutrient (PEMMN, N=16). Milk fat, protein, lactose, true protein, and non-protein nitrogen was measured using mid-infrared spectroscopy; infant weight-for-age, length-for-age, and weight-for-length Z-scores were calculated for growth analysis. We constructed general linear models to test the effect of prenatal supplementation on milk macronutrients and infant Z-scores. Controlling for infant sex and season of birth, results show that mothers who received FeFol produced milk with significantly higher NPN than mothers who received PEMMN ($p<0.01$), MMN ($p<0.01$), and PE ($p=<.0001$); after further controlling for prenatal supplement, infants who received milk with higher NPN had significantly lower WHZ scores ($p<0.05$). These initial results suggest mothers with disease burdens may experience altered liver function; impaired metabolism of blood urea nitrogen might elevate NPN in milk, impacting infant growth via underutilization of a protein metabolite. Analysis of additional samples and time points will clarify the relationship between prenatal supplementation, milk composition, and infant growth.

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Effects of Human Maternal Placentophagy on Postpartum Iron-Status

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Recently, human maternal placenta ingestion, known as placentophagy, has emerged as a rare but growing practice among postpartum mothers in industrialized societies, and is currently found in both home birth and hospital birth settings. The practice is purported to result in certain health benefits for postpartum mothers, some of which could be related to the iron content in full-term placenta (e.g., increased energy and an improved and more rapid postpartum recovery, among others). The aim of this research project was to investigate the effect of ingested encapsulated placenta on maternal postpartum iron status via a randomized, placebo-controlled pilot study (n=23). The majority of participants were Caucasian (87%), with at least some college education (91.3%), and married or in a domestic partnership (87%). Maternal iron status of women in the placenta supplement group (n=10), and the placebo group (n=13) was measured via hemoglobin, transferrin, and ferritin taken from blood samples at four time points; the 36th week of pregnancy, within 72 hours of parturition, between days five and seven postpartum, and during week three postpartum. All participants' iron levels were within the normal reference range at the initial meeting, and all were consuming at least adequate amounts of dietary iron. Results reveal no statistically significant differences in the maternal iron status (including postpartum iron rebound) of women in the placenta supplement and placebo groups. The current study suggests that encapsulated placenta supplementation neither significantly improves, nor impairs postpartum maternal iron status for women consuming at least adequate amounts of dietary iron.

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Perikymata distribution relative to total perikymata number within the genus *Homo*

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Perikymata, growth increments on the surface of enamel, are distributed differently in Neanderthal and modern human teeth. The difference in perikymata distribution is not related to enamel surface curvature and, therefore, differences in enamel formation are more likely to be responsible. Recently, we suggested that for upper central incisor and upper canine tooth types, the more uniform distribution of perikymata in Neanderthals is an ancestral feature, as it is also present in early *Homo*. Here, we expand the comparison of perikymata distribution relative to total perikymata number to all anterior tooth types for early *Homo*, Neanderthals and anatomically modern humans. Per tooth type, sample sizes range from two to four for early *Homo*, four to 14 for Neanderthals, and 44 to 73 for modern humans. For the upper anterior tooth types, results confirm statistically significant differences between modern humans and both early *Homo* and Neanderthal samples. Both early *Homo* and Neanderthals display a more uniform perikymata distribution pattern for all upper anterior tooth types. For the lower anterior tooth types, while the Neanderthal-modern human differences are statistically significant, perikymata distribution in early *Homo* is not significantly different from that of modern humans. Early *Homo* shows a relatively wide range of variability across all anterior tooth types, in some cases exceeding that of Neanderthals. While we interpret these results with some caution, we suggest that in anterior teeth, the conclusion that Neanderthals retained an ancestral *Homo* feature in the distribution of their perikymata is supported only for upper anterior tooth types.

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A simple, economical protocol for DNA extraction and amplification where there is no lab

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The collection of genetic samples has become standard at many primate field sites, yet analyses of these samples frequently entail transporting them, often internationally, to specialized molecular laboratories. It would often be preferable for original biological samples to remain available for research in the country of origin, as well as to avoid potential long project delays stemming from the logistics of exporting/importing samples. To address these issues, we developed protocols for easily and reliably performing front-end genetics bench work at off-the-grid field locales. We tested these protocols using swabs collected during routine capture of sifaka lemurs (*Propithecus verreauxi*) at Bezà Mahafaly Special Reserve in Southwest Madagascar. Our optimized pipeline entails a Chelex-based DNA extraction followed by whole genome amplification using reagents stored at ambient temperature. Our equipment consisted of an ultra-lightweight portable

thermocycler programed through a tablet and powered by a fold-up solar panel and compact battery, all of which can fit in a standard carry-on bag. This protocol allows the original sample and DNA extractions to remain in Madagascar, while amplicons are brought to the US for subsequent analyses. Our results show a high success rate (>80%) for down-stream procedures, which we tested via PCR amplifications targeting seven microsatellite loci. These preliminary results demonstrate the promise of such protocols for performing basic front-end genetics in a range of field situations and for facilitating the sharing of samples between researchers internationally without having to invest in costly onsite lab setups or freezer storage.

Childhood diet at medieval (1240s AD) Solt-Tételhegy, Hungary as reconstructed from stable carbon and nitrogen isotope analyses

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From 2005 to 2009, more than 100 skeletons were excavated from the medieval (1240s AD) Hungarian archaeological site of Solt-Tételhegy. While previous stable isotopic research has examined the diet of medieval European peoples, here we present the first such research conducted on a medieval Hungarian population. Stable carbon and nitrogen isotope analyses were performed on dental enamel and dentin from first and second molars from 24 individuals to reconstruct their childhood diet. The enamel $\delta^{13}C$ values range from -14.4‰ to -8.6‰, with an average of -11.1‰, and the dentin $\delta^{13}C$ values range from -19.4‰ to -14.9‰, with a mean of -17.4‰. These data suggest that C_3 plants were the predominant plant type consumed by the majority of the study population, although varying quantities of C_4 plants may have also been included in the diet. These results reflect the archaeological evidence suggesting the dominance of C_3 plants over C_4 plants in medieval Europe. The dentin $\delta^{15}N$ values range from 9.5‰ to 11.6‰, with a mean of 10.6‰, showing that animal protein constituted a moderate proportion of the diets of the sample population. Despite clear signs of status differences indicated by burial location, stable nitrogen isotope values also suggest that the individuals had relatively egalitarian access to animal protein. The results of this study reveal new information about diet during a very dynamic period of Hungarian history.

Using endocranial coefficient of variation (ECV) to assess the place of Dmanisi fossils in the early *Homo* lineage

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The site of Dmanisi has been crucial to the hypothesis of a single evolving lineage within the genus *Homo*. The Dmanisi researchers consider that that population originated from an Early Pleistocene expansion of *H. erectus* lineage from Africa, therefore, *H. ergaster*, Dmanisi, and *H. erectus* would form a single group. We evaluated such assumption through the calculation of the endocranial coefficient of variation (ECV) a measure of relative variability. Data publicly available about species of the genus *Australopithecus*, *Paranthropus*, *Homo,* including Dmanisi, and *Pan* were analyzed. ECVs were estimated first with groups formed by single species and by greater groups formed by the sum of two or more species. Second, with all data in the dataset ordered by chronological ranges, independently of species. The time range chosen was 2.0 to 1.5 Ma, and an ECV value of 15.2% was used to distinguish between species. In general, when groups of all species were structured by type, greater values of ECV were observed than when they were ordered by time. When data were grouped by taxon, ECVs were below 15.2%. Data concerning the endocranial volume of *H. habilis sensu lato* added to the Dmanisi can be classified as a single group (ECV = 13.8). However, *H. ergaster* specimens and the Dmanisi samples, and *H. ergaster* and *H. habilis* cannot (CV =16.6% and 16.2%, respectively), which suggests a multiple lineage hypothesis for early *Homo*, thus, our findings do not support the same correlation regarding morphological features presented previously by the Dmanisi researchers.

Brain evolution and the evo-devo of endocranial shape

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In contrast to the elongated braincases of our closest living and fossil relatives modern humans are characterized by globular neurocrania. In recent *Homo sapiens* this is the result of an early postnatal globularization-phase, which is absent from the postnatal development of *Pan* and *Homo neanderthalensis*. Given the characteristic altricialty of modern humans, it is conceivable that in other hominids a globularization-phase occurs prenatally, but little is known about endocranial shape changes during fetal development. Moreover, it is unclear how the complex interplay of early brain development and neurocranial bone growth affects brain shape.

Here we explore (1) whether bonobos have a prenatal globularization-phase, and (2) the link between brain shape and brain growth rates. To this end we collected in vivo 3D ultrasound images to study fetal brain development in *Pan paniscus*. Measurements digitized from longitudinal series of several bonobo individuals were then compared to modern human growth standards.

We find that bonobos do not have a globularization-phase just before birth; the difference in growth trajectories between *Pan* and modern humans is therefore not simple heterochrony. The shape of the brain changes dramatically during fetal development in both *Homo sapiens* and *Pan paniscus*; these shape changes are linked to the growth rate of the brain. Endocranial shape changes throughout development are therefore potentially informative about growth rate and timing of early brain development in extant and fossil groups.

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Seasonal foraging in Early Pleistocene Olduvai Gorge, Tanzania

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This study is the first to use dental microwear texture analysis (DMTA) to evaluate the role of seasonality in hominin foraging at Olduvai Gorge, Tanzania, a site at the center of debates about the evolution of hominin hunting and landscape use. Hominin foraging strategies are central to hypotheses about the evolution of the modern human body plan, behavioral flexibility, and modern life history. Each of these hypotheses presume the substantial inclusion of meat in the diet of early *Homo*, but how it was acquired remains a controversial issue. As hominins ate more meat, they entered into competition with carnivores. Some organisms avoid this kind of direct competition through seasonal niche partitioning.

Here I present the dental microwear results from hominin and carnivore prey at the Olduvai localities of FLK Zinj and FLK North. These sites existed during comparably arid climates, contain large samples of the same species, and provide strong stratigraphic and taphonomic evidence for confined phases of carcass deposition. With these natural controls in place, it is possible to compare prey dental microwear signatures to those of modern analogues to determine the predominant season of death for each taxon at each site. The results indicate the preferred seasons of operation for both hominins and carnivores at watering holes in the paleo-savanna, characterize the nature of competition between these taxa, and contribute to the discussion of the significance of meat in times of low precipitation and relative resource scarcity.

Lineage-specific patterns of brain expansion and dental reduction in hominins

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Brain enlargement and postcanine dental reduction are two of the most extensively studied trends in hominin evolution. We use evolutionary simulations and new developments in ancestral reconstruction to quantify and compare lineage-specific patterns of variation in endocranial volume and tooth crown size in a hominin sample including *Australopithecus, Paranthropus*, early and late *Homo* species. We show that the rate of increase in endocranial volume is greatest before the emergence of premodern and modern *Homo* (including *H. erectus, H. neanderthalensis* and *H. sapiens*), with the amount of change before the emergence of this clade exceeding by almost 3.5 times that seen in a simulated scenario that does not include selection. The rate of reduction in tooth crown size is relatively constant since the emergence of the genus *Homo* until the origin of *H. sapiens*, approximately twice as fast as that expected under a neutral model. Shape changes within postcanine teeth, which consist mostly of a preferential reduction of the distal cusps, show a closer-to-neutral pattern of evolution, with all lineages showing an amount of change within a range of 0.5-1.5 times that observed in simulated scenarios without selection. Our results show that 1) brain expansion and dental reduction show similar but not matching patterns of change across hominin lineages, which points to different selective scenarios for the two trends; and 2) postcanine dental shape has evolved following a quasi-neutral model, which makes this trait especially useful for taxonomic and phylogenetic inferences.

Cross-sectional geometry vs traditional indices: capturing tibial morphology as a means of studying mobility in the Nile Valley

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The standardization of recording strategies is an important element of physical anthropology, allowing results to be compared between sites and publications. Many osteological recording guidelines include anteroposterior and mediolateral diameters of long bones at varying points on the shaft. However, these points differ on the bone, resulting in measurements that can vary according to the observer. Of particular concern is the platycnemic index, which compares diameters at the tibial nutrient foramen. The nutrient foramen appears to be a variable point, differing in location between legs from the same individual and, consequently, affecting calculations of the platycnemic index. However, over 100 years of recording this has led to a large amount of data. Here, we analyze the benefits of switching to a midshaft measurement using assemblages from the Sudanese Nile Valley and explore whether the platycnemic index data should be utilized in modern morphometric and biomechanical analyses of ancient mobility. Nile Valley sites are presented as a case study, contrasting the differing data sets. Preliminary results indicate that measurement at the nutrient foramen leads to an artificially low index that is not as biomechanically relevant or as precise as a midshaft measurement. The benefits of new recording strategies, including midshaft outline alongside measurements, and the practical and conservation aspects of recording these data using 3D laser scanning, contour molding, and photography are also considered.

Is market integration associated with physical, mental, and social wellbeing among Ethiopian young adults? It all depends on the measure

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The question of how and to what extent participation in markets impacts on health and wellbeing has received much attention in anthropology and the social sciences. In this study, I construct a range of different measures of market integration and explore how they predict mental and physical health, social inclusion, and self-reported health. Our results, from approximately 1500 young people in rural, urban, and semiurban Ethiopia settings, suggest that the relationship between market integration and wellbeing depends critically on the measures of integration and wellbeing. Preliminary analyses show a generally positive association between measures of market integration and physical wellbeing but negative associations with measures of mental health. Results also vary depending on the scale of the market integration measures. I then use qualitative and quantitative data to explore possible explanations for these inconsistencies and mismatches.

Virtual reconstruction of the MH2 pelvis (*Australopithecus sediba)* and obstetrical implications

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The shape of the pelvis is central for locomotion and obstetrics and thus shows fundamental differences between australopithecines and humans. The presence of derived morphologies in *Australopithecus sediba*, including a reduced lateral flare of the vertically-oriented iliac blades, a well-developed sigmoid curvature and an anteriorly deflected ASIS, suggested that pelvic reorganization preceded the emergence of bigger-brained babies and modern form of bipedalism. Here, we present a virtual reconstruction of the MH2 pelvis. The tight articulation of the left and right pubic fragments at the symphysis guided the orientation of the midsagittal mirror plane. The fragment of the right pubic basis could then closely be aligned with the pubic ramus. Finally, the right ilium fragment was fitted in between the pubic basis fragment and the mirror-imaged reconstruction of the MH2 sacrum, using the articulation point at the inferior sacroiliac joint and congruence with the arcuate line. Our reconstruction confirms a more gynaecoid pelvic inlet shape compared to A.L. 288-1, but challenges the presence of other derived features in *A. sediba*.

Based on this reconstruction we simulated childbirth using 3D-models of minimum and maximum newborn head sizes and shapes predicted by applying a reverse chimpanzee growth curve for DIK-1-1 and Taung. We performed simulations with varying degrees of sacro-iliac joint laxity and different orientations of the fetal head (left occipital anterior, transverse and occipital posterior, thus including the most eutocic and dystocic configurations). Most birth simulations showed eutocic deliveries, suggesting that feto-pelvic constraint was smaller in MH2 than in extant humans.

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The sex difference in depression is explained by the sexual dimorphism in upper body strength

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Depression is a major contributor to global disease burden. This burden is disproportionately borne by women, who are twice as likely as men to be depressed. The sex difference in depression

has yet to be explained. One evolutionary model of depression proposes that loss of interest in virtually all activities is a bargaining strategy to compel reluctant social partners to provide more help in the wake of adversity. An evolutionary model of anger proposes that high upper body strength predisposes individuals to angrily threaten social partners who offer too few benefits or impose too many costs. Here we propose that when social partners provide too few benefits or impose too many costs, the physically strong become angry and the physically weak become depressed. The sexual dimorphism in upper body strength means that men will be more likely to bargain with anger and physical threats, and women with depression.

We tested this idea using the 2011-2012 National Health and Nutrition Examination Survey (NHANES), a large nationally representative sample of US households that included measures of depression and upper body strength. The odds of depression in those with high upper body strength were less than half those with low upper body strength (OR=0.4, p=0.0079). This effect did not appear to be a consequence of confounds with anthropometric, health, hormonal or socioeconomic variables. Upper body strength mediated most of the effect of sex on depression, but the mediation effect was unexpectedly moderated by age, with a stronger effect in older vs. younger individuals.

The enigmatic Burtele partial foot: further evidence for middle Pliocene hominin locomotor diversity

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The foot is crucial to understanding locomotor adaptation in early hominins; however, their rarity and fragmentary nature have been major impediments. Recent fossil discoveries have demonstrated that not all early hominins were engaged in similar modes of terrestrial bipedality. The Burtele Partial foot (BRT-VP-2/73) was compared to *Ardipithecus ramidus*, *Australopithecus afarensis*, early *Homo*, and other early hominin foot fossils from South Africa. The comparative analyses show that BRT-VP-2/73 is fundamentally different from those that made the Laetoli footprints 3.6 million years ago (presumably *Australopithecus afarensis*), while it shows certain similarities with the earlier *Ardipithecus ramidus* (4.4 million-years-old) and younger hominins from South Africa (for example, Stw 89). BRT-VP-2/73 has a mosaic of derived human-like (domed lateral metatarsal heads) and primitive ape-like (abducted big toe, internal torsion of the second metatarsal head) features, also seen in many of the hominins analyzed here, less early *Homo*. This implies that several forms of bipedal locomotor adaptations existed during the Plio-Pleistocene. Although selection for terrestrial bipedality may have intensified throughout the Pliocene, it appears that human-like pedal morphology that allowed long distance travelling may not have evolved until after 2 Ma, coinciding with the first occurrence of hominins outside of Africa. While the question of why hominins did not leave Africa until that time remains a mystery, however, the Burtele foot suggests that the lack of a human-like foot may have played a role. More complete fossil foot remains from 2.0-3.0 million years ago are of paramount importance to test this hypothesis.

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Ill-health or the burial environment: differentiating developmental defects from postmortem stained enamel in deciduous dentition, prehistoric Tonga, Polynesia

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Developmental defects of the deciduous dentition, usually manifested as enamel discolouration, and can be used as indicators of physiological stress in human bioarchaeological research. Although these defects can provide a wealth of information regarding maternal and early life stress, they are often overlooked as it is sometimes difficult to ascertain whether discolouration in enamel is a developmental defect or the result of a taphonomic process. Our previous research on discolouration of dental enamel has proven x-ray microtomography as a valid and reliable method for differentiation between hypomineralised enamel discolouration and taphonomic discolouration. The aim of this research is to use x-ray microtomography for the investigation of severe macroscopic deciduous dental discolouration of enamel in a Chiefdom Period skeletal sample from 'Atele, Tonga, and to assess whether these discolourations are true enamel hypomineralised defects or not. This assessment can aid in the interpretation of stress responses in the infants and children, widely held to be excellent indicators of population health, during this time of increasing hierarchy in Polynesia. Our results found evidence of reduced mineral density in discoloured teeth. These findings indicate that discolourations in deciduous dentition from 'Atele are more likely the result of developmental dental enamel defects rather than post-mortem staining. We interpret this evidence of developmental defects in the environmental context of maternal and infant infection and nutritional stress and previous palaeopathological work that has been undertaken on this sample. Our work also highlights the need for a quantitative method of analysing suspected hypomineralised developmental defects.

Carbon and nitrogen stable isotope ratios of anadromous fish: Is there a distinctive isotopic signature?

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In their classic 1983 publication "Stable nitrogen isotope ratios of bone collagen reflect marine and terrestrial components of prehistoric human diet," Schoeninger et al. showed that the stable isotope ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) are elevated in the bone collagen of known heavy salmon consumers from the Pacific Northwest of North America. Since anadromous fish spend a large portion of their lives feeding in marine environments before migrating to freshwater to spawn, they are expected to have a marine isotopic signature that, theoretically, should be distinguishable from terrestrial and freshwater resources in inland areas. However, there has been comparatively little stable isotope research on the actual skeletal remains of salmon and other anadromous fishes. In this meta-analysis of published isotope data, as well as new data on both fauna and humans from prehistoric Alaskan sites, bone collagen carbon and nitrogen isotope values of anadromous fishes (including Pacific and Atlantic salmon and sturgeon) are compared to those of marine, terrestrial, and freshwater resources to determine if anadromous fish have isotopically distinctive signatures.

The Shady Grove Ossuary (22QU525), Quitman County, Mississippi: Issues in Reconstructing Health Patterns

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A Middle Mississippian period ossuary containing 80-100 individuals was identified at the Shady Grove Site (22Qu525) in northwest Mississippi. Although remains were highly commingled, 24 individuals, consisting minimally of a skull and two different long bones, were reconstructed based on similarities in size, MSM development, and taphonomy. In order to explore how these reconstructions might affect interpretations of population health, this study evaluated frequencies of various pathologies in the reassociated individuals as compared to those observed in analysis of individual elements.

Porotic hyperostosis (PH), cribra orbitalia (CO), and periosteal reactions were scored on crania, humeri, femora, and tibia. Lesions considered very slight in expression were not included. Among individual elements, 18% of crania (N=67) were affected with PH and

approximately the same proportion of orbits (N=43) exhibited CO. One-quarter of humeri (N=24) displayed periostitis as compared with 21% of femora (N=42) and 19% of tibiae (N=48). Among the 24 reconstructed individuals, 17% of femora showed periostitis, a frequency similar to that seen in analysis by individual element, but rates of affliction in crania, humeri and tibiae were less than half in comparison. Two individuals showed evidence of systemic infection.

One explanation for the varying health pictures emerging based on the unit of analysis may be related to better preservation in unaffected elements. Lesions may have weakened bone quality with their more fragmentary condition making evaluation of variables used in reassociation more challenging. Other pathology findings for the ossuary are presented, and possible implications in interpretation of ossuary data are discussed.

The embryonic origins of primate encephalization: allometric and growth analyses

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Primate encephalization is the ontogenetic product of a shared increase in relative brain size across fetal life. A recent meta-analysis of ontogenetic brain/body allometry in twelve primate and fourteen non-primate mammals indicates two evolutionary changes to primate prenatal brain/body allometry: first, higher average allometric slopes indicate either faster brain or slower body growth in fetal primates, and second, higher allometric intercepts indicate changes to initial neural and somatic proportions following embryogenesis. Previous work in primate life history indicates decelerated somatic development across postnatal ontogeny relative to other mammalian lineages, which may reflect changes to somatic development in earlier fetal periods.

In order to clarify these novel features of primate prenatal life history, this study examines embryonic brain and body development in primate and non-primate species via volumetric reconstruction from whole embryo stereology; this data is supplemented with meta-analysis of fetal brain, body, and visceral organ growth rates across mammalian lineages. Stereological analysis indicates that relative brain size peaks during embryonic development in all species; primates retain this high brain/body proportion into later fetal life, while relative brain size decreases in non-primate mammals following embryogenesis. Aged fetal growth data suggest that high allometric slopes during prenatal development in primate species are due to decelerated somatic growth, while primate fetal brain growth rates are comparable to those of other mammals. These complementary analyses suggest that primate prenatal encephalization – the ontogenetic source of adult allometric trends – are products of evolutionary changes in fetal somatic growth rates beginning early in embryonic development.

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Toward a working model of chimpanzee ecology in anthropogenic landscapes

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Chimpanzees face a conservation threat posed by a growing number of encounters with humans, brought about by core ranges that are increasingly shared with human communities and cultivated lands. As deforestation continues in Africa at roughly twice the world's rate, and habitats continue to become fragmented, interactions with humans are becoming a reality for all wild chimpanzees. It is therefore crucial to the survival of the species to understand the variables that dictate the dynamics of human-chimpanzee interactions. In an effort to accomplish this, a meta-analysis of data from 26 chimpanzee sites was performed in order to determine possible variables that influenced these encounters. The results were then used to create a flow-chart that showcased the nature, probability, and severity of human-chimpanzee encounters with a given set of variables that included chimpanzee ecological factors (density, feeding patterns, corridors in and out of the fragment/study area, etc.) along with human social and economic factors (primary economic practices, hunting practices, community perceptions of chimpanzees, etc.). The flow-chart reveals a mutually influential system of complex factors that govern both human-chimpanzee interactions, as well as general chimpanzee binomics in anthropogenic habitats. The flow chart is evidence that anthropogenic chimpanzee habitats are highly complex landscapes and ecological deterministic models may be overly simplistic in determining the dynamics of human-chimpanzee interactions in such areas. Rather, models pertaining to these areas must include a complex and multivariate design if we are to understand this dynamic coupled human-nature system.

Establishing Philopatry and Home Range Size with Strontium Isotopes: An Extant Model from Kibale National Park

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Mobility patterns including sex-biased dispersal and home range size have direct consequences on primate social organization. Understanding shifts in social behavior is integral to understanding human evolution; however, their reconstructing is notoriously difficult. Strontium isotopes are often used to assess modern human mobility, but their utility in establishing landscape use in non-human primates has never been tested. This study explores using strontium isotopes to reconstruct extant non-human primate and faunal mobility patterns in Kibale National Park, Uganda. I used opportunistically gathered skeletal collections to address the following questions: what degree of underlying isotopic variability is required to accurately reconstruct mobility patterns? Can intra-individual tissue comparisons establish philopatry patterns, and do comparisons between local vegetation and tooth enamel yield similar results? Does intra-individual variability correlate with home range size? First, I included 200 plant and water samples in a hierarchical cluster analysis to identify three isotopically distinct spatial zones. Second, I compared bone apatite (adult signature) and tooth enamel (juvenile signature) samples from 191 specimens, including 29 chimpanzees. Isotopic differences between tissues were significantly greater in the dispersing sex than the philopatric sex for all primate species. Comparing enamel and local vegetation yielded similar results. Intra-individual variation positively correlated with home range size. This study confirms that strontium isotope ratios can be used to reconstruct primate mobility patterns provided that there is an isotopically robust ecological baseline. It highlights the importance of incorporating variation and provides an extant model for similar studies in fossil communities.

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A hominoid-like femur from the late Oligocene of Kenya

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Molecular divergence estimates place hominoid origins in the Oligocene, but direct paleontological evidence for such an ancient split of apes from Old World monkeys is currently limited to ~25.2 Myr dental material from Tanzania. The limited fossil evidence, and complete absence of postcranial fossils older than 20 Myr, has precluded efforts to understand the early adaptations of hominoids.

Dentognathic material of *Kamoyapithecus hamiltoni* is also known from the late Oligocene (~24-28 Myr) Eragaleit Beds of Losodok, Kenya, but it is unclear whether *Kamoyapithecus* is an early hominoid or stem catarrhine, given its conservative dental morphology. Here we describe the first catarrhine postcranial bone from the Eragaleit Beds — and the first primate

postcranial bone from the entire late Oligocene of Afro-Arabia — a nearly complete femur (KNM-LS 18350) that most likely belongs to *Kamoyapithecus* on the basis of size and abundance, though it was not found associated with dental remains of that species. KNM-LS 18350 is derived relative to the stem catarrhine *Aegytopithecus*, and shares a suite of features that characterize early hominoids (e.g., *Proconsul, Morotopithecus*).

The distinctly hominoid-like morphology of KNM-LS 18350 provides support for the hypothesis that *Kamoyapithecus* is a stem hominoid, and additional evidence for an Oligocene divergence of hominoids and cercopithecoids. The surprisingly specialized morphology of KNM-LS 18350 suggests that there was already considerable locomotor diversity among late Oligocene crown catarrhines, and that modifications to the hip and knee joints of basal hominoids represent early adaptations that drove the divergence of the clade away from Cercopithecoidea.

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Energetic costs of eating raw foods in humans

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Data on the costs of behaviors are central for understanding human evolution and life history. Although chewing biomechanics are well-characterized, the energetic costs of chewing in humans are poorly documented. Here we describe whether human chewing costs are proportional to body size, and determine whether raw food chewing is positively correlated with food toughness. Finally, we examine where chewing fits into the spectrum of energetic costs of digestion and locomotion.

Metabolic rate during chewing was measured by indirect calorimetry in adult humans (54-100 kg) eating eleven different raw foods of varying size and toughness. Resting and postprandial metabolic rates were also measured. Net chewing costs (J/sec) neither increase nor decrease in proportion to body size (tau=-0.11, p=0.38). Time spent chewing (sec) is a significant determinant of total chewing costs (J) (r=0.65, p<0.0001). Net chewing costs per unit of food mass (J/sec/gram) are positively correlated with food toughness (tau=0.25, p=0.05) but highly variable within a food type. Compared to walking (2.5 J/sec/kg, from Gotschall and Kram), mass-specific chewing costs (1.53 J/sec/kg) are low. Chewing costs (mean=18.3 J/sec) are comparable to postprandial costs (mean=12.6 J/sec, from Secor), though daily chewing time is likely of comparatively short duration suggesting that digestion is a larger component of total energy expenditure, at least in modern humans. These data support the hypothesis that chewing kinetics and the anatomy of the feeding apparatus are strongly influenced by the need to increase thermodynamic efficiency of the digestive tract.

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Artificial Cranial Modification on the Copacabana Peninsula

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This study examines the cranial vaults of preserved human skulls to determine the frequency and style of artificial cranial modification over 2000 years of human occupation on the Copacabana Peninsula, in the Lake Titicaca basin of Bolivia. We hypothesized that the crania from the area (N=41) would predominantly follow the same method of cranial modification (i.e. annular, tabular, or none), with little deviation from this pattern. However, examination of the collection determined that there was signifacnt variation present in the distribution of the annular and tabular styles of modification.

Three sites (Ch'isi, Muruqullu, and Kusijata) yielded remains from the Early Horizon (800-50 BC) and Early Intermediate Period (50 BC - AD 200) which showed evidence of artificial cranial modification. Of the 16 skulls from the Early Horizon and Early Intermediate Period, nine were modified in the annular style, two were tabular, and five were unmodified. Similar patterns were found in the 17 crania from the Early Intermediate Period and Middle Horizon burials from the site of Cundisa; six of these crania had annular modification, eight tabular, and three unmodified. Finally, Late Intermediate Period (AD 1000 - 1250) burials from Ch'isi exhibit annular modification in five crania, with three additional unmodified skulls. This pattern of modification was not linked to sex, burial site, or mortuary associations. We interpet this apparent lack of patterning to suggest differences in kinship organization, geographic origins, and overall the presence of multi-ethnic communities present in the lake basin over time.

Developmental variation in perikymata expression in co-interred child foragers

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The juvenile period is a time of increased risk within the lifespan, where dietary transitions, susceptibility to infectious disease, and increasing self-reliance are features of "normal" childhood. Burials of children allow for investigation of the experience of child "health" through lesions in bones and teeth, and may be interpreted as a signal of the challenges encountered by groups of people in the past. Here, we examine markers of stress in three juveniles who were buried together, and who had unhealed cranial trauma. The co-interment, and the violent event preceeding it, are atypical in the southern African Later Stone Age context. These circumstances provide an opportunity to investigate hard tissue markers of stress in children who likely grew up in the same community and were otherwise healthy prior to their deaths. Perikymata spacing was examined microscopically in the dentitions of the older two children to locate accentuated perikymata defined by increased relative spacing. Disruptions to enamel formation are evident in the fourth year of life in both cases. Variation in enamel development is discussed in relation to skeletal markers of stress among the three co-interred children and additional juvenile southern African foragers of comparable age at death.

Tracking adaptations in sexual dimorphism between subgroups of an historic population

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A research project that evaluates sex estimation methods provided an opportunity to compare two African American populations that share a common history. Both populations worked in similar living conditions as laborers in the cotton industry of the South before and after the Civil War; both migrated to the North. The adults in the Hamann-Todd Osteological Collection (HTOC) migrated To Cleveland from Kentucky, Tennessee, Mississippi and Alabama; those in the Terry Collection (TC) migrated to St. Louis from Arkansas, Texas and Louisiana. These urban cities offered jobs in different types of industries. Can a lifestyle change affect sexually dimorphic characteristics; can adaptations be tracked using sex estimation methods?

The cranium, mandible, pelvis, humerus and femur were assessed using 35 morphological and 32 metric methods on adult samples: 80 skeletons from the Terry Collection and 110 from the Hamann-Todd Collection. The highest difference in accuracy appeared in the femur; morphological appearance resulted in accuracies of 95% for TC and 80% for HTOC. Using the mean for metric measurements resulted in accuracy differences in femoral head diameter and epicondylar breadth of 92% for TC vs. 86% for HTOC and 91% for TC vs. 86% for HTOC. Humeral appearance also showed a contrast – 97% for TC vs. 87% for HTOC but not when using metric measurements. The results related to the femur using sex estimation methods suggests a way to track adaptation from occupational life style changes. Sex estimation

methods can provide more information than just defining a skeleton as male or female.

Improved mitochondrial aDNA sequence quality and recovery rates using Next-Generation Sequencing (NGS): A case study using highly degraded material from Cahokia Mound 72

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Although gross preservation is not a perfect indicator of the preservation of ancient DNA (aDNA) within skeletal material, the poorly preserved taphonomic state of the Mound 72 individuals described in the excavation report as compressed, soft, and fragmented combined with the often waterlogged soil and temperature extremes of the American Midwest create a less than ideal environment for DNA preservation. However, the archaeological importance of Cahokia, the most complex polity in the late pre-historic Eastern Woodlands, and the potential of genetic analysis to give insight into population structure and the relationship between other contemporaneous locations produce enough interest to warrant further analysis of the difficult material. Previous genetic analysis of Mound 72 attempted more than a decade ago was largely unsuccessful and contained clear evidence of contamination from European sources.

Using standard polymerase chain reaction (PCR) methods to target and amplify four overlapping fragments of approximately 150 base pairs in length to obtain the mitochondrial HVS1 sequence, we produced informative sequences for 11 of the 34 individuals (32% of the sample). The extracts from a 12 individual subset were used to produce double stranded NGS libraries, enriched for mitochondrial DNA using in solution capture and sequenced using the Illumina MiSeq platform. Our analysis shows a significant increase in recovery rate using NGS analysis as well as increased coverage and improved sequence quality, demonstrating the relative value of PCR and NGS analyses in data production and research costs.

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Polytrauma or Injury Recidivism? A bioarchaeological analysis of individuals with multiple injuries

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In bioarchaeology it is difficult to determine if an individual sustained multiple injuries at the same time (polytrauma) or over their lifetime (injury recidivism). This research evaluates methods of identifying patterns of injury and re-injury using osteological techniques. A sample of 21 skeletal remains, showing evidence of multiple traumatic injuries, was compared to 318 other bodies from the pre-contact American Southwest and Great Basin. The individuals had one of three types of trauma: (1) they had both cranial and postcranial trauma; (2) they had injuries present on multiple postcranial elements; or (3) they had multiple cranial facial fractures in different areas. The traumatic injuries were differentially diagnosed using biomechanical reconstructions along with clinical and forensic data. Once a pattern of injury was established, the following were identified on each individual: sex, age-at-death, indicators of stress, pathological conditions, and activity-related changes. Data from the sample were compared to the rest of the assemblage. The associated archaeological context was also examined and proved vital in providing insight into the community perception of individuals. The results of these analyses suggest that the most straightforward indication of repeated injuries could be observed when the traumatized bone showed evidence of different stages of healing (well-healed, healing, and no signs of healing). The identification of trauma patterns with consideration of a person's lived experience and a reconstruction of context increased the likelihood of documenting injuries over the lifetime.

Supporting big eyes: bone or no bone?

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Primates have relatively large eyes and support orbital tissues with a complete or partial postorbital bar or septum. Some mammals with relatively large eyes lack posterolateral osseous support, and presumably rely on connective tissue sheets including the sac-like periorbital membrane (PM) to support the eyes. Here, we examined the soft tissue surrounding the eye of three species of fruit bats (Pteropodidae:*Cynopterus sphinx*, *Macroglossus sobrinus*, *Rousettus leschenaulti*) and two nocturnal strepsirrhines (*Otolemur garnettii* and *Microcebus murinus*). Dissection and light microscopy were employed to identify support structures of the orbit. Dissection of *Cynopterus* reveals that the eye is supported posterolaterally by a series of transverse ligaments. Examination of serial histological sections of *Macroglossus* and *Rousettus* reveals these fascial planes connect to the zygomatic bone, but are located superficial to the PM. All fruit bats studied lack a postorbital ligament. In both bats and primates, the PM is a thin layer mostly composed of dense connective tissue and smooth muscle which surrounds the eye and extraocular muscles. The PM and orbital periostia merge together in some locations. However, they are usually distinct, especially in subadult specimens (suggesting fusion over time). Therefore, the PM does not appear to be equivalent with the periosteum, as is commonly described for humans. These findings demonstrate that relatively big eyes can be supported primarily with fibrous connective tissues as well as the PM, in absence of posterolateral bone. In addition, our findings suggest that the PM is developmentally independent of the periostea of orbital bones.

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Wading, and seeing, through mud: A biplanar x-ray study of human foot motion and footprint formation within deformable substrates

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Fossil hominin footprints are unique direct records of locomotion that circumvent inherent obstacles to interpreting biomechanics from isolated, fragmentary fossils. But tracks are not simple, direct representations of the foot's anatomy or external motions as measured on solid ground, being instead influenced by complex interactions between the foot and substrate. It has previously been impossible to visualize, much less measure, foot motion in deformable substrates and study foot-substrate interactions.

Here, we present data from biplanar x-ray video recordings, which allowed the first opportunity to quantify subsurface foot motion during human footprint formation. Subjects had 70 radiopaque beads affixed to their feet and they walked along radiolucent trackways of varied consistency, including extremely stiff carbon fiber and three synthetic muds of increasing hydration. Three-dimensional bead movements were reconstructed (using software designed for XROMM) and connected to form an animated polygonal model in Maya. This low-resolution mesh was used to drive motion of high-resolution models of subjects' feet, which were integrated with calibrated photogrammetric models of resulting tracks. Preliminary results reveal distinct patterns of foot motion and deformation on different substrates, and suggest that parts of human tracks are not as reliable indicators of foot anatomy and/or motion as

often assumed. Specifically, the midfoot region may not directly reflect arch anatomy, and substrate collapse can alter records of toe motion. These results caution against using gross observation to draw anatomical or functional conclusions from track morphologies, and encourage continued experimental work to elucidate reliable anatomical and functional information within fossil hominin tracks.

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Tracking hominin mobility in late Pleistocene Central Asia with an agent based approach

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Hominin site locations with associated archaeological, paleontological and paleoclimatic records provide valuable data from which the trajectory (the pattern and timing) of hominin dispersals can be modeled and hominin metapopulation interactions and their consequences interpreted. The current research further tests a recently proposed model of hominin dispersals within greater Central Asia during the late Pleistocene. The model of Beeton et al. suggests the foothills of the Inner Asian Mountain Corridor (IAMC) served as a glacial refugium for hominin metapopulations like the Neandertals, modern humans and the Denisovans. Here, an agent based approach is used to explore the trajectory of population expansion and contraction using those bioclimatic variables that best predict hominin site location in Central Asia and also define the abiotic characteristics of the fundamental hominin niche. The locations of Teshik-Tash Cave, Denisova Cave, and Ust'-Ishim are used as starting points for population migration, with the model simulating routes and likely points of meta-population contact. Preliminary results support Beeton et al. For example, Ust'-Ishim agents move southwards and eventually overlap with the simulated agents from Teshik-Tash, along the western slopes of the Tien Shan Mountains. However, the population simulated at Denisova Cave remains mostly isolated from the other two metapopulations. Several model scenarios also support migration from the IAMC towards northern Europe, a result supported by genetic and archaeological evidence not used in the agent based model examined here. Some of the pitfalls of agent based modeling and the assumptions on which the approach relies also will be examined.

Millennial-scale population dynamics and the anthropology of introgression

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Ancient DNA information has profoundly shifted our understanding of the movements and interactions of prehistoric peoples. Until recently, it was widely assumed that except for the largest-scale cultural changes, such as the initial advent of farming or appearance of Upper Paleolithic hunting technology, most of human prehistory was dominated by in situ evolution with isolation-by-distance. Now, however, it is clear that regional to continental-scale genetic turnover was a frequent phenomenon in prehistoric human populations. The mechanisms and dynamics of such genetic turnovers are not well explained by traditional models of human migration and population mixture, as derived from the ethnographic record of hunter-gatherers and other small-scale societies. Here, I explore a spectrum of complex systems models to understand how small-scale societies in the past may have repeatedly exploded across large geographic areas. By examining the interaction of demography, selection, and culture, it appears that the migration and mixture among populations on a generational scale give rise to self-organized criticality on a millennial scale, often causing substantial redistribution of genetic variation across large geographic regions. This dynamic is consistent with evidence from ancient DNA, and brings a new perspective on the existence, coherence and disappearance of Pleistocene human groups like the Neandertals and Denisovans. In particular, the pattern of ancient population structure and subsequent introgression of ancient alleles may an outcome of these complex dynamics of cultural population systems in the face of human population growth.

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Male Excess Infant Mortality In Four Post-Medieval London Populations

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Male excess infant mortality describes the natural higher mortality of male infants over female infants, including higher proportions of still-births and higher susceptibility to respiratory ailments and other infections.Male excess infant mortality in Europe rose from approximately 10% to approximately 30% between 1750 and 1970 due to a relatively quicker decline in female infant mortality rates. Infant mortality in four post-Medieval London populations is examined in order to identify which factors disadvantaged male over female infants. These populations are curated by the Museum of London; age assessment was based on dental development and epiphyseal fusion, whilst metric and morphological methods were used to determine sex.Broadgate Cemetery (1569-1714), Redcross Way (1800-1853) and St Brides Lower (1770-1849) show male excess mortality in the fetal and perinate age groups. Male excess mortality at Redcross is particularly high, above the 25-50% excess mortality reported in studies of modern populations, suggesting a potential bias towards care of female infants.No male infants were identified at the higher income site Chelsea Old Church (1712-1842) below approximately three months of age. Absence of males in the sample may be due to better access to medical care but may also be a result of the use of wet-nurses in the counties surrounding London and failure to repatriate.This study suggests that socio-economic factors had a greater influence on proportional infant mortality than environmental change in post-Medieval London.

The influence of speed and foot shape on lateral midfoot loading in an ontogenetic and adult human sample

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Human feet are unique among primates in possessing a longitudinally-arched foot that acts as a stiff propulsive lever during locomotion. Recent studies of human walking have demonstrated, however, that some humans exhibit elevated lateral midfoot pressure that is often associated with lateral midfoot dorsiflexion, similar to the "midtarsal break" characteristic of non-human primates. The aim of this study was to investigate further lateral midfoot loading patterns in an ontogenetic and adult sample of humans in response to variation in speed and foot shape variables.

We analyzed plantar pressure data from 74 individuals ranging in age from 1-57 years. All subjects walked and ran (when able) at self-selected speeds across the pressure mat, and adults (>18yrs) also jogged. In our sample, peak pressures experienced in the lateral midfoot ranged from 3-97% of total peak pressure, and 34% of adult individuals experienced peak pressure >200kPa in this region. ANOVA results show that individuals experience significantly greater peak pressure in the lateral midfoot during running and jogging compared to walking. Multiple regression analysis indicates that speed and body mass have a significant effect on lateral midfoot peak pressure, while longitudinal arch height does not. Video analysis indicates that many of the adults exhibiting lateral midfoot peak pressures >200kPa also exhibit dorsiflexion at the lateral tarsometatarsal joints consistent with a "midtarsal break". These results offer additional evidence of lateral midfoot mobility among humans and suggest speed is an important factor influencing lateral midfoot compliance.

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From action perception to toolmaking: adaptations to fronto-parietal circuits in human brain evolution

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Humans have unique capacities for action understanding, social learning, and toolmaking – all behaviors that rely on fronto-parietal circuits. Comparisons with our closest living relatives, chimpanzees, can identify uniquely human neural adaptations that may underlie these uniquely human behaviors. To investigate differences in brain function, we compared activation during the observation of manual action in chimpanzees and humans. Chimpanzee activations were mainly prefrontally-focused, while humans also strongly activated temporal, parietal, and ventral premotor regions, suggesting greater metabolic allocation to processing details about kinematics, positions, and objects. To investigate anatomical differences, we used diffusion tensor imaging to virtually dissect the longitudinal fasciculus (SLF), a fronto-parietal white matter tract. In macaques, the third branch of the SLF terminates in ventral premotor cortex, but we found SLF III connectivity with anterior inferior frontal gyrus (aIFG) in chimpanzees. In humans, this connectivity was even more pronounced, especially in the right hemisphere. Right aIFG is involved in hierarchical processing of action goals; the prefrontal extension of SLF III could provide right aIFG with new details about kinematics and positions from inferior parietal cortex. Finally, we measured neuroanatomical changes that occurred while human volunteers learned to make Paleolithic stone tools. This revealed increases in inferior parietal cortex, ventral premotor cortex, and right aIFG – all regions that show differences relative to chimpanzees. This suggests that human toolmaking arose via adaptation of an earlier, core fronto-parietal circuit and may have co-evolved with other behaviors that rely on this circuit, including action perception and social learning.

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A fully terrestrial lifestyle allowed humans to become both fat and smart: Comparative evidence

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Food is a key limiting resource for animals, especially for species living in seasonal habitats. We propose two complementary strategies on how animals cope with seasonally lean periods: species buffer food shortage either by storing fat or by cognitive flexibility to find alternative resources. While a large brain entails direct metabolic costs, a large amount of body fat is expensive indirectly by increasing locomotor costs. We therefore predict a tradeoff between the ability to store body fat and relative brain size. This tradeoff is expected to be stronger in arboreal clades compared to terrestrial ones, because climbing involves higher costs of transport for additional adipose depots than moving horizontally. Here, we report a phylogenetic comparative study of 95 mammalian species, including 30 primates, using seasonal variation of body mass as a proxy of the ability to store fat. Overall, arboreal mammals exhibit less seasonal variation in body mass than terrestrial species. Controlling for phylogenetic relatedness, we found a negative correlation between relative brain size and seasonal body mass variation, which was particularly strong in arboreal species. We therefore suggest that the adoption of energetically efficient, terrestrial locomotor habits, accompanied by a loss of reliance on climbing, has allowed for the human peculiarity of having both unusually large brains and unusually large adipose depots for a primate of our body size.

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A 30-year perspective on the eclipse and rejuvenation of tooth size allocation analysis for reconstruction of population affinities

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After sparking early interest, human differences in tooth size have been dismissed as merely indicative of dietary behavior and technological innovation, but useless for biodistance analysis. This is because variation in tooth size among modern and recent humans is largely, but not exclusively, characterized by upward and downward isometric scaling of size across the dentition. However, recent application of principal component analyses, coupled with canonical variates analysis of allocation of geometrically-scaled tooth size, demonstrates that isometry alone does not characterize differences in tooth size across populations. Instead analyses of tooth size allocation across the dentition by tooth class, dimension and jaw yield distinct and robust insights into patterning of biological distances across modern human populations. Application of tooth size allocation analysis to a dataset of 18 contemporary ethnic groups of South Asia encompassing 3,158 individuals yields a pattern of porous regional continuity that confirms inter-regional patterns of affinity identified by molecular genetic studies and by dental morphology. In addition, tooth size allocation analysis shows that: ethnic identity signals biological identity in some, but not all cases; some ethnic groups appear to be isolates without close affinities to other groups; expression of sex dimorphism is largely, but not completely a reflection of ontogenetic scaling; and macroregional identification of unknown individuals from South Asia can be made with a high degree of certainty. Such findings signal that odontometric analyses based on tooth size allocation ought to take their place alongside analyses of dental morphology for reconstruction of regional population histories.

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Cranial contrasts: thin ideas about vault bone thickness in LB1 and robust inferences about Down syndrome diagnosis

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In 2004, Brown, et al. reported that LB1 "cranial vault bone is thick and lies within the range of *H. erectus* and *H. sapiens*." Showing that features of LB1 do not establish the uniqueness or normality necessary for a type specimen, Eckhardt, et al. demonstrated that for the average of six published LB1 cranial vault thicknesses, two were above their global population midpoint, one the same, and three below, commenting that "the skull vault of LB1 is not unusually thick objectively…." Baab, et al., nonetheless wrote "We identified additional signs of DS not addressed in the initial diagnosis that are also absent in LB1, including thin cranial bones…." Thin cranial vault bones do not characterize all DS patients. Al-Shawaf & Al-Faleh showed that about 40% lack supposedly diagnostic thin cranial vault bones, vitiating the "thin" or "thick" false dichotomy for diagnostic purposes.

Additionally, the initial rhetoric that "LB1 cranial vault bone is thick"seemingly counters the more recent characterization of "H. floresiensis" as a late-surviving African early *Homo*. Nawrocki showed early Pleistocene hominins have relatively thin cranial vault bones. The Dinaledi Chamber hominins are consistent with that observation: "The cranial vault bones are generally thin" though not yet quantified (stated by Berger, et al.).

Cranial vault bone thickness in LB1 is equivocal and in DS is variable; on these points as well as many others, the available data for the anomalous LB1 specimen are phylogenetically indeterminate and do not withstand hypothesis testing that is the norm in biomedical research.

Cranial variation and biodistance in three Imperial Roman cemeteries

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Ancient Roman populations are expected to exhibit considerable biological variation due to extensive trade networks and migration patterns throughout Europe and the circum-Mediterranean. The purpose of this research is to examine regional biological variation in Italy during Imperial Roman times (I-III Centuries AD) using three samples exhibiting distinctive class and economic systems. The individuals buried at Isola Sacra and Velia represent middle class tradesmen and merchants from coastal port populations from central and southern Italy respectively; while the individuals from Castel Malnome represent an inland population near Rome of freed slaves and other lower class individuals, involved in heavy labor associated with salt production. Data were recorded from 25 cranial three-dimensional landmark coordinates and analyzed using Procrustes Superimposition and associated multivariate statistics in MorphoJ.

Procrustes ANOVA statistics were unable to detect any significant group differences for centroid size or shape (size p=0.5957, shape p=0.1970), suggesting that the three samples are similar to one another. However, canonical variates analyses based on Procrustes distance values indicated that while Castel Malnome was not significantly different from either of the coastal sites (Isola Sacra, p=0.2071 and Velia, p=0.8015); Isola Sacra and Velia were significantly different (p=0.0119). The similarity of Castel Malnome to the other sites may reflect inherent heterogeneity in the sample, as it represents a group of freed slaves likely originating from various geographic locations. The separation of the two coastal sites is not unexpected, as Velia's location may be influenced by an influx of Greek populations in the southern Italian peninsula.

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Sowing the Dead: Massacres and the Missing in Northern Uganda

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The 1986-2006 conflict in Northern Uganda between the Lord's Resistance Army (LRA) rebels and central government resulted in small- and large-scale massacres of civilians throughout the region. Post-conflict transitional justice processes to date have focused on reuniting families fractured by internal displacement and the social reintegration of those abducted as children by the LRA rebels. However, the challenges of exhuming and identifying the dead in mass graves, displacement camps, and on ground surfaces have yet to be addressed. Our project examines the cultural and geopolitical landscape of massacres in the north to assess if and how the recovery of unidentified human remains should proceed. This paper focuses on two aspects of the project. First, we address whether the modus operandi of killings and mass grave location and construction can be used to predict which organization committed the massacre. Given the forced displacement, temporal distance from the events and bias, current residents may not recall the locations of graves or who committed the massacre. We also address how the violent deaths and improper depositions affect if and how survivors want graves investigated. Many survivors believe that the spirits of the dead directly impact the fate of the living. The unhappy dead may cause disease, crop failure, mental illness, and further social conflict. Our ethnographic research indicates that while many survivors want to know the fate of loved ones and conduct reburials, they are divided by the religious, political, legal, and economic issues tethered to scientific investigation.

Micromammal community structure of Cooper's D and the paleobiology of *Paranthropus robustus*

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Micromammals are often used as paleoenvironmental indicators. Though presence/absence data for individual micromammal species are commonly considered as part of broader taxonomic patterns, micromammal species are rarely analyzed from a community perspective. Here, we use multivariate community analyses to reconstruct paleoenvironments from several *Paranthropus* sites in South Africa based on recovered micromammalian assemblages, and compare the results to those of analyses focusing on larger mammals.

The Bloubank Valley, South Africa, has yielded multiple *Paranthropus* sites, including Cooper's Cave, Sterkfontein Member 5, and others. Dated to 1.5-1.4 Ma, Cooper's D is the best constrained age for a *P. robustus* assemblage, and comparing the micromammal assemblage from it to those of other Cradle sites provides a unique opportunity for *Paranthropus* habitat reconstruction that is clearly situated both temporally and geographically. Multivariate analyses were used to characterize modern micromammal community structures of 53 extant African sites in a range of habitats as a comparative sample for reconstructing paleohabitats of fossil assemblages.

Results of preliminary Correspondence Analyses suggest that the Cooper's D community reflects a dry, shrubby habitat, which is in accordance with reconstructions of the micromammal paleohabitat of other Cradle sites including Sterkfontein Member 5. Because micromammals tend to be more localized to the site of deposition, there are implications for how these results should be compared with analyses of large mammal communities, and how both together may provide a paleohabitat reconstruction for *Paranthropus* from both local and regional perspectives, reflecting variation in hominin paleobiology and the landscape.

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Sub-Regional Population Structure within South America Using MtDNA

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The genetic structure of South America has been primarily explored in the context of human dispersion patterns within the Americas, with the assumption that the local environment does not significantly affect the continental apportionment of between-population genetic variation. Therefore, regional variation and population structure within South America has not been extensively examined. To explore the impact of environment on regional genetic structure, we calculated correlations between mtDNA haplogroups of 50 South American populations from 5 macro-regions, linear geographic distances, and five climatic variables (mean annual temperature, annual temperature range, annual precipitation, isothermality, and altitude). Mantel tests and Partial Mantel test correcting for geographic distance were performed for each region independently. When looking at the whole of South America, there is a significant geographic signal ($r = 0.17$, $p = 0.004$) and no correlation with climate variables. However, this varies considerably when South America is broken down into regions. A nonmetric MDS analysis shows a strong East - West division in the continent, with the Andes being the geographic divider. Moreover, when analyzed separately, some regions maintain a strong geographic signal (Andes region, $r = 0.45$, $p < 0.001$), some correlate better with temperature changes (Southern Cone, $r = 0.62$, $p < 0.001$), while others show no discernable

structure (Amazon region). These results suggest that local environmental conditions did play a differential role in the apportionment of mtDNA variation in the continent, possibly affecting the rate of drift and gene flow between groups.

Testing the adaptive radiation theory for the evolution of lemurs on Madagascar

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Adaptive radiation theory predicts that some lineages which exploited unique ecological opportunities had rapid lineage and phenotypic diversification as they filled new adaptive zones. The endemic lemurs of Madagascar have long been hypothesized to be an adaptive radiation. I tested the following predictions from adaptive radiation theory: 1) lineage and phenotypic diversification exhibited an early burst of rapid evolution followed by decelerating rates, 2) speciation and phenotypic change were greater in lemurs than their sister clade in Africa and Asia (lorisiforms), and 3) optimal lemur body mass diverged in adaptive zones of diet and activity. I used phylogeny-based inferences of speciation, extinction and trait evolution to estimate lineage-specific rates and test for rate shifts on a near-complete phylogeny of living and extinct lemurs and extant lorisiforms. Counter to adaptive radiation theory, lemur lineage diversification rate was low early in their evolution and increased towards the present, while lorisiform diversification was constant through time. No significant shift in diversification dynamics was observed between lemurs and lorisiforms. Lemur body mass evolution was highest after colonizing Madagascar and declined toward the present, while in lorisiforms, the rate was low and constant over time. Optimal body mass and rate of body mass evolution differed among adaptive zones of diet and activity pattern, suggesting phenotypic evolution was adaptive. The results provide mixed support for the adaptive radiation hypothesis in lemurs. Phenotypic evolution suggests adaptive diversification, but extinction may have eroded any signal of an early burst of speciation in these ancient lineages.

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Sorting the fragments and assessing the relationships of the Ayioi Omoloyites tombs of Hellenistic to Roman Period Cyprus

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Commingled human skeletal remains present methodological and interpretive challenges for skeletal biologists. Recent research on commingled human remains from archaeological and forensic contexts has focused on advancing methodological and theoretical approaches. Using a modified version of Knüsel and Outram's fragmentation zonal coding system, a collection of commingled human remains from the Hellenistic (310-30 B.C.) to Roman (30 B.C. to A.D. 330) period tombs from Ayioi Omoloyites located in Nicosia, Cyprus was examined. In addition to the basic osteological assessments, dental morphology traits were collected using the ASU Dental Anthropology System (ASUDAS) to compare to recent biodistance research by Harper and Tung on a series of Hellenistic-Roman and Venetian tombs recorded in the Malloura Valley south of Nicosia, Cyprus. Preliminary results from two smaller tombs (Tombs 47 and 48) and the partial analysis of the large tomb (Tomb 49) will be presented. In total, 986 elements have been inventoried with 89, 148, and 731 elements from Tomb 47, 48, and 49, respectively. Minimum Number of Individuals (MNI) estimates based on zonal scores and demographic parameters will be presented and discussed relative to the three tombs from Ayioi Omoloyites. In addition, 110 individual teeth were scored in ASUDAS and Mean Measure of Divergence (MMD) values calculated to compare to the Malloura Valley samples. Implications of these relationships will be discuss relative to historical data concerning Cypriot population movements and interactions during the Hellenistic to Venetian Period.

Core Fulbright U.S. Senior Scholar - Cyprus

Degenerative Joint Disease and its Relation to the Osteological Paradox: A Study of Modern Geriatric Cypriot Skeletons

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The purpose of this research is to provide a pathological assessment for exhumed geriatric remains from the St. Nicholas Cemetery in Limassol, Cyprus. In this study we focus specifically on the degenerative joint disease (DJD) in the wrist, hand, ankle, and foot of 30 individuals. Scholars suggest that DJD is most closely associated with age. Cemetery records provide an opportunity to work with a geriatric sample with known demographics and allow this study to address the osteological paradox. DJD is assessed by joint complex in regards to the severity of arthritic lesions (porosity, lipping, osteophytes, and eburnation). In this study, DJD was evaluated on a 1-3 severity scale (mild, moderate, severe).Skeletons in this sample range from 43-100 years of age, 50% are males and 50% are females. This skeletal sample falls into four age categories: middle-aged (43-56), young-old (64-74), middle-old (75-84), and old-old (85 +). H1: Age will not have a statistically significant effect on the DJD severity of the wrist, hand, ankle, or foot. No statistical significance was found in any of the age-specific testing in the four joint complexes examined. This thesis shows that accuracy of specific age estimations in prehistoric burials may not affect how DJD is assessed. Frequency and severity of DJD was the same for all geriatric members of this sample. Therefore age has no bearing on the assessment of skeletal lesions specific to degenerative joint disease in geriatric individuals.

Machete and Axe Tool Mark Assessment Using Fully Fleshed Pigs

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The purpose of this project is to contribute to the literature and techniques associated with the creation of a clear means for identifying tool marks caused by heavy bladed instruments during dismemberment. This research examines the trauma patterns associated with specific weapons (machete or axe). Thirty-two fully fleshed pig limbs (*Sus scrofa*) were dismembered by 4 volunteers. Evidence shows that it is possible to differentiate between machete and axe strikes on certain characteristics. Two different types of statistical testing were used to evaluate the data collected in this study. A t-test showed that the kerf width made by the axe is statistically different from the kerf width made by the machete. Then a two-tailed Fisher's exact test was created to determine if there were statistically significant patterns in the frequency of tool marks. The tool marks include: fracturing, shattering, and crushing. The frequencies of specific tool marks are taken from the total number of tool marks made by each weapon; for example of the 121 tool marks associated with the axe; 84 are crushing tool marks (69.4%). Statistical significance was discovered in regards to kerf width, the frequency of shattering, the frequency of crushing, and when the bone was completely sliced through.

Evidence that anthropoid call frequencies are shaped by sexual selection

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Some anthropoid primates exhibit conspicuous sex differences in call frequencies. Although such sexual dimorphisms in secondary sex traits are often the products of past sexual selection, no systematic test of this hypothesis has yet been conducted regarding sex differences in anthropoid vocalizations. We therefore measured fundamental frequency (F_0), the acoustic correlate of pitch, in 1723 calls from 34 species representing 24 anthropoid genera, obtaining data on mating system and body mass from the literature. We found that (1) among apes, humans exhibit the greatest sexual dimorphism in F_0, (2) across species, body mass negatively predicts F_0 in both sexes, and (3) with sexual dimorphism in body size controlled, males exhibit lower F_0 relative to females in polygynous species than they do in monogamous species. In addition, phylogenetically independent contrast analysis revealed increases in F_0 sexual dimorphism during evolutionary transitions toward polygyny and decreases during transitions toward monogamy. The results of the present study thus support the hypothesis that sexual selection favors lower F_0 among male anthropoids.

A comparative analysis of upper limb cross-sectional properties in the Lake Mungo 3 skeleton from the Willandra Lakes, Australia

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Lake Mungo 3 (LM3) is currently the oldest dated skeleton from Australia (~42.5 Ka), and thus provides a wealth of information about the earliest Aboriginal foragers. The Willandra Lake system transitioned from an extensive deep-water phase to fluctuating flooding ~40 Ka. The densest archaeological deposits corresponding to the LM3 burial are directly adjacent to these lakes and mostly consist of fish and shellfish remains. Researchers disagree whether this evidence indicates focused harvesting of lacustrine resources or that fish and shellfish were only exploited when they were 'easy prey.' To test the hypothesis that early inhabitants of Lake Mungo were involved in intensive lacustrine exploitation, cross-sectional properties of the right and left middistal humerus were calculated from CT images and then compared to a series of samples exhibiting varying foraging patterns. LM3 has a high right-side bias in all cross-sectional properties calculated. Cortical area and polar moment of area asymmetry for LM3 clusters high in the range of Upper Paleolithic and Neandertal samples. LM3 also has a high I_x/I_y ratio similar to Neandertals and Upper Paleolithic samples. These cross-sectional properties are dissimilar from aquatic forager samples. These results indicate that it is unlikely that LM3 was involved in intense fish and shellfish harvesting at Lake Mungo. Rather, these data are consistent with terrestrial foraging with a focus on game hunting. Considering the arthritic degeneration of this skeleton's right elbow joint, the activities that led to a distinct right-side bias must have been important for every day survival.

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Facial width-to-height ratio (fWHR) is not associated with pubertal testosterone

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Several researchers have proposed that facial width-to-height ratio (fWHR) is a sexually dimorphic signal that develops under the influence of pubertal testosterone (T); however, this hypothesis is currently under supported. Here we examine the association between fWHR and T during the period of the life span when facial growth is canalized--adolescence. To do so, we examine the association between T, known T-derived traits (i.e. strength and voice pitch), and craniofacial measurements in a sample of adolescent Tsimane males. If fWHR variation derives from pubertal T's influence on craniofacial growth, several predictions can be made: 1) fWHR should increase with age as T increases, 2) fWHR should reflect adolescent T (rather than adult T per se), 3) fWHR should exhibit a growth spurt in parallel with T, 4) fWHR and T should correlate after controlling for potential confounds, and 5) fWHR should show a strong relationship to other T-derived traits. These effects were not observed. We also examined three additional facial masculinity ratios: facial width/lower face height, cheekbone prominence, and facial width/full face height. In contrast to fWHR, each of the three additional measures exhibit a strong age-related pattern of change and are associated with both T and T-dependent traits. In summary, our results challenge the status of fWHR as a sexually-selected signal of pubertal T and T-linked traits.

The legacy of slavery in the Middle East has been underappreciated by a factor of two

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During the height of the slave trade an estimated 7.2 million sub-Saharan Africans were transported into the Middle East and North Africa (MENA) to serve as domestic servants, concubines, soldiers, and laborers. This represents a movement of people similar to that of the transatlantic slave trade. While there are currently ~160 million descendants of the transatlantic slave trade in the New World, clear descendants of the Arabian Slave Trade in the MENA are extremely rare. This is thought to be a result of the combined practices of castrating male slaves, and the assimilating of female household slaves into local families. Previous genomic estimates of sub-Saharan ancestry in Middle Eastern populations have been surprisingly low (~8%) given the historic scale of the slave trade. However, we recently showed that Horn of Africa (HOA) populations derive much of their ancestry from the Middle East due to a pre-agricultural back migration. If Arabian Slaves were sourced from areas with a high proportion of this Middle Eastern ancestry, then the genetic impact of the slave trade will have been underestimated by this fraction. Here, we use genomic SNP data from nine Middle Eastern populations to reassess the genetic legacy of slavery in light of Eurasian ancestry in HOA populations. We find a two-fold increase in the average amount of slave-derived ancestry in the Middle East (~16%). Our findings suggest that assimilation occurred more frequently than thought, and that many slaves were taken from HOA populations with considerable Eurasian ancestry.

Phenotypic variability, cemetery structure, and kinship in an early Iron Age mortuary complex at Wadi Fidan, Jordan

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We present the results of a preliminary study of phenotypic variability in a skeletal series from an Iron Age (ca. 11^{th}-10^{th} centuries BCE) mortuary complex in Wadi Fidan, Jordan. Wadi Fidan is the gateway to the Faynan district, one of the largest sources of copper ore exploited by ancient societies in the southern Levant. The skeletal remains reported here significantly contribute to the regional assemblage of excavated skeletal remains dating to the Iron Age and therefore provide critical data on mortuary practices, population structure, and processes of biological integration during a period of political and economic change. Craniometric (n=40), odontometric (n=44), and cranial nonmetric (n=34) variables were recorded for individuals from two localities, WFD40 (n=22) and WFD61 (n=19). We test archaeological hypotheses that the mortuary complex was kin-structured and the population practiced patrilocal postmarital residence. Using

a pre-treated phenotypic dataset, we performed two sets of biodistance analyses: 1) kinship analyses were conducted to assess correspondence between biological structure and spatial cemetery organization, and 2) postmarital residence analyses were conducted to assess sex-specific within-cemetery variation. Results are discussed in reference to recently-discovered regional practices of social and biological integration, which have significant implications for the mediation of individual, kinship, and group identities during a time of rapid secondary state formation throughout the southern Levant. These findings illuminate aspects of population structure and social organization of a potentially influential (yet understudied) population and the nature of their interactions with surrounding groups during a formative period in the Middle East.

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The emergence of inequality: An analysis of fifty years of anthropometric data from Nuñoa, Peru

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Nuñoa, Peru has been the site of anthropological research on human adaptability and health since the 1960's. At this time, several large-scale anthropometric studies were conducted. Subsequent data collections have taken place in the 1980s, 1990s, and 2012-15. This temporal depth of data collection provides an unparalleled opportunity to examine changes in patterns of growth across time. Data collections serendipitously timed such that they precede and follow major social, political and economic shifts in the area including: a major agrarian land reform in 1969, the civil conflict between the *Sendero Luminoso* revolutionary movement and Peruvian military, and the flood of state and NGO sponsored development projects aimed at fostering the emerging dairy industry throughout the southern highlands. In this paper, we present results from a meta-analysis of anthropometric data from the 1960s, 80s, and 90s alongside the contemporary data. Z scores for both height-for-age and weight-for-age are re-calculated using the 2009 WHO growth standards to allow for comparability across time periods. We observe improved stature and weight between the 1960s and 1980s, almost no change between the 1980s and 1990s and statistically significant reductions in stunting between the 1990s and 2015. Recent anthropometric data reveals emergent childhood overweight and obesity as well as a trend toward greater inequality, patterned on variation in economic activity. Specifically, we find the largest improved growth in higher SES families in town, followed by families involved in dairying, with poor families in town and herding families having the highest rates of stunting.

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Women in war: A multi-isotopic analysis of females discovered in a mass grave with Napoleonic soldiers

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Women have participated actively in war for thousands of years, traveling with armies and serving a number of roles including soldier, prostitute, wife, sutler, nurse, and laundress. The campaigns of the Napoleonic Wars of the early 19th century offer abundant examples of women journeying with Napoleon's Grand Army. During the Russian Campaign of 1812, women traveled, died, and were buried with soldiers on their retreat from Moscow. A mass grave excavated in 2001 containing the remains of Napoleonic male soldiers in Vilnius, Lithuania also held the remains of female individuals. A focused analysis of three females from the mass grave provides insight into the experience of this underrepresented group in war convoys. Stable carbon, nitrogen, and oxygen isotope ratio analyses were performed on femoral collagen and apatite of these individuals to investigate variability in diet and migration of female war participants, and were compared to those of their male counterparts from the mass grave. Among females, stable nitrogen isotope ratios exhibit low variation (range of 0.5‰), whereas stable carbon isotope ratios from collagen and apatite and oxygen stable isotope ratios exhibit wider ranges (range=3.9‰ for collagen carbon, 1.29‰ for apatite carbon, and 2.06‰ for oxygen). The oxygen isotope data in particular point to different geographic origins for females accompanying the army. Such isotopic variation among females in this sample reflects the diversity of experiences of these individuals, as detected from differences in diet and movement across the European landscape.

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Body mass and femur length of *Orrorin tugenensis*

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A cast of the left proximal femur (BAR 1002'00) of the 6.0 Ma hominin species *Orrorin tugenensis* is examined to estimate the specimen's body mass and femoral length. The specimen's anteroposterior femoral head diameter (32.2 mm) is used to estimate body mass with formulae derived from modern humans, yielding an estimate of ca. 34.4 kg, close to the estimate of 35.8 kg reported by Grabowski and colleagues. We also estimate body mass using African ape formulae from Jungers and Susman and Jungers, yielding an estimate of 42.2 kg. Femoral length of the specimen was then estimated using the position of the femoral waist. As defined by Friedl, the femoral waist is the weakest point along the shaft. We find that the femoral waist of BAR 1002'00 is located 7.6 mm proximal to its preserved distal end. Using a sample of 244 humans, an OLS regression of the distance from the head to the femoral waist on femoral length yields a femoral length estimate for BAR 1002'00 of ca. 408 mm, with a 95% CI of 354 – 462 mm.

When these data are plotted in ln-linearized bivariate space, *Orrorin tugenensis* falls well above the African apes in terms of femur length to body mass, and falls near the *Homo sapiens* OLS and RMA regression lines. If *Orrorin tugenensis* is indeed a 6.0 Ma hominin, this indicates very early elongation of the lower limb associated with terrestrial bipedalism.

Why Paleoneurology Needs the Lunate Sulcus

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The infamous lunate sulcus, controversial as it is, is one of the few sulci that can sometimes be seen on ape and hominin endocasts. The position of this sulcus, whether anterior as in apes, or posterior as in hominins is of great importance, because this sulcus marks the boundary between primary visual cortex, area 17 of Brodmann, and peri- and para visual cortices (areas 18 and 19), and posterior parietal association cortex. Since endocasts can provide accurate volumes, the posterior placement of a lunate sulcus on an ape-sized hominin endocast (e.g., Taung, AL 162-28SK1584, Stw 505) indicates that brain reorganization has preceded endocranial volume increases and that these hominins had relatively expanded parietal and posterior inferior temporal lobe cortices, which are of considerable significance regarding cognitive abilities.

Recently, Falk has suggested that the landmark be discarded, while keeping the

"Affenspalte" for the anthropoids. Falk also suggests that the deep, crescentic furrow I identified as the lunate sulcus on Stw 505 is possibly a lateral calcarine sulcus. None of the lateral calcarine sulci examined on 48 ape hemispheres are ever as deep or curve in the same crescentic shape as does the lunate. Furthermore, the lateral calcarine does not appear on either ape or human endocasts, except for an occasional dimple at the occipital pole.

There is no anatomical or functional basis for discarding the lunate sulcus. Instead, it needs to be more carefully studied and its relationship to operculization and primary visual cortex better understood.

Ontogenetic shifts in the pattern and magnitude of mandibular covariance

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The structure of covariance in developing morphological structures can alter due to shifting ontogenetic and functional demands. This is important for complex morphological structures, like the primate mandible, because covariance may determine how susceptible such structures are to adaptive influences. Here we used a cross-sectional sample of laboratory mice to determine when/how the *pattern* (how traits covary) and *magnitude* (strength of trait covariance) of covariance change in the mandible. Specifically, we predicted that mandibular covariance is stable before the onset of weaning but alters after introduction of an adult diet.

Micro-CT scans were collected from a series of embryonic, peri-weaning and adult mouse skulls (n=79). Three-dimensional landmark coordinate data were collected from each mandible. Procrustes superimposition was applied to coordinate data to produce shape variables. Covariance matrices and Scaled Variance of Eigenvalues were generated from shape variables and used to compare patterns and magnitudes of covariance between age groups, respectively. Significance was determined via permutation tests.

Patterns of covariance in the mandible were different between adults and the younger mice ($p>0.05$; null of *no similarity*), but not between embryonic and peri-weaning ages ($p=0.035$; null of *no similarity*). However, observed matrix correlation values were remarkably low ($R_{obs}<0.2$) in all comparisons. Furthermore, the magnitude of trait covariance decreased markedly throughout ontogeny ($p<0.001$). Mandibular covariance structure does in fact change over growth even before dietary shifts, suggesting that other processes (i.e., somatic or dental growth) are involved. These results are important for future analyses regarding plasticity or constraint in primate mandibular evolution.

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What level of biogeographical information is available from ^{18}O and ^{13}C signatures in late-erupting molars of modern humans?

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Stable isotope analysis of biogenic tissues such as tooth enamel and bone mineral has become an increasingly important method for determining the provenance of human remains. Both ^{18}O and ^{2}H stable isotope signatures are widely used proxies as environmental indicators of climate and source water and are therefore considered reliable indicators of human geographic life trajectories. Similarly, ^{13}C abundance data have distinguished dietary preferences in ancient human populations, and have been used to qualify ambiguous ^{2}H and ^{18}O geolocational data. This study tested some of these widely held assumptions using data from tooth enamel of living individuals with known life histories.

Tooth enamel was sampled from 10 Canadian volunteers undergoing routine third molar extractions. Crown enamel was drilled, chemically cleaned, and subsequently analyzed for its ^{18}O and ^{13}C composition using IRMS.

Pooled mean enamel carbonate $\delta^{13}C_{VPDB}$ and $\delta^{18}O_{VSMOW}$ values, -10.37 ‰ and 24.39 ‰, respectively, were consistent with self-reported residential history (i.e., Ontario, Quebec) and dietary preferences (e.g., persistent C_4 plant dietary influence). However, no statistically significant correlations were evident between calculated drinking water $\delta^{18}O$ values and their corresponding modeled annual average $\delta^{18}O$ values in precipitation. Merging the isotopically homogenous Canadian dataset with geographically diverse ^{18}O data from a relevant feasibility study yielded a strong positive correlation ($R^2=0.87$) between drinking water and source water $\delta^{18}O$ values.

These findings illustrate the importance of considering isotopically complex site-specific hydrogeological processes and using multi-isotope data obtained from multiple tissues when investigating the geographic origins of humans in an archaeological or forensic context.

Functional morphology of the metatarsophalangeal joints in chimpanzees and humans: A kinematic and morphometric approach

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During bipedal walking, humans dorsiflex their metatarsophalangeal joints (MTPJs) to a high degree just prior to toe-off. This motion tightens the plantar aponeurosis, converting the foot into a strong propulsive lever. Particular features of human metatarsal (MT) head morphology (e.g., "dorsal doming") are thought to help enable this mechanism. In contrast, chimpanzees are thought to possess MT head morphology that precludes loading of the MTPJs at high dorsiflexion angles.

To test this notion, we measured MTPJ motion in 5 human and 2 chimpanzee subjects during walking using 3-D kinematic methods. We also used 3-D geometric morphometric (3DGM) techniques to quantify MT1-5 head shape in a large sample of human and chimpanzee specimens. We found that humans exhibit significantly greater peak dorsiflexion angles at all MTPJs than chimpanzees, with the greatest disparity between species occurring at MTPJ 1. Among MTPJs 2-5, both species exhibited a mediolateral gradient from higher to lower peak joint angles. These results are reflected in the morphometric data; PC1 separated chimpanzees and humans, and PC2 separated MT rays within species. PC1 was driven primarily by a dorsal versus plantar orientation of the MT head, whereas PC2 captured relative mediolateral breadth of the MT head.

This research provides the first marker-based quantification of motion differences at all five MTPJs in humans and chimpanzees, and indicates that 3DGM complements experimental approaches, making it a useful method for capturing functional signals in the MTPJs. Our results should ultimately aid reconstructions of early hominin locomotion.

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Ontogeny of nasal integration in males and females

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Potential integration between the nasal region and other non-cranial components of the respiratory system has significant implications

for understanding the determinants of naso-facial variation. Indeed, broader systemic factors associated with bioenergetics and the need to meet requisite oxygen demands is thought to contribute to variation in nasal development and patterns of sexual dimorphism in recent humans. To further our understanding of the influence of energetics on nasal variation, we examined the ontogeny of sexual dimorphism in nasal shape using coordinate landmark data from lateral cephalograms and body size data from n=20 males and n=18 females between 3.0 and 20.0+ years of age. We first tested whether there are sex differences in nasal shape related to ontogenetic increases in body size. Additionally, we examined whether there are male-female differences in patterns of non-allometric variation in nasal shape. Next, we tested whether there are sex differences in the strength of integration between the nasal region and other aspects of the craniomandibular skeleton. While our results indicate a number of similarities in the nasal region between males and females, relative to body size, the male nasal cavity exhibits a disproportionate increase in height that is not present in the female sample. Moreover, the male nasal region is less integrated with the surrounding facial skeleton when compared to the female sample. These results are consistent with the hypothesis that sex differences in nasal development are associated with male-female differences in energetically relevant variables and suggest that larger systemic factors influence variation in facial form.

Genetic analyses of pre- and post-contact North American *Mycobacterium tuberculosis* complex strains

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The origins of tuberculosis (TB) in the New World have long been a topic of debate. Ample skeletal evidence for TB is present in the pre-contact New World. Currently, New World TB is caused by *Mycobacterium tuberculosis* complex (MTBC) strains of European origin, suggesting that pre-existing MTBC strains were replaced following European contact. Previous research from our group led to the recovery of three 1000-year old MTBC genomes from skeletal TB cases from coastal Peru; these ancient Peruvian MTBC strains are closely related to MTBC strains found in pinnipeds. However, it remains unknown whether such pinniped-derived MTBC strains spread to the inland parts of South America as well as North America by human-to-human transmission. The present work focuses on skeletal TB cases (n=13) from pre-contact, protohistoric, and historic sites from Alaska. DNA was extracted using a silica-based method and tested for presence of MTBC DNA using quantitative PCR (qPCR) assays. Eight DNA extracts tested positive for a region of the rpoB gene specific to the MTBC and nine extracts tested positive for the IS6110 repeat element. In-solution target enrichment and sequencing of MTBC-specific genes is underway for these samples, as well as for samples from other pre- and post-contact sites from the Americas. Such analyses will help determine coverage as well as authenticate the presence of ancient DNA. Additionally, samples that test positive are being enriched for the entire MTBC genome using an array-capture method and then sequenced. Analyses of these genomic data are currently ongoing.

This work was supported by funding from the National Science Foundation (BCS-1063939 and BCS- 1515163) and the Wenner Gren Foundation.

Human males have low reproductive skew compared to other mammals: An analysis of new data from small-scale human societies

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To what extent are human patterns of reproduction typical or atypical compared to other mammals? In this presentation, we give an answer to this question focusing on one aspect of reproduction: reproductive skew, or the degree of inequality in reproductive outcomes within a population. We draw on a new cross-cultural dataset to provide estimates of reproductive skew for each sex in small-scale human societies, including hunter-gatherers, horticulturalists, pastoralists, and agriculturalists prior to the demographic transition to low fertility. We compare these values to estimates of reproductive skew for a variety of non-human mammals. The results indicate that while reproductive skew among human females falls within the expected range for non-human mammals, reproductive skew among human males is substantially lower than expected compared to non-human mammals. We hypothesize that the remarkably low levels of skew among human men are due to the high frequency of monogamous pair-bonding and paternal investment observed small-scale human societies. This talk also introduces a new method for measuring skew that overcomes weaknesses of previous methods.

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Building ancient noses: a functional approach to paleogenomic data

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Taste and smell (chemosensing) are the first senses to evolve. Smell has an intricate and complex neuronal structure which reflects the dynamic interaction among genes, biology, environment, and perception. Olfactory science is emerging as a multi-disciplinary field aimed at understanding these interacting elements. A key area of interest is the link between genes that allow detection of odors (and create an olfactory repertoire) and how this might influence food choice. Taken in the broader evolutionary hominin context of human olfaction, our aim was to determine if novel variants in the paleogenomes of Altai Neandertal and Denisova resulted in distinct olfactory repertoires. Identifying variation in olfactory repertoires within a comparative evolutionary frame advances knowledge on hominin dietary evolution and evolutionary ecology. Traditional approaches to inferring gene function in extinct species have relied on computational methods. We introduce a transformative and novel approach that allows reconstruction of hominin olfactory receptors from paleogenomic data and experimental validation of their functional responses to odorants. Results include: 1) catalog of variants in paleogenomic sequence data using a custom bioinformatics pipeline; 2) creation of ancient hominin olfactory receptors using overlap extension PCR; 3) experimental validation of functional variant impact on odorant response in ancient hominin olfactory receptors.

This research was funded by NSF Grant BCS-1550409.

Polyspecific associations of red uakaris in northeastern Peru

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Red uakaris (*Cacajao calvus ucayalii*) remain one of the least studied Neotropical primates. They are restricted to northeastern Peru and have extremely large home and day ranges. They are known for their extremely fluid social system, able to change in size and composition nearly hourly. Red uakaris have been reported to form polyspecific associations (PSAs) with other primates.

As part of a larger project on primate community ecology within a mosaic landscape, we report data on the occurrence of PSAs as red uakaris navigate through varying habitat types. The study took place at the Tahuayo River Amazon Research Center (TRARC) in northeastern Peru (September 2012-February 2014). The mosaic landscape of the TRARC is home to 12 primate species, including the red uakari. We tested the hypothesis that red uakaris

would be in PSAs with different species for varying portions of time.

Our data show that PSAs between uakaris and four of the 11 other primate species at the TRARC occurred 31.4% of observation time. These species were *Saimiri sciureus*, *Lagothrix poeppigii*, *Cebus albifrons*, and *Cebus apella*. Of the percentage of time in PSAs, 69.5% was with *S. sciureus*, 15.6% with *L. poeppiggii*, and 7.3% with each *Cebus* species. PSAs including uakaris and 2 other species occurred 12.2% of the time.

This study, one of only a few long-term studies (>12 months) with emphasis on red uakaris, contributes to the limited data currently available on how a widely ranging species copes socially with sharing a heterogeneous landscape with many other primates.

Funding for this project was provided by IDEA WILD and Southern Illinois University's Uakari Research Fund.

The social brain in human evolution: neuron density in the prefrontal cortex in Williams Syndrome

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The prefrontal cortex (PFC) is linked to many higher-order functions involved in human cognition and social behavior, and has likely undergone recent, rapid and functionally significant change in human brain evolution. It has been hypothesized that recent neural specializations and increased connective complexity in the human brain, which allow for the cognitive and social behaviors characterized as uniquely human, may have also resulted in an increased vulnerability to neurodevelopmental disorders. Comparative neuroanatomical studies with neural pathologies that include a social component may therefore illuminate characteristics of neural architecture that are critical for normative function of the social brain, and may offer new insight into the evolutionary trajectory of the social brain in humans. Here we examined neuron density in the supra- and infragranular layers of the PFC (BA 10 and 11) and three other areas, including sensory, motor, and visual cortices (BA 3, 4, and 18) in six typically developing individuals (TD) and six individuals with Williams Syndrome (WS), a neurodevelopmental disorder with a known genetic deletion and a distinct socio-behavioral phenotype. We found that neuron density was decreased in WS relative to TD in the PFC areas only, with the infragranular layers, which have connections to subcortical structures of the social brain, such as the amygdala, demonstrating the largest decrease in density. These results suggest that cytoarchitectonic changes in neuron density in the PFC underlie the socio-behavioral abnormalities of WS, and may be indicative of neural specialization and increased connective complexity of the social brain in human evolution.

WS subjects obtained by the Laboratory of Cognitive Neuroscience at the Salk Institute. TD tissue obtained from University of Maryland Brain and Tissue Bank, of NIH NeuroBioBank.

***E. coli* exposure, intestinal barrier function and immune health in Galapagos, Ecuador**

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Sub-clinical intestinal infections are a primary cause of undernutrition among infants and children living in highly pathogenic environments. Habitual ingestion of fecal bacteria due to contaminated water and unsanitary living conditions may cause poor intestinal barrier function and chronic immunostimulation. However, due to the plasticity of the immune system, pathogenic exposures during childhood that do not cause serious illness can provide the necessary inputs for proper immune development. We test the hypothesis that exposure to *E. coli* in household tap water used for non-drinking purposes that does not result in diarrhea, will have a negative relationship with endotoxin core IgG antibodies, which indicate compromised intestinal barrier function. Health and demographic interviews were conducted, and water quality assessments and blood samples were collected from 118 mothers and 166 children living on San Cristobal, Galapagos. Approximately 42.4% of households had more than 10 *E. coli* bacteria per 100 mL of water and 11.8% had over 100 bacteria. The mean antibody value for mothers was 184.0 MU/mL (SD 90.6 MU/mL) and 17.0% were above the healthy range for European adults. Children had a mean of 158.6 MU/mL (SD 65.7 MU/mL) and 8.4% were above the healthy adult range. We found a significant protective effect of *E. coli* exposure on endotoxin core IgG antibodies among children, while adjusting for cofounders. These results suggest that chronic, low-level exposure to pathogens during childhood that do not directly result in overt infection may help regulate and promote intestinal immune function.

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Associations between skeletal DNA methylation and baboon femur morphology

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Complex skeletal traits are the product of genetic, environmental, and epigenetic mechanisms. DNA methylation is one such epigenetic mechanism which regulates gene expression. Because epigenetic modifications are influential in the development and maintenance of skeletal traits, they may also contribute to the evolution of primate skeletal anatomy. Skeletal morphology in relation to DNA methylation variation has not, however, been assessed in non-human primates. This study addresses this knowledge gap by identifying intraspecific methylation variation in primate skeletal tissue to test the hypothesis that specific features of femur morphology are associated with specific variations in methylation. Skeletal tissue DNA methylation patterns were assessed in right distal femur trabecular bone from adult female baboons (n=12) using the Illumina HumanMethylation 450K BeadChip. Twenty-nine linear measurements of the femur were measured using calipers. Several loci were significantly differentially methylated across morphological variants. Out of over 450,000 positions, approximately 5.67% were differentially methylated across femoral anatomical neck heights, 5.75% across femoral anatomical neck depths, and 8.53% across femoral medial condyle widths. These measurements produced the highest number of differentially methylated loci. From an evolutionary perspective, these findings give us an appreciation of DNA methylation variation in skeletal tissue from one primate species. They also give us insight into the degree to which this epigenetic variation relates to variation in skeletal morphology. Expansion of this sample set and more focused testing of specific genes will further inform our understanding of epigenetic regulation and complex trait evolution in primates.

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Anthropologists under pressure: perceptions of stress, conflict and support in the pursuit of career-family balance

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Cross culturally, psychosocial stress challenges an individual's overall wellbeing. These stressors have been shown to be particularly problematic under conditions of status incongruence where one part of a person's identity conflicts with another part. In academia, competing pressures from career and family life can compound stressors, making it difficult to fulfill either role. Although anthropologists have a long fascination with the stress of others, there has been little work on the influence of stress in our own profession. Anecdotally, shifts in anthropology have resulted in a greater acceptance and support of academic parents. This increased support ostensibly reduces the cost of family investment on career success. However, it remains unclear whether this support is equal for parents of all sociodemographic groups in anthropology. As part of our ongoing Family and the Field project, we reviewed responses from 381 anthropologists (298 females, 82 males) using a Qualtrics online survey. Using a regression model, civil status, employment, age, self-reported career-family balance, and parity were able to predict perceived stress (p = .04)(r^2 = .04). Having children was the most significant predictor (standardized β = .30, p = .02). Interestingly, civil status was the only significant predictor of perceived stress in females (p = 0.02), while significant predictors for males was having children (p = .001) and being younger (p = .03). These data provide a timely reflection of the stressors associated with the career-family balance in anthropology.

Paleoamerican cranial variation in global microevolutionary perspective: Implications for the settlement of the Americas

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The origins of the biological diversity observed among Native Americans is the subject of intensive debate, and a consensus on the tempo and mode of human settlement of the Americas has yet to be achieved. Here, we contribute to this debate by applying a factorial model testing approach designed to partition the effects of historical among-population divergence ("history") from geographically-mediated gene flow ("geography") on observed global cranial affinity patterns. Procrustes distance matrices were derived for 17 extant populations and a sample of Paleoamerican specimens from Lagoa Santa (Brazil) based on 3D geometric morphometric analyses of large cranial landmark configurations, divided according to vault, face, and basicranium. In contrast with previous studies of Paleoamerican cranial diversity, our approach does not assume particular geographically-explicit models *a priori*. Rather we built a hierarchical model of human population history informed by neutral genomic data, and began with the parsimonious (null) assumption that the Lagoa Santa population was most closely related to their most proximate geographic neighbor in the extant dataset. Thereafter, by keeping the effects of geography and time constant, we test the statistical fit (using Mantel and Dow-Cheverud tests) of all possible "history" scenarios against the observed among-population Procrustes distances for each cranial dataset. Our results show that alternative history models that consider Paleoamericans to share common ancestry with extant Inuit populations explain statistically more craniometric variation than the null model. Therefore, our results suggest that observed phenotypic variation within the Americas cannot be explained on the basis of *in situ* evolutionary processes.

A novel approach for detecting adaptive introgression in modern humans

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Comparisons of DNA from archaic and modern humans show that modern and archaic humans interbred, and in some cases received an evolutionary advantage from doing so. This process, adaptive introgression (AI), may lead to a faster rate of adaptation than is predicted from models with mutation and selection alone. Within the last couple of years, a series of studies have identified regions of the genome that are likely examples of AI. In many cases, once a region was ascertained as being introgressed, commonly used statistics based on both haplotype as well as frequency information were employed to test for positive selection. Introgression by itself, however, changes both the haplotype structure and the distribution of allele frequencies, and these are the patterns that many methods use to detect selection. Therefore, patterns generated by introgression alone may lead to false inferences of positive selection. Here we use simulations to investigate the false positive rate of these statistics under null models that include introgression and examine known examples of AI to discover new statistics that can specifically differentiate between introgression and adaptive introgression. We then examine the 1000 Genomes data to identify regions under adaptive introgression.

Genetic and dental variation: Complementary data for understanding the population history of the Americas

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Recent ancient DNA analyses of two Paleoindian skeletons have revolutionized the study of the population history of the Americas. Analysis of a 12,600-year-old human skeleton from Anzick, Montana had closer genetic affinities to Central and South American populations than to North America. DNA analysis of the 9,000 year-old skeleton from Kennewick reported genetic similarities with recent Native Americans. Both of these studies stand in contrast to analyses of cranial variation, where some researchers suggest population replacement in the Middle Holocene.

Given the hurdles facing ancient DNA research, dental variation can offer significant insights as to the population histories, especially in North America where DNA analyses are further complicated by political considerations. The significant additive genetic contribution to dental variation makes it the best skeletal proxy for DNA. We explored newly-collected data for populations from the Early to Late Holocene and geographically from Brazil to California to test for concordance with the recent ancient DNA results [Brazil (n=129), Peru (n=154), Chile (n=10), Central Valley, California (n=78), San Francisco Bay Area, California (n=137), alongside two outgroups: Southeast (n=129), east and north Asia (n=104)]. Mean Measure of Divergence, and pseudo-D^2 were used. Results suggest that some of the Californian series nest within the variation observed in South America, echoing the genomic analyses of the Anzick DNA. Our results suggests that dental variation is a powerful resource for identifying populations on which future ancient DNA work should be prioritized to more efficiently reconstruct the details of this last phase of the global human diaspora.

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The modern human dentition: insights from three decades of studies on twins

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Human dentition demonstrates significant variation in development, form and function. Variation exists within and between individuals, families, sexes, ethnic groups and populations. It has been attributed to temporal effects acting at the level of the individual (within a lifetime) and the population (across generations). Such variation poses two fundamental questions:

1. How does plasticity of the genome give rise to population adaptation to a particular environment?

2. How do genes and the environment interact to produce a specific phenotype?

Both questions can be addressed using family studies; the former through use of

population modelling of traits that exhibit familial aggregation; the latter through the use of linkage and association analyses to elucidate the role of specific genes in trait development. The role of the epigenome in dental development and patterns of trait transmission can also be addressed through judicious use of family data.

The Craniofacial Biology Research Group at The University of Adelaide have been working with cohorts of twins and their families for over 30 years. Dental data collected from the twins has been used be partition population variation into genetic and environmental components using mathematical models of the twin relationship. This poster explores how such models can reveal information about relationships between dental features, and how these family models can advantageously incorporate molecular marker data to identify genes of major influence. The poster will also examine how studies of monozygotic twins can be used to examine the role of the epigenome in dental development.

Research support was provided by National Health and Medical Research Council, Australian Dental Research Foundation, Colgate Australia, Australian Twin Registry.

Growth disruption and adult mortality: the deferred consequences of early-life stress in industrializing London

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This study examines the effects of prolonged or repeated stress during growth and development on later adult mortality in two skeletal samples from industrial-era London (high-status Chelsea Old Church and low-status Lower Saint Bride's Churchyard). The risks of mortality associated with cribra orbitalia, linear enamel hypoplasias (LEH), and short tibia length are explored using the Cox proportional hazards model, taking sex and socioeconomic status into account as markers of heterogeneous frailty.

In the low-status female cohort there are no significant associations between any of the indicators of childhood stress and risk of mortality. Among high-status females, there is a significant association between short tibia length and increased risk of mortality that persists when the effects of cribra orbitalia are removed but not when the effects of LEH are removed. In low-status males, cribra orbitalia is associated with significantly increased risk of mortality, but when the effects of tibia length or LEH are removed from the model the association is no longer significant, and LEH are associated with a significant decrease in risk of mortality when the effects of tibia length are removed. When the effects of LEH are removed from the model there is a significant association between short tibia length and risk of mortality in both low- and high-status males.

Results suggest the causes of these childhood indicators of stress acted not only synergistically, but also antagonistically, on risks of adult mortality, and that both sex and socioeconomic status influenced adult outcomes of childhood exposures to risk.

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Osteological analysis can still shed light on a recent forensic case

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Bio-archaeologists rarely engage in cases involving gunshot wounds as guns are a modern era weapon. However, detailed knowledge of osteology can help to interpret the circumstances surrounding a gunshot event. A Hispanic male aged 30 years, who died in 1962, from the Terry Collection, was investigated due to the presence of a gunshot wound to the skull. Detailed analyses of the morphology of the skull, including the entry and exit wounds, secondary fractures and missing fragments were conducted. This allowed for the events, which may have occurred before the individual's death, to be reconstructed. A clean small circular entry wound in the right pterion area (5.5mm) and a larger oval (41.1x22.2mm) exit wound on the left pterion suggest a high powered weapon, possibly a small calibre handgun. The bullet would have exited the skull with a significant amount of its energy after yawing beyond 90 degrees and tumbling. The high velocity of the projectile would have created an increased intracranial pressure which may have contributed to the secondary fractures. Part of the orbit roofs and the cribriform plate of the ethmoid were missing. They were most likely fragmented by the pressure wave and were misplaced when the skull was prepared. Naso-frontal and maxillo-frontal sutures were also separated by the pressure. Inspection of the brain case indicates left occipital petalia, thus indicating right handedness. This suggests a possibility of suicide.

Variation in the skeletal and ectodermal phenotype of mouse hybrids

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Hybridization occurred between later hominins including modern humans, Neanderthals and Denisovans, and is common among different primate species. Primate hybrid skeletons exhibit atypical trait variation including supernumerary teeth and extra sutures stemming from interactions between divergent parental genomes. Genes regulating ectodermal tissue growth affected by genetic interactions such as dominance and epistasis could account for these traits. Providing an important link between skin/pelage and skeletal trait variation. Neanderthal genes related to keratin production have been retained in modern humans, suggesting key differences in the genes responsible for hair and skin color traits between hybridizing Neanderthals and early populations of *Homo sapiens*. Therefore, we might expect the earliest hybrids between these taxa to display skeletal traits that stem from a breakdown in the regulation of these ectodermal genes. To understand the relationship between skeletal and ectodermal traits in hybrid populations, phenotypic variation in pelage was examined in crosses between mouse sub-species (*Mus musculus musculus, M.m.domesticus, M.m.casteneous*), and species (*M. musculus*, *M. spretus*). Mean RGB values for the pelage and non-metric pelage data such as the presence of white spots were collected from photographs. Some hybrids are similar to one parent while others are significantly different from both parents in pelage colour. Hybrids closely resemble one parent for non-metric pelage traits while other traits were lost in the F1 hybrids. These data, along with associated skeletal data, will elucidate the relationship between pelage and skeletal variation in hybrids, and to what extent differences in skeletal variation can predict differences in ectodermal traits.

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Brushing Off the Dust: A Dietary Study of a Forgotten Collection

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The transition between the Early Intermediate Period (1750-1350 BP) and the Middle Horizon Period (1350-950 BP) in the southern coastal region of Peru has been relatively unexplored in bioarchaeology. As the Middle Horizon began, the Nasca polity waned along the coast while the Wari state spread from the central Peruvian highlands to dominate the region. The reconstruction of pre-Hispanic demographics and subsistence patterns is critical to understanding how state level controls were expressed in subordinate populations. Nestled in the Canate Valley, the site of Cerro Del Oro is an ideal setting to explore the impact of state

formation on subject populations' subsistence, diet, health and subsequent well-being; however, the sizable cemetery sample (N=58) from this site has remained unstudied at the Field Museum for almost a century.

This study presents the osteological and isotopic data from human bone and tooth enamel from individuals recovered during the 1926 excavations of Cerro Del Oro by Alfred Kroeber. Carbon and oxygen isotopic data in enamel carbonate represent childhood diet and are compared to bone carbonate data from the same individual to reconstruct dietary trends throughout life. Analyzed in conjunction with carbon and nitrogen isotopes from bone collagen, these data sets provide an in-depth picture of dietary consumption and variation within the study sample. Preliminary results indicate variation in dietary composition; possibly linked to the transition between political influence.

Vertebral neural canal (VNC) diameters and their association with earlier age at death in a Medieval Polish population

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Vertebral neural canal (VNC) diameters are used as non-specific indicators of stress in archaeological populations whereby smaller measurements have been associated with earlier age at death. Growth disruption in the expansion of the antero-posterior (AP) and transverse (TR) dimensions indicate underlying factors affecting adult health status and a population's generalized ability to survive future stressors. Therefore, smaller VNC dimensions are expected to be associated with earlier age at death. This study tests the association between VNC size and earlier age at death in an early Medieval sample (Gz4) from Giecz, Poland. AP and TR measurements were obtained from all available thoracic and lumbar vertebrae (T1-L5) for adult individuals (>17 years) for which no further growth of VNC diameters will occur (n=189). Age at death categories were created for "young" (17-35 years) and "old" (36+). Males and females were compared separately due to sexual dimorphism found throughout the vertebral column. Males in the "young" category demonstrated significantly smaller AP and TR diameters from T6-T12 (p=0.003-0.038) and T1-L3 (p=0.001-0.021) respectively than those males surviving to a later age. However, "young" females only demonstrated significantly smaller AP and TR diameters from T12-L1 (p=0.021-0.036) and T12-L4 (p= 0.003-0.027) respectively. Thus, smaller VNC diameters were associated with earlier age at death suggesting a level of stunting or growth disruption; the cause of which may have resulted in detrimental health consequences later in life. Variation in developmental timing of VNC diameters allow for temporal resolution in understanding non-specific stress incurred by individuals in Medieval Giecz.

Fragmentary skeletal remains, trauma, and sampling biases: Quantifying antemortem traumatic data lost due to fragmentation in samples from Hasanlu Teppe, Iran (12th-9th Centuries B.C.E)

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The analysis of injury data from fragmentary skeletal remains is limited by problems in counts, MNIs, and quantitative comparisons to other better preserved samples. For some settings, however, fragmentary skeletal remains represent the only material available for study and protocols that discard fragmentary remains from sample counts are not practicable. There has been little way of knowing how many instances of trauma have been masked by postmortem fragmentation because there is seldom a "control" sample where we may assume differences in levels of antemortem trauma observed are due to taphonomic processes rather than lifeways. The population from Hansanlu Teppe might serve as such a collection where it is possible to see the effects of taphonomic sampling biases in the collection of data: the Lower Mound skeletal remains represent very well preserved burials and the Upper Mound skeletal remains represent high levels of perimortem trauma and postmortem fragmentation with very little time/cultural differences separating the two groups. Using several protocols for the collection of data from fragmentary remains, we tested the null hypothesis that we would observe the same distributions of antemortem trauma in both samples based on similar lifeways for each group. For almost every element, we rejected this hypothesis with statistically significantly more antemortem trauma being visible in the Lower Mound Sample. We conclude that antemortem traumatic data is lost significantly due to taphonomic processes and quantify this loss to create a baseline by element for estimating potential loss in other comparisons in paleoanthropological and bioarchaeological settings.

Unravelling the evolutionary forces driving skin color diversity in India

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Human skin pigmentation represents a classic example of a quantitative trait that is highly polymorphic in humans. Models based on natural selection suggest that pigmentation variation has accumulated in response to human dispersals and colonization of diverse environments, primarily due to differences in the damaging versus vitamin D synthesis-related effects of UV radiation (UVR) at different latitudes. Indian populations, despite being spread across a relatively narrow latitudinal range, show a high level of variation in skin pigmentation phenotype. To unravel the evolutionary processes affecting skin pigmentation in India, we recorded Melanin Index (MI) readings from populations throughout the subcontinent. We found that, rather than UVR levels, population affiliation is the better predictor of an individual's pigmentation phenotype. Furthermore, the significant sexual dimorphism for skin color detected in some of the Indian populations infers the likely presence of sexual selection as an evolutionary force that further shaped pigmentation diversity in India. In this context, the already established complex patterning of the SLC24A5 light skin allele across India and the significant effect of this genetic variant on pigmentation variation in some, but not all, of the Indian populations studied, points to the presence of phenotypic "overprinting" due to successive population migrations and the action of both natural selection and demographic forces. These results thus suggest that the sequential and variable influence of environmental and social factors, in the context of a unique populations structure (pronounced endogamy), has been instrumental in shaping the remarkable skin pigmentation diversity found today throughout India.

Dental characteristics of clinically diagnosed cases of congenital syphilis in the United States of America prior to 1910

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There is a debate on the survivorship of congenital syphilis (CS) patients before antibiotic treatment was available. Before 1910, toxic mercurial treatments were used, as described by Hutchinson for Britain. They were not fully effective while producing characteristic enamel hypoplasia, not to be confused with "classic" syphilitic signs on incisors and first molars. It is unclear to what extent mercury was used for treating CS in the USA. A total of 28 specimens with diagnosed treponemal infections were inspected at the Smithsonian Museum in Washington DC. Among those, five African Americans, who died before 1908, had CS. They display varying degrees of dental abnormalities. P249552, an infant skeleton, shows widespread skeletal signs of CS with no syphilitic signs on teeth. An ~20 years old female P219398, has classic Hutchinson's incisors and Fournier's molars with no mercurial signs. P000161, a female, 45 years old, demonstrates severe enamel defects on incisors and canines (molars lost to caries) typical for mercurial treatments, but no syphilitic signs. Male P000707, aged 26 years, displays mercurial signs on incisors, canines and first molars, however, incisal edges of the upper central incisors are without Hutchinson's anomaly. Female P000679, aged 33 years, demonstrates screw-driver shape upper central incisors and altered occlusal morphology of first molars, but also hypoplastic effects of mercurial treatment. Concluding: (1) "classic" dental signs do not occur in all cases of CS, (2) not all CS patients were treated with mercury, (3) a number of CS patients survived to adulthood without modern medical care.

Tracing the "Bantu Expansion" from its source: Dental nonmetric affinities among West African and neighboring populations

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Bantu-speaking populations living throughout sub-Saharan Africa are relative new-comers to this vast area. Archaeological, linguistic, and other evidence (e.g., oral histories) revealed that their origins lie to the northwest. Specifically, ca. 8,000 BP the desiccating Western Sahara forced precursors of 'proto-Bantu' peoples south into Nigeria and Cameroon. Between 4-3,000 BP these now-agriculturalist proto-Bantu began expanding farther south – to become so-called 'western' Bantu, and eastward – 'eastern' Bantu, who continued populating the sub-continent. The goal of this research is assess the likelihood of these proposed migrations, i.e., before and during the initial phase of this "Bantu Expansion."

Over 120 traits from the Arizona State University Dental Anthropology System were recorded in 14 skeletal samples (n=526 individuals). One small sample from Niger (ca. 7600 BC) was used to explore the purported proto-Bantu Saharan origins. The remaining samples, dating to the Iron Age and historic periods, are from west, west-central (i.e., western Bantu), and central (eastern Bantu) Africa. After editing, data from 24 traits were compared using the mean measure of divergence to yield inter-sample phenetic distances. The following results were obtained: 1) the Niger sample's affinity to west Africans supports the possibility that it is representative of proto-Bantu ancestors, 2) temporal affinities are apparent, in that older samples are more similar to one another, and 3) spatial divergence is evident in the form of an apparent cline from more to less dental complexity between west Africa and the other regions. All told, these results seem supportive of the hypothesized migrations.

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Using Paleopathology Techniques to Detect Childhood Neglect in Forensic Cases

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Paleopathology analyses commonly compare dental and skeletal age of subadults to detect evidence of biological stress that resulted in growth stunting. This is based on the premise that dental development is less susceptible to biological insults, such as nutritional deficits and disease, than long bone growth. Thus an individual's dental age will more closely reflect their chronological age and discrepancies between dental and skeletal age may indicate stunting. Such analyses could be invaluable as an indicator of neglect in unexpected subadult deaths. In this pilot study, children three years of age and younger who underwent a postmortem examination were evaluated for indicators of stunting. Dental and skeletal ages were assessed from radiographs taken as part of a routine postmortem skeletal survey. Dental ages were assigned based on The Atlas of Tooth Development and Eruption (AlQahtani 2009). Diaphyseal lengths of lower limb long bones were measured within imaging software and were compared to Maresh (1970) to produce a skeletal age estimate. In approximately 39% of the cases evaluated, dental age was greater than skeletal age. These results were compared to the infant's status on the WHO Child Growth Standards (2006) according to their measured height and weight at autopsy. It was found that of the children in this sample considered low-height-for-age (<2nd percentile on the growth chart) 75% also had indications of stunting from dental and skeletal data. This pilot study suggests paleopathological stress indicators may prove valuable in detecting subadult neglect in forensic investigations.

Vervet monkey (*Chlorocebus pygerythrus*) alarm calls affect leopard (*Panthera pardus)* behavior

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Predation has long been considered a strong source of selection on primate behavior, morphology, and social organization. However, many adaptations attributed to predation are largely based on logic rather than empirical data because predator-prey interactions are exceedingly difficult to observe when primates are studied on foot and predators avoid humans. To circumvent this problem, we conducted a 14-month field study in which we minimized human presence and collected data on predator-prey interactions remotely by employing acoustic recorders, camera traps, and GPS/radio-collars deployed on vervets (*Chlorocebus pygerythrus*) and leopards (*Panthera pardus*) in Laikipia, Kenya. Acoustic recordings at the focal vervet sleeping site revealed that vervets gave "leopard" alarm calls more frequently near dusk and dawn than at night whereas photographs from camera traps at that sleeping site showed that leopards (collared and uncollared) approached vervets more closely during the night than at dusk and dawn. Thus, although leopards could be near the sleeping site anytime between dusk and dawn, they approached more closely when vervets gave fewer alarm calls, suggesting that the alarm calls function as a predator deterrent. This was confirmed by GPS data indicating that collared leopards moved away within minutes after vervets alarm-called. Vervets are well known for their functionally referential alarm calls, acoustically unambiguous vocalizations that different predators evoke and that warn conspecifics, which then respond in an appropriately evasive manner. This study shows that one of their alarm call types also communicates to, and changes the behavior of, their predators, resulting in lower risk of predation.

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Distal humerus morphology and ecological variation among *Gorilla* subspecies

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Several features of the distal humerus have been considered to reflect varying locomotor adaptations among apes. Ecological diversity among *Gorilla* subspecies offers the opportunity to test the functional significance of these

features. *Gorilla gorilla gorilla* lives in lowland forests, traveling long distances terrestrially to find fruit trees and climbing trees to obtain fruit, while *Gorilla beringei beringei* lives in montane forests lacking fruit trees and relies on terrestrial herbaceous vegetation, resulting in less climbing and shorter day ranges. *Gorilla beringei graueri* occupies habitats over a range of altitudes.

Six linear distal humerus measurements were collected from *G. g. gorilla* (n=146), *G. b. beringei* (n=26), and *G. b. graueri* (n=22), and variables were size-adjusted using the geometric mean. Based on Bonferroni-corrected t-tests, male and female *G. g. gorilla* had significantly larger capitular widths than *G. b. beringei*, as predicted, but significantly smaller trochlear widths and olecranon fossa depths contrary to predictions. In separate analyses of males and females, principal components analyses separated these two taxa on PC1, and antero-posterior trochlear diameter had the highest loading, although the larger diameters (shallower trochlear notches) observed in *G. g. gorilla* were not predicted. Despite its range of habitats, *G. b. graueri* does not exhibit intermediate morphology. In males, *G. b. graueri* clusters with *G. b. beringei* on PC1, while in females, *G. b. graueri* clusters with *G. g. gorilla* on PC1. Results suggest the distal humerus may not reflect locomotor variation within *Gorilla* in the same ways it reflects such variation among ape genera.

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Infant mortality in white-faced capuchins: The impact of alpha male replacements

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For primate species residing in multimale/multifemale groups characterized by male dispersal, alpha male replacements (AMR) can occur in a variety of ways, including: group takeovers by extragroup males, rank reversals by subordinate resident males, successions by resident males following the death/disappearance of the alpha, "waltz-ins" by extragroup males following group desertion by resident males, or via group fission. Increased infant mortality in association with AMRs has been reported for many primate species, though it is unclear how AMR type influences infant mortality rates. We studied five groups of white-faced capuchin monkeys (*Cebus capucinus*) for variable periods between 1984 and 2015 in the Sector Santa Rosa, Área de Conservación Guanacaste, Costa Rica. During these years, we recorded 223 births. Seven of these infants are still alive and < 1 year of age, 69 died, and 147 survived their first year of life. Infant mortality across all years was 31.9%, however, infants born during periods of group instability (N=62 infants born in association with 22 AMRs) experienced significantly higher mortality rates (48.4%) than those born during periods of group stability (25.3%) [$X^2(2, N=216)=10.81$, $p<.01$]. All types of AMRs were associated with infant mortality rates higher than during times of group stability (takeover=62%; rank reversal=47%; succession=43%; waltz-in=40%; fission=33%). These data further document the enormous impact of alpha male replacements on infant survivorship and female reproduction in our study population.

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Feeding and gouging in a wild pygmy marmoset group: Results from a camera trapping pilot study

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Pygmy marmosets are small (128g), cryptic, exudativorous platyrrhines that live in cooperatively breeding societies. Groups contain one reproductive female who incurs high reproductive costs associated with rapidly growing twins, but cooperative breeding behaviors of other group members, such as infant transport and food sharing, may offset these costs. In this pilot study, our goals were determining if camera trapping is an effective, primary data collection method and documenting whether a reproductive female has feeding priority over other group members. We studied one pygmy marmoset group, consisting of one parous female, one nulliparous adult female, and one adult male, at the Tamshiyacu Tahuayo Community Regional Conservation Area, Peru. We collected fifteen complete days of camera trap data, resulting in 22.75 hours of video footage. Contrary to our expectation, the male ate more exudates than either female, measured as the number of chews [$X^2(2, n=517)= 44.823$, $p= 0.0001$], and the females showed similar frequencies of consumption [parous female (n=134), nulliparous female (n=139)]. Furthermore, while both females gouged less than the male, measured as the number of pulls [$X^2(2, n=4,280)= 237.424$, $p= 0.0001$], the parous female gouged more than the nulliparous female [$X^2(2, n=2,408)= 33.968$, $p= 0.0001$]. The results suggest that a breeding female, who is not nursing twins, may have similar nutritional needs as other group members. Additional data are needed for determining if the observed feeding patterns are consistent when females are nursing infants. Our study proves that camera trapping is an effective method for studying wild pygmy marmosets.

Dichromacy as an adaptation for foraging in red-bellied lemurs (*Eulemur rubriventer*)

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Trichromatic color vision in primates is generally considered to be adaptive, and multiple hypotheses highlight its potential advantage for foraging on reddish food. Adaptive explanations accord well with the prevalence of routine or polymorphic trichromacy in diurnal haplorhines. In lemurs, polymorphic trichromacy occurs in some diurnal/cathemeral taxa, but others are strictly dichromatic. It is unknown what evolutionary mechanisms lead to differences in color vision, but variation in species' foraging ecologies might play a role.

Eulemur rubriventer in Ranomafana National Park (RNP) is dichromatic with a long wavelength (L) opsin and may have lost polymorphic trichromacy, which is observed in at least one other *Eulemur* species. Using reflectance spectra of 40 plant species (72 plant parts) consumed by *E. rubriventer* in RNP, we quantified their chromaticities as perceived by trichromatic and dichromatic *Eulemur* phenotypes. Our results indicate that under day and dusk light conditions, red-green chromaticities (indistinguishable to dichromats) of many food items would be conspicuous to a trichromatic *Eulemur*, suggesting trichromacy may be advantageous during diurnal foraging. When blue-yellow and luminance contrasts were calculated for the two possible dichromatic *Eulemur* phenotypes (L opsin vs. medium-wavelength opsin), luminance contrasts were significantly greater for dichromats with the L opsin. *E. rubriventer* in RNP may use luminance cues during foraging, potentially leading to relaxed selection on or selection against trichromacy, as chromatic information may corrupt luminance vision. Fixation of the L opsin could represent directional selection and adaptation for maximizing luminance cues, which may be important to this cathemeral species during nocturnal foraging.

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Human grooming in phylogenetic perspective: grooming rates and dyad composition in six traditional societies in comparison to other primates

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Although models of primate grooming have been at the center of critical debates about the evolution of human sociality, cooperation, and language, detailed quantitative research on human grooming has been conspicuously absent. Using a sample of detailed behavioral observations among six traditional societies – the Maya, Pume', Sanöma, Tsimane', Yanomamö, and Ye'kwana – our goal was to present novel comparative data on human grooming rates, dyadic patterns, age and sex differences and to put them in phylogenetic context. Comparing grooming rates among our six study populations to a sample of 74 primate species indicated that humans seemed to groom less than expected given their terrestrial habitat, group size, and body size; this trend was confirmed using Bayesian phylogenetic prediction, wherein the observed grooming time was lower than 90% of the posterior predictions. However, when expanding the definition of grooming to include any hygienic behavior as well as 'vocal grooming', observed rates fall well within the range of predictions. Focusing on dyad composition, we found that human grooming was mostly a female- and family affair; grooming dyads were most commonly composed of kin rather than non-kin, males groomed significantly less, and male-male grooming dyads and grooming outside the household were exceptionally rare. Together these findings suggest that human grooming predominantly has a simple hygienic function, performed by female kin, rather than serving to build affiliative social bonds with non-kin as it does in some other primates. We discuss these findings in the context of human sociality and hominin evolution.

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The genomic footprints of Stone-Age Europeans

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Genomic information from ancient human remains is beginning to show its full potential for learning about the human prehistory, including the debated agricultural transition in Europe and the colonization of the continent after the last glacial maximum. We generate and analyze genomic data from several Neolithic farmers and Mesolithic hunter-gatherers from Europe that illuminate the impact of the agricultural revolution on patterns of genomic variation in Europe. For instance, Stone-Age individuals show remarkable population structure corresponding to their material culture association and the farmers are genetically most similar to extant southern Europeans, contrasting sharply to the hunter-gatherers whose genetic signature is unique, but closest to extant northern Europeans. The strongest genomic pattern in present-day Europeans is a south-north gradient that can be understood by Neolithic migrations and extensive, but varying, admixture over several millennia. We also find distinct local admixture between resident hunter-gatherers and incoming farmers in Scandinavia and in Iberia – areas at the fringe of the Neolithic expansion – showing that substantial admixture was ongoing in situ. These findings show that lifestyle was the major determinant of genetic similarity in pre-historic Europe rather than geography as in modern-day Europe.

Differences in circadian electrolyte excretion between women with and without a family history of hypertension: reproducibility over the menstrual cycle

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Using cross-sectional data, we previously showed that otherwise healthy women with a family history of hypertension (FH+) had elevated nocturnal rates of sodium but not potassium excretion when compared to women with no family history (FH-). Whether the FH differences persist over the menstrual cycle is unknown. The purpose of this study was to compare the variation in circadian urinary sodium (Na), potassium (K) and aldosterone excretion and morning plasma renin activity (PRA) between women with (FH+) (N=31, age=34.9+7.2) and without (FH-) (N=40, age=34.9+ 8.2) a family history of hypertension over the menstrual cycle. The women all worked in clerical or technical positions at a medical center in NYC. Urinary Na, K and aldosterone excretion rates were measured across three contrasting daily microenvironments: work (11AM-3PM), home (approx. 6PM-10PM) and during sleep (approx. 10PM- 6AM) on a mid-follicular and a mid-luteal workday. PRA was measured on the same cycle days in the morning. History group comparisons by menstrual phase were made using repeated measures ANOVA models. The results show that the patterns of K, Aldosterone and PRA do not differ between FH+ and FH- women, although there is an increase in Aldosterone (p=.002), PRA (p=.001) and Na (p=.065) in the luteal phase. The circadian pattern of Na excretion of the FH+ tends to change across the cycle (p=.087). These findings suggest that while aldosterone and PRA increase in the luteal phase similarly in both FH groups, their effect on Na but not K excretion may change depending upon menstrual cycle phase.

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Dietary adaptations in digestive enzymes of New World primates

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Insects are important food sources for extant primates, including many human populations, and are thought to have been a crucial resource during the evolution of the earliest primates and hominins. Efficient digestion of insect exoskeletons would be a valuable adaptation for human and nonhuman primates feeding on insects. Whether primates have endogenous digestive enzymes that digest chitin, such as chitinase, has not been conclusively answered. Previous research by Krykbaev and colleagues found evidence for a chitinase gene (*CHIA*) in *Macaca*. To investigate whether this chitinase enzyme represents an adaptation for insectivory, I sequenced the *CHIA* gene in primate taxa with higher levels of insect consumption than *Macaca.* Preliminary analyses of these sequences indicate that the chitinase gene is conserved and functional in two platyrrhine genera, *Callithrix* and *Cebus.* Confirmation that these sequences, like that of *Macaca*, exhibit chitinolytic activity *in vitro* would suggest that nonhuman primates may endogenously produce a chitinolytic digestive enzyme giving them the ability to degrade insect exoskeletons. Expanding this line of research to compare highly insectivorous and non-insectivorous species can provide additional insight. Using published diet data, I conducted a phylogenetic targeting analysis to determine the ideal platyrrhine species to select for such pairwise comparions. The *PhyloTargeting* approach resulted in the following pairs: *Alouatta palliata – Saimiri sciureus, Brachyteles arachnoides – Lagothrix lagotricha, Callimico goeldii – Callithrix jacchus, Leontopithecus rosalia – Saguinus mystax, Cacajao calvus – Chiropotes satanas, Callicebus moloch – Pithecia pithecia.* Focusing sequencing efforts on these species maximizes the statistical power of future studies.

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Another partial skull from the early Miocene: the first cranial fragments associated with both upper and lower dentition of *Limnopithecus legetet*

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Limited cranial material and a dearth of associated upper and lower dental elements have hindered taxonomic and phylogenetic interpretations of East African early Miocene small-bodied catarrhine species. Here we report a partial skull attributed to this group from the Hiwegi Formation of Rusinga Island (early Miocene; >18.0 Ma) which preserves associated upper and lower tooth rows and documents previously unknown aspects of cranial anatomy. The new skull includes the frontal, palate, and temporal, as well as a complete upper C-M3 series, i2, p3, p4, and two m1 specimens. Dental morphology precludes referring this skull to *Dendropithecus macinnesi*, with differences documented in the C, P3, i2, and m1. Likewise, the molars differ significantly from those of *Nyanzapithecus vancouveringorum* in their crown proportions and cresting patterns. Both upper and lower cheek teeth of our fossil most closely resemble specimens attributed to *Limnopithecus legetet*. A particularly important aspect of the new material is the combined presence of a frontal sinus and ossified tubular ectotympanic. The presence of a frontal sinus among early Miocene small catarrhines was previously only documented in *Lomorupithecus harrisoni*. The ossified tubular ectotympanic is the first of its kind preserved in an early Miocene small-bodied catarrhine, and suggests that our specimen is closely related to the crown catarrhine clade. The combined presence of a frontal sinus and a tubular ectotympanic in this specimen as well as the associated upper and lower dentition provide compelling new evidence for interpreting the phylogenetic relationships among both early Miocene and crown catarrhines.

The roots of all evil: aggression and below-ground feeding in female geladas

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Socioecological theory predicts that aggression among females should accompany the presence of a clumped and defensible resource. One of the many frustrating exceptions to this rule are female geladas (*Theropithecus gelada*), who exhibit high rates of aggression among females yet feed on one of the most dispersed and non-defensible resources of any primate - montane grasses. However, below-ground food comprises a substantial proportion of the gelada diet in the dry season, when the availability of green grass declines. Although grasses are an abundant and evenly distributed food with low handling time, below-ground food (e.g., roots, corms, and tubers), which contain large reserves of water and carbohydrates, require substantially more time to excavate. Here, we investigated the seasonal patterns of female aggression in wild geladas in the Simien Mountains National Park, Ethiopia (2014-2015). We used behavioral data collected in both the wet and dry season to quantify monthly aggression rates and time budgets. We have two main results. First, aggression rates among females are higher in the dry season than in the wet season. Second, the aggression rates when geladas are feeding below-ground are disproportionately high. These results indicate that dominant females may be using aggression to gain access to below-ground food by supplanting subordinate females from sites where subordinates have invested in digging a hole to extract below-ground resources. In other words, we argue that dominant females are "sub-contracting" their digging to subordinate females; and thus the primary defensible resource that leads to aggression among female geladas is *excavating time*.

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Long-term genetic stability and a high altitude East Asian origin for the peoples of the high valleys of the Himalayan arc

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The high altitude transverse valleys (> 3000 masl) of the Himalayan arc from Arunachal Pradesh to Ladahk were among the last habitable places permanently colonized by prehistoric humans due to the challenges of hypoxia, cold stress, and resource scarcity. The modern populations of these valleys share cultural and linguistic affinities with peoples found today on the Tibetan plateau, and it is commonly assumed that these modern peoples are the descendants of the earliest inhabitants of these valleys. However, this assumption has been challenged by archaeological and osteological evidence that suggests that these valleys were originally populated from areas other than the Tibetan plateau, some of which are found at low elevation. Importantly, long-term inhabitants of the Tibetan plateau are known to have evolved genetic adaptations to hypoxia, including selection of an *EGLN1* allele that is rare in lowlanders. Therefore, migrants into these valleys would have been at a disadvantage relative to pre-existing adapted populations. To investigate the peopling and early population history of this dynamic high altitude contact zone, we obtained low-coverage genome-wide sequences (0.04-0.65x, mean 0.25x) and high coverage mitochondrial sequences (20.8-77.8x, mean 46.4x) from eight individuals dating to three periods with distinct material culture in the Annapurna Conservation Area (ACA) of Nepal, spanning 3150-1250 BP. We demonstrate that the region is characterized by long-term stability of the population genetic make up despite marked changes in cultural remains. Genome-wide markers, mitochondrial haplotypes, and high altitude adaptive alleles suggest a high altitude East Asian origin for prehistoric Himalayan populations.

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Digging in the museum: Preliminary report on three unpublished Neanderthal teeth from Carigüela Cave (Píñar, Granada, Spain)

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Revision of collection items from past archeological excavations occasionally leads to significant discoveries. Here we report on the re-analysis of materials from Carigüela Cave recovered by the research team of the Washington State University (USA) during the excavation seasons of 1969-1971. Close examination of this zooarcheological collection (housed at the Museo Arqueológico de Granada, Spain) revealed three previously unrecognized Neanderthal molars representing right mandibular M_1-M_3. Chronostratigraphically, the teeth come from a section, which comprises levels VIII to XI (>46 ka), and also yielded Mousterian tools.

Patterns of occlusal and interproximal wear indicate that the three teeth belonged to the same individual. They exhibit an intriguing combination of strong, moderate, and weak expression of non-metric traits typically associated with the Neanderthal dentition. M_1 has five main cusps, with a well-developed hypoconulid. It presents an almost continuous, moderately developed mid-trigonid crest (MTC), which is only visible on the enamel-dentine junction (EDJ). The anterior fovea is absent. M_2 presents only four main cusps, but an accessory 7th cusp (*tuberculum intermedium*); cusps 1 and 2 are connected by a shallow but continuous crest visible only on the EDJ, and delimiting the anterior fovea. M_3 presents five main cusps with an anterior fovea delimited by a continuous MTC also only visible on the EDJ. Neither M_1 nor M_2 have an enlarged pulp chamber, but M_3 is clearly taurodont. The "new" Carigüela molars thus add to the growing evidence that trait expression in Neanderthal molars is highly variable, both within and between individuals.

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Building heads: Morphological and genetic variation in facial length, cranial base angle, and endocranial volume in baboons

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The Spatial Packing Hypothesis (SPH) proposes that basicranial variation, especially the angle (CBA) between the planes of the anterior and middle cranial fossae, allows brain size to increase independent of neurocranial length or breadth. Evidence for strong correlations between CBA and indices of encephalization (RE) across primates supports the SPH. Additionally, in mutant mouse strains CBA is negatively correlated with indices of RE and positively with those of facial length (FL). For CBA to respond to natural selection, the associated traits must be heritable, but such heritability has not been demonstrated. We tested this expectation using skulls from 937 pedigreed baboons (genus *Papio*), a primate with extreme facial sexual dimorphism.

Four traits fundamental to the SPH show significant additive genetic variance in baboons: endocranial volume, ECV (h^2=0.40); CBA (h^2=0.29); FL (h^2=0.64), and anterior cranial base length, ACB (h^2=0.28). Furthermore, we used the baboon linkage map to identify quantitative trait loci (QTLs) influencing these traits and successfully mapped 2-8 QTLs for each trait. Thus, in baboons, selection could potentially alter ECV, CBA, FL, and ACB. However, we found weak correlation (after correcting for sex differences) between CBA and indices of either RE or FL (r^2=0.006 and 0.001, respectively). CBA does not differ between the sexes (P=0.23), although FL and ECV do (P<0.001 for both). Contrary to SPH expectations, it appears that in baboons the ACB lengthens with increasing FL (P<0.001,r^2=0.07) and ECV (P<0.001,r^2=0.04). This is the first study to explore genetic variation underlying craniofacial variation directly relevant to testing the SPH.

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Nutritional and isotopic correlates of diet in forest-living olive baboons (*Papio anubis*)

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Baboons are useful models for understanding the ecology of early hominins and fossil papionins. While many studies have focused on baboon behavioral and dietary flexibility in savannas, little research has focused on baboons in forested habitats. We provide a detailed study of nutritional and isotopic composition of the diet and feces of forest-living olive baboons (*Papio anubis*). We performed full-day focal follows (n=360) of females in Kibale National Park, Uganda in 2013-2014, and collected 512 food samples (n=79 species, >99% dry matter dietary intake) and 216 fecal samples. The staple diet included fruits (46%); stems (33%); tubers (7%); leaves (7%); seeds (4%); insects (1%); mushrooms (1%); bark, gums and soil (1%). Foods contained between 1-56% hemicellulose, 3-52% cellulose, 2-44% lignin, 2-28% crude protein, 1-12% fat, and 1-60% non-structural carbohydrates. Baboons consumed a mixed C_3/C_4 diet with $\delta^{13}C$ values of foods ranging from -36.0 to -8.4‰ (mean $\delta^{13}C$ value=-25.3+7.7‰ for all foods). However, the $\delta^{13}C$ value of fecal samples ranged from -31.3 to -25.1‰ (mean $\delta^{13}C$ value=-28.1+0.9‰ for all feces). $\delta^{15}N$ values of foods range from -3.0 to 11.4‰ (mean $\delta^{15}N$ value=4.3+2.4‰), and $\delta^{15}N$ values of feces range from 2.2 to 12.0‰ (mean $\delta^{15}N$ value=5.5+1.7‰). We show that baboons consume C_4 resources in forested habitats, even though it is not reflected in the isotopic composition of feces, which indicates a C_3-dominated diet. This study demonstrates the need for comparative nutritional and isotopic ecology of baboons across a wider range of habitats to clarify paleoecological reconstructions of African fossil hominins and papionins.

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Obesity-related cross-sectional changes in the femur due to body proportion changes

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Gait changes have been associated with compensatory reinforcement of femoral cross-sections. In particular, the body proportions of children, with wide torsos as compared to short limbs, has been suggested to lead to mediolateral femoral reinforcement. Similar body proportions are found among the obese, who also have altered gait. Therefore, we hypothesize that the morbidly obese should also demonstrate mediolateral reinforcement at the femoral midshaft. Right femora from 29 obese individuals (BMI 30+) and 27 normal-weight individuals (BMI 19-25) were obtained from the collection housed at the Forensic Anthropology Center at Texas State. Cross-sectional properties were calculated using bi-planar radiographs at the femoral midshaft level. Bi-iliac breadth was taken to control for variation ascribable to skeletal body breadth. Structural properties were calculated using the EMM Macro for Excel by Ruff, which models cross-sections assuming an

ellipse shape. A ratio of I_x to I_y was not significantly related to BMI, body mass at death, or body breadth, leading to a rejection of the hypothesis of mediolateral reinforcement. Future directions involve using external contour molds to better approximate diaphyseal shape in order to determine if more subtle differences in cross section shape could influence results.

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Dynamic contact: examining histories of migration, hunting, and conflict at the human-nonhuman primate interface

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Environmental and economic histories of people can enhance our understanding of human-nonhuman primate interactions. Using the Sangha-Mbaére Region of the Central African Republic as case study, this paper contributes to the symposium's aim of highlighting the importance of migration in anthropological research by demonstrating the significance of migration histories within contexts of changing subsistence practices and wildlife economies. This papers draws on 210 semi-structured interviews (2008-2009) among hunters in the Dzanga Sangha Protected Areas (APDS). Interviews are contextualized within ecological line transect data (n=135.4km) documenting low encounter-rates of primates. Hunters surveyed in APDS represent 28 language groups, though are regionally classed as either BaAka (indigenous foragers) or *Bilo* (non-Aka). Of 210 hunters surveyed, 35% (n=73) were BaAka. Non-Aka represent 65% of hunters (n=137), 72% of whom are migrants. In-migration to forested zones increases the presence of individuals with varying practical and symbolic ties to the forest. The historical cyclical influx of migrant populations in APDS is coupled with the flow of firearms from national and international conflicts. Gun availability has fundamentally shifted the prey base accessible by hunters and has emerged as the most efficient form of hunting. Using guns results in greater off-take rates (guns=9.83 animals/1.4 days vs. snares=3.07 animals/1.4 + days), as well as a greater percentage of cercopithecoid monkeys in hunter catchments. In APDS we see how the migration of people and objects has direct implications not only for conservation policy and sustainable management regimes, but also for the long-term survivability of biological and cultural diversity.

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Identifying Region of origin in a 18th Century Charleston Slave Cemetery

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This study uses carbon, oxygen and strontium isotopes in bone and enamel to investigate region of origin and migration in a revolutionary war era cemetery of 28 enslaved individuals found in Charleston, South Carolina. The mean $^{87}Sr/^{86}Sr$ enamel value was 0.71536 +/- 0.01 (2σ, N=29), and the mean $^{87}Sr/^{86}Sr$ bone value was 0.71040 +/-.002 (2σ, N=35). The $^{87}Sr/^{86}Sr$ baseline for the Charleston area was 0.7100 to 0.7107 (N=3). The mean $\delta^{18}O_{VSMOWenamel}$ value was 26.7 +/- 1.56‰ (2σ, N=28), and the mean $\delta^{18}O_{VSMOWbone}$ value was 25.6 +/-2.8‰ (2σ, N=35). The mean $\delta^{13}C_{pdbEnamel}$ value was-7.9 +/-8.4‰ (2σ, N=28), and the mean $\delta^{13}C_{pdbBone}$ value was-9.3+/-2.7‰ (2σ, N=35). Values for drinking water were generated from enamel and compared to drinking water values for the Charleston area (0‰ to -3.9‰), Wind Ward and Gold Coast regions (-2.29‰ to -5.79‰) and Barbados (-2.5‰ to -5‰). Enamel data for seven individuals (SC1, SC15, SC18, SC24, SC16, SC36, SC35) had a range of $\delta^{18}O_{dw}$ (-5.75‰ to -3.34‰), $^{87}Sr/^{86}Sr$ (.7097 to .7296) and $\delta^{13}C_{pdbdiet}$ values consistent with West African origins possibly in Senegal or Nigeria. Twenty-one individuals had $\delta^{18}O_{dw}$ values that were not consistent with Charleston, Barbados, or the west coast of Africa. Estimations of $\delta^{18}O_{dw}$ for drinking water for this population ranged from (-6‰ to -9.5‰), strontium isotope values ranged from (0.7094 to 0.7329) suggesting Southern Central Africa (Zambia and Namibia) or North Africa (Morocco) as probable regions of origin. No one was born in Charleston and only one individual showed bone isotopes acclimated to the region.

"Altitude Sickness: Health in the Titicaca Basin of the Bolivia"

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Lake Titicaca is the highest navigable lake in the world, at 3810 meters above sea level. Despite the extreme altitude and alpine climate, humans have productively occupied this region for millennia. This study investigates the health impacts of sedentary settlements and agriculture for groups living in this landscape between 800 BC and AD 200. During this time, people formed fully to semi sedentary settlements, relied on domesticated plants and animals, invested fields through the creation of raised fields and terraces, utilized long-distance trade networks, and participated in an emerging ritual tradition. The transition to agriculture in other parts of the world resulted in marked increases in disease and malnutrition; the high altitude of the Titicaca Basin could have exacerbated these problems. To test this, I analyzed human remains excavated from seven archaeological sites on the Copacabana Peninsula for markers of diet and disease. These markers included: dental caries and abscesses, porotic hyperostosis, cribra orbitalia, periosteal reactions, osteomyelitis, and linear enamel hypoplasia. Frequency of lesions were statistically compared across age, sex, and sites, to see if certain groups were at particular risk. Results showed that markers of diet did not vary significantly between categories, and overall indicated a relatively diverse diet for all individuals. Markers of disease also did not vary significantly but were common for all groups, indicating circulation of pathogens or chronic bodily stress for these populations. This may indicate that while diets remained nutritious, investment in the landscape exposed populations to issues of sanitation and disease.

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The relationship between ante-mortem tooth loss in molars and the mandibular ramus shape examined using 3-D geometric morphometrics

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The purpose of this study is to examine the relationship between ante-mortem tooth loss (AMTL) in molars and the mandibular ramus shape. It is hypothesized that ramus shape variation is related to AMTL in terms of the function-induced alteration.

The 64 adult mandibles (33 males and 31 females), excluding specimens with congenital M_3 loss, from Joseon Dynasty (15^{th} to early 20^{th} centuries) in Korea were analyzed using 3-D geometric morphometrics. Remaining molars were counted when their occlusal function was possible. With MicroScribe G2X, 11 landmarks were digitized on the left side of ramus. Statistically, the effect of age, sex, and allometry was controlled by adopting the residuals from regression of age, sex, and size factors on Procrustes coordinates. MANOVA was conducted with the number of remaining molars and shape variables (residuals). Moreover, additional MANOVA was conducted with the number of remaining molars, age factor, and shape variables (residuals including age factor). The statistical analyses were performed using Morpho J and SPSS 18.

The results showed that the effect of AMTL on residuals was statistically insignificant (p = 0.273). However, the effect of AMTL on residuals including age factor was statistically significant (p = 0.023). Moreover, correlation

between the number of remaining molars and age factor was statistically significant ($r = -0.463$; $p < 0.01$). These results indicate that the hypothesis may not be valid and that some of ramus shape alteration by AMTL in previous studies may be related to the age factor in addition to function-induced changes.

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Bioarchaeology of the Wall of the Crow Cemetery, Giza: Changes in the Levels of Systemic Stress from the Saite to the Roman Period

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The Saite period in Egypt (664-525 BCE) is often described as the last peak of Ancient Egyptian culture. The country was independent, ruled by native kings, and both arts and economy flourished. In contrast, Egypt during the 1st and 2nd century CE was subsumed into the Roman Empire as a mere province. After the fall of Ptolemaic Egypt, Augustus imposed rigid social and fiscal barriers between Egyptians, Greek and the Hellenized elite, that effectively confined many native Egyptians, particularly women, to the lower classes of society. In addition, continued Roman conquests were financed by higher taxes imposed on the Egyptian population. The bioarchaeological material from the Wall of the Crow cemetery, Giza, offers an opportunity to investigate how these changes may have impacted those on the lower rungs of the status scale, since it was a final resting place of the non-elite during both the Saite and early to mid-Roman periods (1st-2nd century CE). To assess levels of biological stress between and within periods, data was collected on cribra orbitalia, porotic hyperostosis, enamel hypoplasias, oral health, stature and degenerative joint disease. It was hypothesized that levels of systemic stress would be higher in the Roman period sample. However, with the exception of poorer dental health, the skeletal analysis revealed very little evidence of heightened stress in the Roman population. Thus, it appears that the effects of the Roman conquests were not as detrimental to the non-elite as previously thought, at least in the Giza region.

Do site residence time and aggression reflect dietary preference among wild Diana monkeys (*Cercopithecus diana*)?

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Temporal and spatial characteristics of primate foods significantly impact female sociality. Food site residence time is a consequence of these ecological characteristics: foods with longer residence times tend to be readily monopolizeable, have clumped distributions, and elicit greater competition. For example, among arboreal mangabeys, patches of seasonally important resources (bark) have the longest site-residence time, are the focus of more agonism, and are monopolized longer by high ranking females.

Cercopithecus diana is an excellent taxon for testing relationships between diet, food site residence time, and sociality because Diana monkeys are highly frugivorous and engage in comparatively frequent intragroup aggression. I collected data on feeding behavior, site residence time, and social interactions among females in two Diana monkey groups in Cote d'Ivoire's Taï National Park from 2013-2015. These data were combined with long-term food preference data from the same groups to test the hypothesis that preferred foods have longer site residence times and elicit more aggression than those less preferred.

Preliminary analyses revealed no significant difference between site residence times for ripe fruits (mean=79 seconds), invertebrates (mean=91 seconds) or mature leaves (mean=107 seconds). No significant difference was detected between preferred and non-preferred fruits' residence times. However, aggressive interactions between females were observed three times while foraging on ripe fruit (2% of focals) and twice while foraging for invertebrates (0.5% of focals). These results suggest that while site residence times may not reflect food preferences of female Diana monkeys, higher value foods may still elicit greater rates of aggression.

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The ontogenetic trajectory of occipital squama convexity in extant humans

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The occipital bun, a pronounced convexity of the occipital squama, is a feature frequently found in Neandertals, as well as some anatomically modern humans. While often cited as a distinct anatomical trait, the ontogenetic patterning of the occipital bun remains unclear. This study establishes the cranial ontogenetic trajectories of bunned vs. non-bunned extant human subjects from several longitudinal growth studies in order to assess whether significant developmental differences exist between the two groups.

Lateral cephalograms from 26 subjects (16 males, 10 females), representing extremes of variation in adult occipital squama convexity, were measured. Each subject is represented at nine longitudinal age points, spanning 3.0 – 20.4 years of age. Seven landmarks and 90 sliding semi-landmarks were digitized at each age point. The ontogenetic trajectory of each individual was established using multivariate regression of midsagittal cranial shape vs. subject age and bun status. Procrustes ANOVA and permutation were used to evaluate differences between bunned and non-bunned subjects' trajectories.

The ontogenetic trajectories of the two groups were found to share the same slope, but have significantly different intercepts. This parallel trajectory pattern reveals that divergence in midsagittal cranial shape in bunned vs. non-bunned subjects appears prior to the youngest available age point. Therefore, occipital bun morphology, at least in extant humans, is established early in ontogeny – before 3 years of age. This pattern fits with observations from the fossil record, with some very young Neandertals (Engis 2, Subalyuk 2, and La Ferrassie 8) possessing varying degrees of occipital bun morphology.

This study includes subjects from the University of Toronto Burlington Growth Study, the Iowa Facial Growth Study, and the Oregon Growth Study.

Climate and diet signatures in human skull shape: a mixed model approach

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The beauty of shape analysis is its potential to both quantify and concretely represent morphological variation. Preserving this potential in evolutionary studies that require population structure to be disentangled from possible sources of selection has proven challenging. Very often, shape variation and the predictors of interest are reduced to sets of pairwise distances. This transformation makes it possible to account for structure when evaluating other correlates of morphology, but with the unfortunate consequence that shape itself is lost. Here, we take a different approach. Expanding upon a Bayesian mixed model for highly multivariate data, we quantify three-dimensional shape change associated with climate and subsistence strategy in a global sample of modern human crania (484 specimens from 20 groups) and mandibles (518 specimens, 22 groups). The climate and diet coefficient vectors for cranial and mandibular landmarks each form an axis through the variable space. We visualize climate and diet effects as shape transformations along these axes. Our preliminary results indicate subsistence differentiation is more evident in the mandible, with an association between agriculturalist diets and relatively taller, narrower rami. In contrast, climate differentiation is more evident in the cranium, with relatively wider vaults and taller faces in colder climates. In model comparison, models of cranial and mandibular shape that incorporate fixed effects for climate and diet outperform structure-only models. The ability to quantify

and visualize the shape change associated with fixed effect predictors is reason to consider wider application of mixed model analysis in physical anthropology.

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Food patch characteristics and dynamics of patch use and sharing in two sympatric lemur species at Tsinjoarivo, Madagascar

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Individuals' access to food patches is impacted by within-group competition, but also depends fundamentally on the size and quality of patches available; feeding patch volume and richness likely influence the time feeding there and the likelihood of sharing/revisits. We quantified resource patch characteristics, use, and sharing in two lemur species at Tsinjoarivo, Madagascar. First, we used 9-10 day-long full-group focal samples (following all group members simultaneously), recording each feeding bout and marking each food patch with a flag and unique identifier; this identifier was recorded for each subsequent use by any animal. Second, we measured crown dimensions and estimated volume for each patch. Common Brown Lemurs (*Eulemur fulvus*) used larger patches (median: 25 m^3, n=174), a greater percentage of which were used by multiple individuals (70%); Diademed Sifakas (*Propithecus diadema*) used smaller patches (median: 13 m^3, n=678) and shared less often (43%). There was a significant linear relationship between crown volume and the number of animals seen using the patch but the amount of variation explained was low (*P. diadema*: R^2 = 0.02; *E. fulvus*: R^2=0.14). The dominant female was first to feed in a disproportionately high percentage of shared patches (*E. fulvus* 32%, expectation 14%; *P. diadema* 33%, expectation 20%; X^2 test P<0.001), suggesting that dominance facilitates priority access for some patches. In sum, much feeding is solitary but female dominance is evident in patch entry order; more work is necessary to better define the conditions, season, and/or social contexts in which female dominance translates directly into fitness benefits.

Globalized diet and individual choices: stable isotopic analysis of hair keratin from a modern population

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Due to globalized trade and technological advancements in travel and agriculture, it is not uncommon for modern diets to offer up a wide variety of foodstuffs for consumption. Are individual dietary choices discernible within the framework of food production policy in a modern U.S. population? Hair was sampled from approximately 30 individuals from the Northern Arizona University community in Flagstaff, Arizona, including students, faculty, and staff to understand dietary habits in a modern population using carbon and nitrogen stable isotope analysis. Self-reported vegans stood out in their lower nitrogen and less positive carbon values, indicating a higher consumption of C_3 plant foods than other individuals. For the rest, this population showed significant inter-individual dietary differences with a 3‰ range in carbon values, but not in nitrogen values. Compared with studies from around the world, this population consumed significantly more C_4 foods but ate about the same level of protein than non-U.S. populations. The widespread and heavy use in the U.S. of maize products in soda, pastries, snacks, and as feed to livestock likely accounts for these high carbon isotope values. Interestingly, limited data suggests that individuals affiliated with the anthropology department ate a more diverse diet than non-anthropology individuals from the NAU community. Even in a modern globalized population, hair analysis shows individual dietary choices despite the consistent effects of wide scale food production policies. The NAU Institutional Review Board approved this study.

Intraspecific variation in hominoid lumbar vertebral morphology

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A combination of developmental and biomechanical constraints limits the intraspecific variation seen in the number of pre-sacral vertebrae in fast running mammals. We hypothesize that functionally significant aspects of vertebral morphology may also exhibit reduced intraspecific variation in taxa exhibiting highly derived and mechanically demanding forms of locomotion. Specifically, we predicted that among hominoids, ricochetally brachiating hylobatids and bipedal humans would exhibit the lowest levels of intraspecific variation in lumbar vertebral morphology.

We tested this hypothesis by calculating intraspecific variation in six functionally significant morphological measurements from the mid-lumbar vertebrae of five hominoid species and one outgroup cercopithecoid (n=225). All variables were scaled to body size using the geometric mean of each individual's diaphragmatic vertebra, and a modified Levene's test was used to calculate levels of variability for each species. We found no significant phylogenetic structure in the variability data. ANOVA and Tukey-tests were used to determine whether the calculated measures of intraspecific variability differed significantly among the six species.

Spinous process length, cranial vertebral body width and vertebral body length differed significantly in variability among hominoid species ($p<0.05$). We found mixed support for our hypothesis. Low variability in *Homo* was responsible for driving a portion of the spinous process and vertebral body length results, as predicted by our hypothesis. However, it was high variability in *Hylobates* that drove the cranial body width result. Our findings suggest that the specific mode of locomotion may be more important than the overall mechanical demands in determining levels of intraspecific variability.

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Using Big Data to Assess Patterns of Traumatic Injury: Skeletal Trauma on the North American Great Plains

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More than a quarter century has passed since the passage of the National Museum of the American Indian Act in 1989 and the Native American Graves Protection and Repatriation Act in 1990. In the interim, museums, laboratories, and universities have focused their efforts on documenting their collections of Native American human remains before materials are repatriated. One outcome of repatriation has been the construction of large-scale databases.

The primary goal of this project was to assess the accessibility and functionality of the Smithsonian's digital data repository for original research. The Smithsonian collections include the remains of roughly 18,000 individuals of Native American descent. As a test of the functionality of the database, the author conducted a geographic and temporally expansive analysis and visualization of violence using a large sample of Arikara-related skeletal materials.

This project utilized data from 1,221 individuals recovered from ten archaeological sites in the Middle Missouri River Basin. Preliminary results suggest that males are significantly more likely to have sustained skeletal trauma and the sample exhibited very few instances of injury recidivism. The vast majority of trauma occurred antemortem, suggesting that many injuries were not imparted with lethal intent. These findings suggest that this horticultural group may not have been subject to high levels of warfare in the protohistoric and early historic periods.

This research has fundamental importance to the field of bioarchaeology because it has the potential to improve methods of data collection and increase our understanding of human violence in the past.

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Molar Morphometric Variation Within Modern U.S. Populations

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Increasingly, geometric morphometric (GM) techniques are being used to answer anthropological questions. Generally, estimation of the biological affinity of U.S. individuals has often been limited to examination under a forensic lens (i.e. simple group classification) without consideration of parent populations. The current study applies GM to human molars with two main goals: 1) to examine biological affinity of each of the four largest U.S. population groups (Asian, black, Hispanic, and white) in regard to population history and 2) examine the variation within and among the four modern groups as a means of classification. The upper and lower first and second molars from 1,225 individuals were digitized with a coordinate digitizer. Each of the four modern U.S. groups was compared to possible parental groups via discriminant function analysis (DFA). Additionally affinity was examined using Mahalanobis distances, the significance of which are compared via permutation tests. Each group demonstrated affinity with parental and geographically similar groups; however, each was also significantly unique from the comparison groups. The four U.S. groups were then compared to one another. Total among-group correct classifications ranged from 33.9-55.5%, indicating a greater classification than random chance (25%). Lastly, a comparison of the three most abundant groups in the U.S. (black, Hispanic, and white), achieved a total correct classification of 72.3%, which is comparable to other studies of the same populations. Restricted gene flow through sociologically constructed barriers and positive assortative mating are the likely factors in the observed variation.

Three-dimensional photogrammetry of wild primates

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The measurement of morphological traits in animals is critical to evolutionary and ecological hypothesis testing, but direct measurement is often not feasible in field settings. Consequently, scientists have devoted considerable attention to developing methods for the remote measurement of morphological traits. Digital photogrammetry is one convenient tool for this because it is non-invasive, accurate, and inexpensive. To date, however, most photogrammetric studies have been confined to two dimensions. Here we describe field-ready technology to accurately characterize the morphological traits of wild primates and other animals in three dimensions. Using a portable multi-camera array, we generate a calibrated and spatially referenced 3-dimensional morphological model using structure from motion (SFM) techniques. From these models, distance, area, and volume of morphological features can be measured. Here we present information on this technique and evidence of its validation based on measurements of osteological collections, domestic dogs, and wild gelada monkeys (*Theropithecus gelada)* at the Guassa Plateau, Ethiopia. This method may help scientists establish more robust links between morphological metrics, performance, and reproductive success, particularly in the context of longitudinal field studies.

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Analysis of Craniofacial Variation and Sexual Dimorphism using the 3D Facial Norms Database

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Craniofacial sexual dimorphism has been extensively studied in modern human populations. Although considerable amounts of literature are dedicated to the quantitative differences between male and female faces, relatively little is known about when these differences arise during postnatal life. Using the 3D Facial Norms database, this study evaluated 36 soft-tissue anthropometric measurements collected from the 3D facial scans of 1,555 healthy individuals, testing for sex differences across a broad age range (3-25 years). Subjects were placed in to one of six age-defined categories: early childhood, late childhood, puberty, adolescence, young adult, and adult. Within each category males and females were compared statistically using ANCOVA. In addition, growth curves were calculated using LMS smoothing, allowing both visual and statistical evaluation of the onset of craniofacial sex differences. Multiple measurements exhibited significant ($p<0.05$) sexual dimorphism very early in post-natal life, including cranial vault width and length, mandibular width, cranial base width, facial depth (upper, middle and lower), facial height, and measurements involving the nasal alae. These early craniofacial sex differences were not a result of overall body size dimorphism. Sexual dimorphism involving subnasal width, upper and lower lip height, minimum frontal width, nasal height, and cutaneous lower lip height did not arise until later in childhood/adolescence. Measures involving the vermillion portion of the lips failed to show any evidence of sexual dimorphism across the lifespan. These results provide a framework for further studies evaluating the mechanisms underlying the ontogeny of craniofacial sexual dimorphism.

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Howler monkey foraging ecology suggests convergent evolution of routine trichromacy as an adaptation for folivory

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Howler monkeys (*Alouatta*) are unique among catarrhines in possessing "routine" trichromatic vision through the fixation of distinct L and M opsin genes on the X-chromosome. Because all other diurnal neotropical monkeys are comprised of mixed populations of dichromatic and trichromatic members, the ubiquitous trichromacy in howler monkey populations has fueled sustained interest among sensory biologists. A hypothesis proposed to explain the independent evolution of routine trichromacy — involving a reliance on foraging nutritious young, red leaves — has received scant attention in howler monkeys. We sequenced the opsin genes of 8 howlers in 4 social groups and conducted colorimetery and perceptual just-noticeable difference (JND) analysis of dietary leaves consumed by *Alouatta palliata*, in Sector Santa Rosa, Costa Rica. For a majority of the food species evaluated, including *Ficus* trees, which are a keystone resource for howlers, young leaves are chromatically conspicuous from mature leaves to the standard trichromatic phenotype of howlers. We also found 18% of howler opsins genes to be M/L hybrids; the resulting anomalous trichromatic phenotype performed relatively well in food detection models. Hypothetical dichromatic phenotypes were significantly disadvantaged compared to trichromatic phenotypes. Our results provide support for the central tenant of the folivory hypothesis and highlight the role that young leaves may play in shaping the sensory ecology of primates that strongly rely on them for nutrition. This is consistent with the hypothesis that independent evolution of routine

trichromacy in primates on separate continents was driven by similar ecological pressures — the search for young, reddish leaves.

Multiple population-specific age estimation methods or one-size-fits-all single age estimation method: which approach works best?

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During the past several decades, there has been a call to develop population-specific age-at-death estimation methods under the assumption of population specificity in the skeletal aging process. However, less emphasis has been placed on developing a more inclusive method that can be broadly applied to different or unknown populations. In response to this call, the current study investigates age progressive changes in modern east and southeast Asian populations to systematically evaluate the assumption of biological uniformitarianism as a first step to develop a broadly applicable aging method.

To minimize methodological error, cumulative probit regression combined with Bayesian statistics (transition analysis) was applied to Japanese and Thai adult skeletal samples. Transition analysis parameters were obtained from the cumulative probit regression on age indicators, including the pubic symphysis, the auricular surface, and cranial sutures. Informative prior probabilities were obtained by fitting the Gompertz hazard model to separate mortality data of Japanese and Thais. Japanese parameters as well as pulled-sample parameters were used to estimate age-at-death of Thais and vice versa. The age estimates were compared to the documented ages and the Markov chain Monte Carlo method was used to generate posterior probability distributions.

The results of the study indicate that, while the two samples have different timing in skeletal trait transitions, the two geographically-distributed groups could be combined to generate age estimates that encompass a wider range of populations.

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Population affinities and postcranial variation in the southeastern Archaic

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The genetic relationships among past populations are often assessed through craniometrics, dental metrics, and nonmetric features of the cranium, teeth, and postcranial skeleton. This study assesses the use postcranial metric data to examine patterns of variation within and among bioarchaeological samples from several middle to late Archaic period shell midden burial sites in the southeastern United States to determine if the relationship between geographic proximity and population affinity holds true when analyzing the postcranial skeleton.

Adults from three samples from west-central Tennessee (Eva, 40BN12, N = 30; Cherry, 40BN74, N = 20, Ledbetter Landing, 40BN25, N = 12) and Kentucky (Indian Knoll, 15OH2, N = 120) were included in this analysis. Eighteen postcranial osteometric variables from the humerus, radius, femur, tibia, and os coxa were analyzed in addition to the brachial and crural indices.

Results show that the samples from the Tennessee sites are very similar to each other in terms of variation in postcranial measurements and in the brachial and crural indices. Additionally, using postcranial data alone it is difficult to separate the somewhat geographically distant Indian Knoll site from the Tennessee sites. These results are discussed in light of previous biological distance studies.

Isotopic perspectives on the dietary ecology of early Miocene catarrhines

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Developing an environmental context for early Miocene hominoids is important for interpreting the adaptive significance of morphological changes and the evolutionary trajectory of the various catarrhine lineages documented in East Africa. While more traditional perspectives tend to situate these events in closed canopy forest habitats, isotopic analyses of the enamel of fossil herbivore guilds at the early Miocene sites of Napak and Moroto (Uganda) instead indicate broken canopy or woodland habitats. To characterize the dietary niches of hominoids within this more open environmental reconstruction and situate the primate isotopic signatures within a broader faunal context, we analyzed the isotopic signature of 7 fossil catarrhine teeth, including those identified as *Morotopithecus bishopi*, *Proconsul major*, and cf *Rangwapithecus*. In addition, for comparative interpretations, we analyzed the isotopic enamel of multiple modern hominoid taxa that were then compiled with other relevant existing datasets of extant hominoid taxa. Relative to modern enamel, $\delta^{13}C_{enamel}$ values of the fossil catarrhines at Napak and Moroto were generally enriched with normalized values ranging from ca. -11 to -13‰, consistent with values of associated fauna in the fossil assemblages, and indicate foraging in more peripheral or open components of the canopy where water stress, evapotranspiration, and irradiance were higher. Fossil catarrhine values (corrected for changes in atmospheric $\delta^{13}C$) are most similar to those of modern highland gorillas but also overlap with modern *Papio* populations. Overall, the fossil isotopic data suggest catarrhine dietary niches consistent with more woodland or open seasonal forest niches with no clear modern analogs.

An Eocene primate frontal from the Devil's Graveyard Formation, Texas

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The Devil's Graveyard Formation (DGF) of southwest Texas is mainly composed of fluvial volcaniclastic sediments that accumulated in the southernmost Laramide basin of North America during the Middle and Late Eocene. Collecting at Late Uintan localities in the DGF since 2005 has yielded a large sample of vertebrate fossils, including jaws and teeth of at least 5 primate genera: *Mescalerolemur*, *Omomys*, *Diablomomys*, *Mytonius*, and Omomyidae gen. nov. The only younger primates known from the southern Rocky Mountain region in Texas are *Mahgarita* (Duchesnean, DGF) and *Rooneyia* (Duchesnean, Chambers Formation). We report the discovery of a primate partial cranial specimen from a new DGF locality that is bracketed stratigraphically by known Late Uintan and Duchesnean assemblages. The specimen consists of articulated left and right frontal bones, which are nearly complete and undistorted. Although lack of associated dental material precludes generic attribution, the specimen shares a number of features with *Rooneyia*. These morphological similarities include partial fusion of the metopic suture, the presence of moderately small orbits, and ventral extension of the postorbital process to form a small postorbital flange. The specimen differs from *Rooneyia* in possessing everted superior orbital margins separated by a shallow midline fossa. Comparisons with extant primates demonstrate that some species (e.g., *Nycticebus coucang*, *Varecia variegata*) also exhibit small postorbital flanges of the frontal. These observations suggest that bony postorbital morphology in primates is more variable than is commonly recognized, and that multiple primate clades independently evolved small bony partitions between the superior orbital and temporal fossae.

Niche expansion and the process of becoming human: using the Extended Evolutionary Synthesis to model the origins of modern human behavior

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Paleoanthropological approaches have focused on locating a specific time, place, and morphology when our ancestors went from archaic Homo sapiens to anatomically and behaviorally modern ones but often this work has been undertaken without integrating modern theoretical issues. From a behavioral perspective, this debate is centered on the question of when humans began to think symbolically. We suggest that in order to properly contextualize the human niche we must incorporate all the possible evidence for complex human thought. Here we report on the final version of a paleoanthropological database of relevant indicators for symbolic expression, including ochre use, engraved objects, human burial, and early art. Using data from +300 from over 100 sites, we investigate how the human niche expanded by exploring the temporal and geographic extent of symbolic behavior in five different time periods from >500 kya to 45 kya and show, using cluster analysis and information theory, that groups of early humans were exploring methods of symbolic expression before the evolution of anatomically modern humans, which argues against the notion the only modern humans could think symbolically. We then show how different types of archaeological data are clustered in different regions, suggesting that community-level information sharing is occurring throughout the Middle Pleistocene. We tie these results into recent fossil and genetic data that shows the relevance of the Extended Evolutionary Synthesis to questions of modern human origins

Asymmetry of the Modern Human Endocranium

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Hominin brain evolution is a topic of great interest in paleoanthropology. Details of this evolutionary process are typically inferred from endocasts. However, very little research has been done to *quantifiably* establish the relationship between an endocast and its corresponding brain. This study investigates this relationship using asymmetry of the entire endocranial surface. As the modern human brain is structurally asymmetric, the results of this study allow for a direct quantitative comparison of this characteristic between the two surfaces. In addition, because important aspects of behavior, such as handedness and language processing, are organized asymmetrically in the brain, it is of great interest to be able to see these same asymmetries on the endocranial surface.

Using innovative geometric morphometric techniques, this study quantified the degree and direction of asymmetry of the entire endocranial surface in adult modern humans. Results indicate the well-known petalia pattern of asymmetry extends beyond the frontal lobe to include the right temporal and anterior parietal regions. In addition to an anterior-posterior and lateral asymmetry, the petalias also differ in superior-inferior distribution. A rightward asymmetry of Broca's area was found, contradicting previous qualitative reports. A leftward asymmetry of the anterior cerebellum was also found and a rightward asymmetry of the temporal pole, as well as several other subtle asymmetries across the rest of the endocranial surface. The findings will be compared with brain asymmetry research and the implications for brain evolution research will be discussed.

Functional interpretation of the *Homo naledi* hand

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Over 150 hand bones of *Homo naledi*, including a complete hand – missing only the pisiform – found in semi-articulation, have been uncovered from the Dinaledi Chamber of the Rising Star cave system, South Africa. These remains are from at least six adult and two juvenile individuals and offer a rare opportunity to investigate overall hand function in a fossil hominin. We conducted linear and 3D morphometric analyses of the wrist bones, metacarpals and phalanges in comparison to extant apes and fossil hominins. The morphology of the *H. naledi* thumb bones indicates powerful grasping combined with a distinctly small trapezium-first metacarpal joint that differs from other fossil hominins. The radial carpal bones demonstrate changes in shape and orientation that are known only in Neandertals and modern humans and have been interpreted as adaptations to tool-related behaviours. In contrast to the derived wrist morphology, the phalanges are remarkably curved, more so than most australopiths, indicating *H. naledi* used its hands for climbing. This combination of later *Homo*-like and australopith-like features in *H. naledi* suggests that the hominin hand could be both specialised for complex manipulative tasks but also be functionally proficient for locomotion. Within the context of the remainder of the skeleton, including an australopith-like shoulder and pelvis, but *Homo*-like foot, *H. naledi* was an efficient biped that still spent a significant amount of time in the trees.

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***Hoxa11* and *Hoxd11* influence pisiform length through altered growth plate organization**

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Mammalian pisiforms are typically elongated, form from two centers of ossification, and contain an organized growth plate at the palmar end; however, human pisiforms are short, have lost an ossification center, and lack a growth plate. Orangutans also have shortened pisiforms, but retain two ossification centers. In mice, *Hoxa11* and *Hoxd11* are expressed around the developing pisiform, and mutations to these genes produce abnormally short pisiforms. This study uses histological analyses to examine the structure of developing pisiforms in *Hoxa11* and *Hoxd11* mutant mice to determine if the growth plate is altered by loss-of-function of either gene. Abnormal pisiform growth plate cartilage organization is observed in both *Hoxa11* and *Hoxd11* mutants in a dosage-dependent manner. Heterozygotes and homozygotes for the *Hoxa11* deletion lack a distinct hypertrophic zone, have a reduced columnar zone, and have shorter pisiforms than wild types. All chondrocytic zones appear reduced in *Hoxd11* heterozygotes, and *Hoxd11* homozygous mutants have disorganized cartilage where the growth plate typically forms. *Hoxd11* mutants also have short pisiforms and an abnormal ossification front, which is less apparent in *Hoxa11* mutants. These results support the role of Hox genes in pisiform growth plate formation and overall pisiform length. Human and orangutan pisiform reduction is likely convergent since orangutans retain a secondary ossification center, while humans do not. Given variability in growth plate structure between *Hoxa11* and *Hoxd11* mutants, these data may also help to explain developmental processes responsible for variation in the piso-triquetral complex in humans and orangutans compared to other hominoids.

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Worldwide population variation in pelvic sexual dimorphism

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Estimating the biological profile from skeletal remains is an essential component of the anthropologist's role in medico-legal investigations and in bioarchaeological analyses. Sex estimation is paramount because many methods for stature and age estimation are sex specific.

The innominate, specifically the pubic bone, is considered the best indicator of sex in adults and is widely used for sex estimation. The Klales et al. method, a modification of Phenice's technique, is currently being used and cited in forensic case reports throughout the United States and internationally; the method is also being used in bioarchaeological contexts. In light of *Daubert* and the NAS report from 2008, the method needs to be tested for validity and reliability. The present research tests the reliability and validity of the method in multiple national and international samples.

A sample of adult pelves (n = 532;females = 239; males = 293) from several collections was blindly scored for the three Klales et al. traits (ventral arc, subpubic contour, and medial aspect of the ischio-pubic ramus) by an experienced observer. The samples are derived from Thailand, South Africa, and various U.S. populations. Using the original logistic regression classification equations by Klales et al., the external validity of the original method was tested. Next, sample specific equations and a pooled sample logistic regression equation were generated. Results indicate that the method works well for classification (accuracy 75.9%-93.3%) and is valid; however, classification accuracy increases when using sample-specific equations (accuracy 97.9%-99.0%).

Do grooming bouts diminish ectoparasite load in wild Propithecus edwardsi in the rainforests of Madagascar?

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Grooming is a well-documented behavioral archetype among primates and is commonly ascribed to both hygienic and affiliated behavior. While grooming is assumed to carry a hygienic function, the quantitative influence it has on an individual's ectoparasite load has not been extensively explored. The hygienic function of grooming may be especially important to consider among strepsirrhines, which exhibit specialized toothcombs utilized during grooming bouts. To understand whether grooming influences hygiene, as measured by ectoparasite load, our research explores the proportion of bouts spent being groomed and relative ectoparasite loads among Milne-Edward's sifaka (*Propithecus edwardsi*) in Ranomafana National Park, southeastern Madagascar. Our research used focal animal behavioral data for *P. edwardsi* collected in the years 1995 to 1998 and 2000 to 2005. Relative parasite loads (scale from 0-5) and presence of specific ectoparasite types (e.g. Hippoboscid flies, ticks, lice) were recorded for all captured individuals over the same time period. Grooming bouts accounted for approximately 16% of all recorded instances. Our results show that increased proportions of grooming bouts for individuals did not have a significant effect on ectoparasite load ($p > 0.05$). These results suggest that grooming may serve a substantial social function in this species beyond pure hygienic purposes. Further research could illuminate the interplay between grooming, ectoparasite load and social contact, a factor which could actually facilitate ectoparasite transmission.

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Battle vs Massacre – the use of perimortem injuries to differentiate between violent encounters

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This presentation is a comparison of distribution, pattern and location of the perimortem traumas from Udbina and Cepin where the difference of the attack can be clearly seen. According to all parameters of the injuries the main question is "how can we compare/ differentiate a massacre and/ or a battle".

The battle of Krbava Field in 1493 was one of the worst defeats in Croatian mediaeval history. Archaeological site Udbina – Sveti Jakov, Croatia, is located within the range of 2 km from the Krbava Field. During the excavations, which have been carried out from 2000 till today, a total of 208 (in situ) skeletons had been recovered (123 males, 40 women and 45 children). Anthropological analysis established that 26 skeletons exhibit 113 perimortem trauma characteristic of mediaeval battle injuries. The remains of all 26 skeletons belong to healthy males aged between 18 and 45 years.

The skeleton material from Udbina is compared to the skeleton material from Cepin, Croatia.

Excavation of the historic period cemetery in Cepin, Croatia, showed the presence of a large number of perimortem injuries distributed among males, females, and subadults. Archaeological and historical data suggest these individuals were victims of a raid carried out by Ottoman akinji light cavalry in 1441. Furthermore, perimortem trauma in the series were analyzed by sex, age, location, and depth of the injury. A total of 82 perimortem injuries were recorded in 12 males, 7 females, and 3 subadults.

Tooth Size and Diet among the Extinct Monkeys of the Caribbean

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Large molars are a defining peculiarity of the recently-extinct primates of the Greater Antilles, but the functional significance of this feature has not been explored. Molar *form* reflects selective pressures posed by the physical properties of foods, and ultimately aspects of the adaptive zone occupied in life. A comprehensive study of molar crown *shape* reported a tendency towards frugivory in these taxa, though molar *size* was not examined. Large molars generally correspond with the mechanical challenges of folivory. Bite force and specific attributes of foods are also associated with molar size (e.g., toughness, abrasiveness, and particle size). Here, the functional significance of large molars among Antillean taxa is explored by calculating relative molar row area in a broad sample of primates with diverse diets. Molar area is scaled to the arcade, permitting inclusion of taxa of uncertain body size. Results from the extant primate sample demonstrate the expected pattern whereby molar area is greatest among folivores, cercopithecines that routinely feed on highly-abrasive foods, and the powerful nut-cracker, *Pongo*. Sampled Antillean genera (*Xenothrix*, *Antillothrix* and *Paralouatta*) exhibit remarkably high values, matching or exceeding the most specialized living anthropoids; *Paralouatta* exhibits the largest relative molar area of all taxa

studied. These primates do not exhibit highly worn teeth indicative of an abrasive diet, nor do they bare pronounced muscle attachments for a powerful bite. Thus, Antillean primate megadontia likely reflects a critical function for the fine comminution of low-quality foods for efficient digestion, perhaps as a fallback strategy when fruit is scarce.

Concerning Dental Wear: an examination of macro-wear in the Erie County Poorhouse Cemetery (1851-1913)

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The Erie County Poorhouse, established in Buffalo, New York in response to growing poverty, provided short term relief for individuals. For those with ailments, the associated hospital provided affordable care. Those that died at either institution were buried in the same cemetery. This research analyzes the dental wear observed on skeletal remains interred in this cemetery.

The sample consists of 64 males and 38 females who had at least 1/3 of their teeth present. Dental wear was scored using the Smith system (1984). The average anterior and posterior wear was calculated for males (anterior=3.9, posterior=3.1) and females (anterior= 2.7, posterior=2.2). To control for age, these averages were compared using age as a covariate. Males had significantly higher rates of wear on both anterior ($p<0.001$) and posterior teeth ($p<0.001$).

Dental wear is typically viewed as the result of an abrasive diet and/or behavioral related wear. It is unlikely abrasiveness of diet is the direct cause these differences, as diet would have been similar for both sexes given a similar socioeconomic status. Diet at the poorhouse and hospital was generally non-abrasive, yet consisted of certain acidic staples (i.e. coffee) that may have contributed to severe wear. These sex differences could be explained by employment—men worked in heavy manual labor while women were domestics. It is possible that men were exposed to more grit than women in their work environment. Other factors, such as overall health and life history, could additionally contribute to these differences.

Trauma Recidivists at Neolithic Catalhöyük (Turkey): Social Context and Implications

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Recurrent injuries often result from structural weakness caused by a previous injury to the same anatomical area. This phenomenon is commonly encountered in athletes. Other recurrent injuries, especially those deriving from traumatic episodes separated in time by differential healing, are more suspicious; if found in infants, for example, abuse may be suspected. Repeated cranial injuries, especially above the hat-brim line, are most often linked to violent traumatic injuries from assault.

The present investigation examines cranial trauma recidivists in the Neolithic skeletal sample from Çatalhöyük, Turkey. Çatalhöyük is a site previously thought to lack evidence for violent confrontation. The presence of recurrent cranial injuries suggests that in fact this may not be the case. Of the adult skeletal remains examined, 12 of the 93 (13%) were cranial injury recidivists showing from two to as many as five injuries. Those with the highest number of recurrent injuries are female. Here, we consider the evidence in the context of community dynamics citing potential scenarios that might explain the presence of cranial injury recidivism at Çatalhöyük.

Exploring the ultrastructure of human hair: Preliminary results and prospects for correlation with genetic variation

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Human scalp hair varies considerably in form and color within and among human populations. Known patterns of variation in hair form are used in forensic contexts to help resolve questions of ancestry and identity. Scalp hair is a defining feature of humans, therefore it is important that the morphological diversity in scalp hair forms within and between populations be thoroughly described at the ultrastructural level. In this project, electron microscopy and light microscopy were used to investigate the nature and distribution of morphological features that contribute to varied human scalp hair forms. Using light microscopy, we measured significant differences in cross-sectional index and cuticle thickness in hairs from diverse human populations. Examination of hairs from persons of European, East Asian, and African ancestry using transmission electron microscopy (TEM) revealed ultrastructural variation in the cortical layer of scalp hair, specifically in the distribution of orthocortical and paracortical cells. Attempts to use three-dimension scanning electron microscopy (3D SEM) to reveal the internal structure of the cortex have been complicated by difficulties in embedding and staining fully keratinized hairs. Preliminary TEM results reveal that salient differences in patterns of orthocortical and paracortical cells can be distinguished, showing the utility of the technique in elucidating scalp hair ultrastructure. Because the hair samples in this study have also been typed for a genome-wide SNP panel, mapping and quantification of differential patterning of cortical cells and association of these patterns with genetic ancestry promises to reveal the genetic basis of diverse morphological traits of scalp hair.

This research has received funding support from a National Science Foundation grant (award 1453571).

Using coalescent simulation to understand the bias inherent in maximum likelihood estimation of ancestry proportions

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We investigate the bias associated with using maximum likelihood to estimate genetic ancestry proportions. We use coalescent simulation to simulate eight models of a single admixture event. Models one through four simulate admixture of an African American population. Models five through eight simulate admixture of a Latino population. The genetic characteristics of African, European, and Native American populations are recapitulated in these simulations. For each model, we vary sample sizes among the admixed population and proxies for their ancestral sources at (i) 100 individuals for each population; (ii) 100 admixed individuals and 20 individuals for each source; and (iii) 20 admixed individuals and 100 individuals for each source. We make ancestry estimates directly from the populations who contributed to the admixture event. We also estimate ancestry from proxy sources. Proxies are related to the actual contributors but are not attributable to the admixed population. We assess the bias of ancestry estimates, by comparing the observed estimates to their parameter values. Our results show low bias among all models that estimate ancestry from the direct ancestors in all sampling scenarios. We observe varying levels of bias under sampling scenario (i) when estimating ancestry from ancestral proxies. High levels of bias exist when we estimate ancestry from sampling scenario (ii). Sampling scenario (iii) presents an overestimation of minor ancestry contributions and an underestimation of major ancestry contributions across all models. These findings show how data sampling and maximum likelihood influences bias in ancestry estimation, which will develop sampling designs in admixture research.

Female reproductive success in an age-inversed hierarchy: the effects of age, parity, and rank

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In many primate societies, female reproductive success is affected by age and dominance rank. Birth rates and offspring survival are often negatively correlated with age; except that primipara may have low reproductive success. Studies of the effect of rank on reproductive success have primarily been confined to matrilineal societies, in which low ranking females may have lower success than high ranking females. The effects of age, parity, and rank are less well understood in hierarchies, in which age is inversely related to rank with young females at the top and old ones at the bottom. Except for howler monkeys, existing studies examined provisioned or captive populations. Here, we present results for wild, unprovisioned gray langurs (*Semnopithecus schistaceus*) exhibiting age-inversed dominance hierarchies. We studied two groups including 31 females over five years near Ramnagar, Nepal. We determined reproductive success via birth rates (57 births) and offspring survival to two years of age (successful births, N=39). We used bootstrap analysis, Fisher's test, and replicated goodness of fit tests for data analysis. Old females had lower reproductive success than expected (birth rate P=0.04; successful births P=0.03), as had low ranking females (P=0.04, and P<0.01, respectively). Young, multiparous females tended to have higher infant survival than primipara (P=0.09) despite primipara having experience from allomaternal care as immatures. Compared to a provisioned population, age effects were stronger and dominance effects were similar indicating that age effects on reproductive success may be masked in populations with high food abundance and negligible predation risk.

Data collection supported by German Research Foundation, Alexander von Humboldt-Foundation, German Academic Exchange Service, Society for Technical Cooperation, and Ernst-Stewner-Foundation.

Comparing hypothetical patterns of modularity in the modern human cranium

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Morphological integration as a theoretical framework for understanding evolutionary processes and explaining specific changes in complex structures has guided research over the last six decades. The modules that interact, or do not interact, with one another must be explicitly defined within the context of the research question. As such, definitions may vary greatly from one study to another. In this study, four commonly defined patterns of modularity in the modern human cranium were tested based on 1) functional demands, 2) developmental origin, 3) special sensation, and 4) the basicranium as a separate module. Three-dimensional coordinate data of 120 endocranial and ectocranial landmarks from 388 anatomically modern adult humans were subjected to generalized Procrustes analysis and then areas of shape variation were identified via principal components analysis of shape coordinates. Calculating the multi-set RV coefficients for hypothesized partitions and comparing them to random partitions of the landmark configuration revealed that the cranium is more integrated when considering functional demands of cranial components (RVM = 0.1831, p = 0.0000) or sensory fields (RVM = 0.1868, p = 0.0994) and is less modular when considering developmental fields (RVM = 0.3422, p = 0.0036) or the basicranium (RVM = 0.3458, p = 0.0001). Depending on how one defines cranial modules, results may be quite different and not comparable across studies. This study highlights differences among theoretical bases of morphological integration. The findings can be used in clinical applications for surgical treatment of craniofacial-related disorders and injuries as well as evaluating models of human evolution.

Multivariate regression analysis of human diaphyseal growth

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Analysis of diaphyseal growth in children is important for assessing the growth status of known age children and for estimating age in individuals of unknown age. In the first context bone lengths are the "response" variables and age is the primary "predictor" for bone lengths. This is a multivariate regression problem where bones are each regressed onto age and the residual variance-covariance matrix is calculated among bone lengths. We argue that multivariate regression of bone lengths onto age is also the appropriate technique in the age estimation context and that the problem can be "inverted" to one of age estimation using a Bayesian analysis.

To demonstrate the properties of multivariate regression in the age estimation context, we begin with a sample of Lodox Statscan images from 798 South African children aged between one month and 12.82 years old from Stull et al. We regressed diaphyseal lengths onto the square root of age for all individuals over the age of 6.75 years and then applied the regression information to all individuals up to the age of 6.75 years. This was done in two different ways. In the first method we used the mean and variance of age in individuals over age 6.75 as an informative prior. This is equivalent to doing a multiple regression of age onto diaphyseal lengths, and it grossly overestimates age. In the second method we used the profile likelihood, which is equivalent to using a uniform prior. The second method appropriately estimated ages without any apparent bias.

Evolution of human-specific gene coexpression networks in neocortex

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It has been hypothesized that one of the consequences of the highly evolved cognitive capacity of the human brain is the development of increased vulnerability to cognitive disorders. Recent technical breakthroughs in genomics have allowed us to begin to identify genetic and molecular signatures in the central nervous system that distinguish humans from non-human primates. We have identified novel human-specific patterns of gene expression and regulation in the neocortex. These data suggest that the human brain has undergone rapid modifications of gene expression patterns to support our enhanced cognitive abilities. In addition, we identified an enrichment of cognitive disease related genes that demonstrate unique gene expression changes in the human brain. We have carried out functional follow up of a number of these genes with human-specific coexpression patterns. We have focused on genes that regulate transcription and/or mRNA splicing. These follow up studies have manipulated these genes in primary human neurons and rodent models followed by further genome-wide expression analyses using RNA-sequencing. These new data have uncovered additional coexpression patterns and molecular pathways that might be involved in human disorders of cognition.

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Investigating heterogeneity in diet across early Iron Age assemblages from Slovenia using stable isotopes

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The paper will present preliminary dietary isotopic analyses of human and animal remains from Slovenia dating to the early Iron Age. This research forms part of a larger HERA-funded ENTRANS Project, examining Iron Age cultural encounters in south-east Europe and the east Alpine region. One stream of this research involves analysis of carbon and nitrogen isotopes to explore differences in diet and health status. Diet is seen to have played a significant role in many societies in the construction of identity attributes, such as status, age or gender. Preliminary results suggest a homogenous, terrestrial C4 plant based diet was adopted across the research area during the early Iron Age. Without evidence of marine protein, the high carbon values suggest a considerable input of C4 plants, most likely millet. The accompanying animal baseline data suggest some variation in

farming and animal husbandary strategies across the region.

This paper will introduce the sites under study, show preliminary isotopic data and discuss some of the issues that one might need to think about when choosing faunal specimens to construct a dietary baseline.

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Energetics and Muscle Use of Human Climbing

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Humans are terrestrial bipeds, but climbing remains an important component of foraging behavior in many hunter-gatherer populations. Previous studies in primates and other animals have shown that mass specific cost of transport for climbing is independent of body size across species, but little is known about the effects of difficulty and speed. Here, we assess the effects of speed, route difficulty, and anatomical variation on the energetic cost of climbing. Eighteen experienced, adult human climbers in two populations (U.S., n=12; Tanzania, n=6) climbed a set of laps over a range of levels of difficulty and speeds, with energy expenditure measured via respirometry. As with interspecific studies, we found no significant effect of body mass on the mass-specific cost of transport. In contrast, climbing speed is negatively correlated with mass-specific cost of transport ($p=0.03$, $R=0.33$). Further, results indicate that route difficulty has no significant effect on energy expenditure. We discuss the implications of these results for understanding ranging ecology of human foragers, living apes, and fossil hominins.

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Delayed reciprocity in sharing networks of Batek hunter-gatherers in Peninsular Malaysia

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Sharing and generalized reciprocity have long been thought to have played an important role in human evolution. As such, patterns of sharing interactions in hunter-gatherers have received a great deal of interest from anthropologists seeking to understand how and why sharing occurs in small-scale societies that engage in the widespread exchange of food resources, child care, and information. In this study we apply social network analysis to a historical economic dataset collected in the 1970's on Batek hunter-gatherers in Peninsular Malaysia. To understand both the endogenous and exogenous factors underlying the exchange of food resources, we analyzed the structure of Batek sharing networks through time using pooled temporal exponential family random graph models. Our analysis reveals a strong effect of delayed reciprocity, in addition to relatedness, marriage ties, and transitivity, on the structure of Batek food sharing networks. Further, we found that the cumulative degree distribution of sharing networks was "scale-free," suggesting that these networks are structurally similar to many other real world networks that demonstrate the small-world property. Our results suggest an important role for delayed reciprocity in structuring Batek sharing networks and demonstrate the utility of placing hunter-gatherer sharing networks in the context of real-world networks more generally.

Cooperative Breeding and the Costs and Benefits of Infant Allocare in Hunter-Gatherers and Agriculturalists

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Across traditional small-scale societies, nearly 50% of infants' direct care comes from someone other than their mother. Although allocare may benefit maternal fitness, it is unclear why helpers invest time and energy raising an infant who is not their own. Further, infant care is a costly form of cooperation since infants do not reciprocate. Two main hypotheses have been proposed to explain this puzzle. First, helpers may benefit directly by learning skills that enhance their future success in raising children of their own. Alternatively, helpers may increase their inclusive fitness by augmenting the reproductive fitness of close kin. While not mutually exclusive, we address these hypotheses using longitudinal time allocation and reproductive history data from two societies, a group of hunter-gatherers and a group of agriculturalists. With data spanning 20 years, we evaluate 1) the age and kin patterning of allocare; 2) the cost of allocare by assessing whether individuals who spend the most time helping, spend less time in activities that might otherwise benefit them; and 3) whether those who helped the most as girls, grew up to be more successful mothers. We find that the cost to provide infant allocare is relatively low in both societies, which is associated with the age profile and low opportunity cost of human allocare. Further, girls who did the most allocare as children, grew up to have earlier ages at first birth. Our results provide empirical support to further comparatively situate humans as cooperative breeders relative to other species and other primates.

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Three-dimensional finite element analysis of femoral neck stress

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The hominin femoral neck is diagnostic of bipedalism. The internal asymmetric distribution of cortical bone is observed in ancient and modern forms, although external geometry varies. Initial analyses evaluated the structure two-dimensionally, but the complex morphology suggests that three-dimensional (3D) analysis may yield additional insights. Moving toward our ultimate goal of understanding variation in femoral neck geometry, we produced a finite element model (FEM; >600K solid elements representing cortical and trabecular bone) from a CT image stack (isotropic voxels, 0.625mm) of a modern human femur. We loaded the model with typical stance loads and ran a linear static analysis in HyperWorks (Altair Corp.). Two questions motivate this initial report: 1) does the FEM reproduce 2D results? and 2) how sensitive are stresses to bone material properties?

We created three material property versions of the FEM, one with no trabecular bone (NOTRAB) and two with the trabecular portion modeled using either typical trabecular (TYP) or cortical (CORT) bone properties. The femoral neck experienced tension on the superior and compression on the inferior surface with tensile stresses ~50% lower than compression, mirroring results from earlier 2D analyses. Tensile loads were concentrated anteriorly, a result not revealed by previously. The CORT version experienced lower stresses than the TYP model, although the position of the neutral axis was similar. The NOTRAB model experienced higher stress and the neutral axis was superior compared to the TYP model. We conclude that 3D analysis using appropriate trabecular properties offers opportunities to better understand femoral neck morphology.

Dental microwear texture differences between permanent and deciduous enamel

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The reconstruction of diet and behavior using dental microwear texture analysis has been extremely useful for understanding past and present hominin adaptation strategies. However, research has focused exclusively on adult individuals. The goal of this study is twofold: to document sub-adult dental microwear textures and to be the first to compare textures between deciduous and permanent enamel within the same skeletal sample. This second goal is essential as deciduous enamel is less mineralized, thinner, and has a higher water content than its permanent counterpart.

High-resolution casts of deciduous (n=14) and permanent (n=23) maxillary central incisors from individuals in the South Tombs cemetery at Amarna, Egypt were created and scanned using a white-light confocal microscope and a 100x objective. Four adjacent scans of each tooth surface, nearest the incisal edge, were created, totaling a work envelope of 204x276 µm. Any defects, such as post-mortem damage or adherent dust, were removed and resultant scans were uploaded into Toothfrax and SFrax SSFA software packages for texture characterization.

Results show dental microwear textures preserved on deciduous enamel. Moreover, comparisons between deciduous and permanent enamel texture values were consistently different in some, but not all attributes. For example, anisotropy and scale of maximum complexity mean values were similar for both enamel types. On the other hand, complexity, textural fill volume, and both variants of heterogeneity mean values were approximately 1.5x higher in deciduous enamel. These data suggest that deciduous textures form differently and these signals should be kept separate from their permanent counterparts.

Thank you to Profs. Jerry Rose and Barry Kemp for granting permission to mold the Amarna specimens. This research was supported by the Loyola University Chicago's Research Support Grant.

Spatial taphonomic reconstruction of the Dinaledi Chamber, Rising Star Cave, by the use of high resolution three-dimensional modalities lends support to the deliberate disposal of hominin remains

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The Dinaledi Chamber of the Rising Star Cave (Cradle of Humankind, South Africa) has yielded approximately 1550 specimens of hominin remains to date, representing a minimum of 15 individuals. Macro-vertebrate fossils within the chamber, which is (and has always been) in the dark zone of the cave system, are exclusively Homo naledi. The excavation environment within the cave represented an exceptionally difficult and dangerous recovery challenge where conventional methods of high-resolution spatial data retrieval proved impossible. Through the innovative use of white-light photogrammetry and laser scanning at scales ranging from landscape level down to individual bone fragments, data collected with these methods push boundaries of both technology and image reconstruction as applied to the analysis of taphonomy, palaeoenvironment and skeletal morphology. Surface scans were created at approximately 5cm intervals, creating a layer based reconstruction of the excavation. By integrating these surface scans with laser scan data of the Dinaledi Chamber, the coordinates of all fossil material recovered was mapped and associated with regards to the spatial context. Spatial taphonomic analyses of bone distribution patterns are consistent with initial geological observations that all the individuals entered the chamber through the the same entrance that remains today. This finding lends support to the hypothesis that the Dinaledi Chamber represents the first incidence of deliberate and repeated body disposal in a single location, presumably by a hominin species other than Homo sapiens.

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Social preference based on direct and third party interactions in captive bonobos

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Foundational to human cooperation is the spontaneous preference that humans show, by three months of age, for agents that help others over those that hinder. Bonobos provide a powerful test of whether this preference is derived in humans, since relative to chimpanzees bonobos are highly gregarious, socially tolerant and even prosocial toward strangers. These traits may be driven by a preference, shared with humans, for individuals that are most prosocial to others. However, we found that bonobos actually prefer animated agents (Study 1) and human experimenters (Study 2 and 3) that hinder third parties over those that help. This phenomenon may be driven by bonobos' preference for dominant over subordinate individuals in third party dominance contests (Study 4). In contrast, when bonobos interacted with human experimenters who had been directly prosocial or antisocial toward them, they always preferred the prosocial experimenter, and even privileged his intentions over the outcomes of his actions in their preferences (Studies 5-8). Thus, it appears that bonobos are capable of discriminating prosocial and antisocial agents, even based exclusively on underlying intentions, and demonstrate a human-like prosocial preference in direct interactions. However, the motivation to favor helpers more generally—based on third party interactions—may be unique to humans and likely played a central role in the evolution of human development and cooperation.

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Cranial Trauma and Victimization among Ancestral Pueblo Farmers of the Northern San Juan Region

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Many remains of ancestral Pueblo peoples who inhabited the northern San Juan region of the U.S. Southwest exhibit cranial depression fractures characteristic of blunt force trauma. Some such fractures were inflicted perimortem, whereas others were antemortem injuries and thus were healed or in the process of healing at the time of death. Among remains that exhibit antemortem cranial depression fractures, a minority exhibit multiple antemortem fractures, which suggests that these individuals belonged to an at-risk subgroup, and that they were subjected to repeated and significant sublethal physical insult during their lifetimes. These blows no doubt immediately and directly impacted the health of the victims and could have resulted in permanent impairment. In addition, the long-term well-being of these individuals might have been indirectly compromised by chronic physical threat and the associated inflation of the allostatic load of stress reactions to the body. Such repetitive trauma appears more commonly among remains that date from the middle-to-late A.D. 1200s, which was a time of heightened economic stress and societal unrest in the northern San Juan region. This research focuses on several adults and one child who suffered multiple episodes of sublethal cranial assault, investigates the targeting of subgroups, and defines possible at–risk

subgroups to which each victim might have belonged. Injury recidivism is thus explored as a physical manifestation of societal upheaval when episodic altercations escalate into frequent violence and warfare, and individuals within targeted subgroups survive but suffer significant negative health consequences.

Tales from the teeth: Investigating the potential of dental microstructure for phylogeny reconstruction

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There is now strong support from DNA sequence analyses, previous molecular evidence, and evidence from soft tissue that support the hypothesis that the phylogenetic relationships among extant hominoids are ((((*Homo*, *Pan*) *Gorilla*) *Pongo*) *Hylobates*). The extant apes remain an important taxonomic context with which to examine the evolutionary relationships of the hominin lineages. But uncovering the evolutionary relationships among extinct fossil taxa depends on whether characters derived from hard tissues can be used to reconstruct phylogenetic relationships. We report the results of a project that investigated the potential of characters based on dental microstructure to recover the relationships supported by molecular and soft tissue evidence. Dental microstructure variables were measured in a sample (n>5 per taxon) of *Homo sapiens*, *Pan troglodytes*, *Gorilla gorilla*, and *Pongo*; *Hylobates* was used as the outgroup. Welch's t-tests were performed to determine and compare variation within and among species. The rate of character evolution was also measured to examine the prevalence of homoplasy. Preliminary results suggest that characters such as enamel daily secretion rate are highly conserved. Other potential characters, such as the angle formed when the Striae of Retzius intersects with the enamel-dentine junction (EDJ), a proxy for enamel extension rate, and the angle formed by the intersection of an enamel prism and the EDJ, a proxy for enamel prism path, vary among and within taxa in ways that suggest they may have utility for generating hypotheses about phylogenetic relationships among early hominin taxa.

An Initial Investigation of the Biological Affinity of the Arikara and Caddo Using Dental Metrics

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In spite of the extensive use of Arikara skeletal collections in bioarchaeological investigations, the origins of the population remain contested. Specifically, studies have attempted to assess the degree of biological affinity between the populations of the Coalescent phase in the northern plains and earlier populations in the southern plains portion of North America. This debate is also confounded by the linguistic affiliations, or more specifically how the Arikara and the Pawnee, both of the Caddoan linguistic family, may relate biologically with other Caddoan speakers. Though archaeological evidence is more conclusive about the relationships of these groups, there is no definitive explanation for how the Arikara relate to these populations genetically despite speaking languages derived from the same linguistic family. This study aims to contribute to the understanding of the population genetic history of the Arikara and their relation to other Caddoan speakers, through analysis of dental metrics as an indicator of biological affinity. Measurements of twenty-four individuals from the sites of Larson (Arikara) and Kaufman-Williams (Caddo) were collected and analyzed. Preliminary results suggest that there is some indication that the Arikara and Caddo do not share similar variance in dental metrics, which may be attributed to genetic drift or differential gene flow.

The Ontogeny of Prehensile-tail use in *Ateles geoffroyi*

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The function of the prehensile tail in black-handed spider monkeys (*Ateles geoffroyi*) has previously been analyzed in terms of the locomotive and positional repertoire of spider monkeys. The role of the prehensile tail in other behaviors is not fully understood however, and its function throughout the lifespan has not been analyzed. The purpose of this study is to analyze the behavioural contexts in which black-handed spider monkeys in the Osa Peninsula use their tails, and to determine how tail use differs among juvenile and adult spider monkeys. It was hypothesized that adult spider monkeys would use their tails to bear mass during feeding more than juveniles, and that juveniles would use their tails to bear mass in social contexts more than adults. Data were collected through instantaneous focal sampling, and examined behavioural categories were feeding and foraging, resting, travelling, and social behaviours. Results indicate a high proportion of intervals during which the prehensile tail is used to bear mass during feeding and social behaviours among juveniles and adults, and that the tail as a mass bearing limb is not used more than other tail positions during travel and rest. The frequency of use of the prehensile tail for mass distribution is relatively close between juveniles and adults in all categories except social behaviours, where juveniles display a slightly higher frequency. These data indicate that the tail is important throughout the lifespan for feeding and foraging, and also provide new details on the social role of the tail across the lifespan.

Research was done in Piro Research Station, Costa Rica, through DANTA: Association for the Conservation of the Tropics.

Ectopic eruption in a zoo chimpanzee and its implications for testing the jaw spatial constraints hypothesis

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Insufficient room in the developing jaws is one of the mechanisms hypothesized to affect tooth eruption. We tested whether ectopic eruption of the second molars in the maxillary sinuses in Field Museum of Natural History (FMNH) specimen 51319, a Brookfield Zoo chimpanzee (*Pan troglodytes*), was caused by spatial constraints on craniofacial size and shape.

We collected 14 cranial and 70 dental measurements on FMNH 51319 and 22 normal adult male chimpanzee specimens using Mitutoyo calipers, and collected additional dental data from the literature. We used t-scores to identify significant differences between FMNH 51319 and comparative samples.

Specimen 51319 falls outside chimpanzee subspecies distributions for maxillary incisor dimensions, buccolingual (BL) breadths of the maxillary molars, and BL breadths of the mandibular postcanine toothrow, but not palate length or mesiodistal (MD) molar dimensions. Palate breadth is short but not outside the range of normal variation.

Soft zoo diets like those administered at the Brookfield Zoo in the 1930's are insufficient for generating high bite forces necessary for proper dentognathic growth. The *pattern* of tooth and face size reduction in this specimen is similar to results from experimental studies in which BL, but not MD, dimensions are affected in animals fed soft foods, but does not support the jaw spatial constraints hypothesis, which emphasizes the relationship between palate length and MD tooth dimensions. If ectopic eruption of the second molars in the maxillary sinuses in FMNH 51319 is related to spatial constraints imposed by the growing jaws, then the mechanism is unclear.

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Functional morphology of the fourth metatarsal in monkeys, apes, and *Australopithecus afarensis*

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Australopithecus afarensis has been interpreted as having a relatively inflexible, arched foot based on footprints and fossils, especially a complete fourth metatarsal (A.L.333-160). Orientation and shape of articular surfaces and longitudinal torsion in this fossil were linked to a stiff, arched foot. These observations were based on two-dimensional metrics of African apes and humans that did not completely capture certain functional aspects of metatarsal form. Additionally, recent analyses of metatarsal torsion and doming of the distal articular surface, have suggested a more complex pattern across anthropoids. To test whether these features reflect human-like foot morphology, we compared A.L. 333-160 with a comparative sample of *Colobus guereza* (n=8), *Colobus polykomos* (n=7), *Macaca fascicularis* (n=9), *Macaca nemestrina* (n=9), *Nasalis larvatus* (n=16), *Papio ursinus* (n=11), *Trachypithecus cristata* (n=11), *Pan troglodytes* (n=26), *Gorilla gorilla* (n=17), and *Homo sapiens* (n=31) using three-dimensional measurements of *in silico* polygonal models of fourth metatarsals. Human and *A. afarensis* metatarsal torsion differed from all taxa except both *Colobus* species and *Papio*. Humans and A.L.333-160 have flatter proximal articular surfaces than all other taxa studied, reflecting a relatively stiff foot likely related to a human-like windlass mechanism. Articular surface orientation and distal doming in A.L.333-160 also resemble that of humans. Discriminant function analysis of all characters considered together clearly separates humans from monkeys and apes and groups *A. afarensis* only with humans. The combination of these functionally relevant morphologies differentiates hominins from monkeys and apes, and supports the hypothesis that *A. afarensis* possessed a relatively stiff, arched lateral midfoot.

On the cusp of a great discovery: Dental morphology in medieval England

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Dental nonmetric traits have long been used to estimate biological distances among African, Asian, Native American, and some continental European populations. However, despite centuries of anthropological research there is a singular lack of biodistance study among English populations. This study begins to address this shortcoming by estimating the phenetic, and by proxy genetic, distance between two medieval samples, one from rural Poulton (n=61) and the other from urban Gloucester (n=64) – both in western England. Trait expression was also contrasted with the Eurodont dental pattern to explore which "characteristic" European traits they exhibit.

Samples were scored for 36 traits from the Arizona State University Dental Anthropology System. They were recorded according to standard procedure, with the aid of 23 standard rank-scale reference plaques. The data were then quantified by calculating trait frequencies and phenetic affinity using the mean measure of divergence (MMD) distance statistic. Despite some temporal and spatial divergence there is no significant difference between samples (MMD value of 0.030, $p \leq 0.025$). This result indicates, at least in this region of England, some measure of population homogeneity through space and time. In addition, European dentitions are generally characterized by morphological reduction and simplicity; both Poulton and Gloucester, not unexpectedly, emulate this pattern. This research problem is currently being expanded to include additional samples from other regions of England to establish if there are notable regional differences, and to ultimately help identify the biocultural origins of these under-studied medieval peoples.

Dental maturity ages in *Pan*: can estimation error be improved?

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Methods to accurately estimate age from developing dental structures are integral to many research questions about the skeletal biology of humans and other living and extinct primates. However, because dental maturity timing is naturally variable and involves a large number of arbitrarily-defined stages, the small known-age samples available for important comparative species such as *Pan* have been problematic. Our previous research assessed different linear and non-linear regression models using individual tooth scores and summary dental maturity scores (DMS), and we have applied multivariate techniques (PCA) to better understand the pattern of individual tooth scores in relation to known age and DMS. Here we attempt to improve the error of estimation using a multiple regression approach informed by PCA analysis, and compare age estimates based on different (8- vs. 12-stage) scoring systems for dental maturity. Using a model incorporating developmental scores (1-8) for permanent teeth, the first two principal components explain over 96% of the observed variance; PC1 represents the variation in timing of crown completion among permanent teeth, and PC2 that of root completion. A multiple regression model incorporating the teeth obtaining the highest loading score on PC axes 1-3 (M1, C, M3 respectively) results in a slightly higher R^2 value, and slightly lower mean prediction error than a linear regression model of age on DMS using all tooth types. However, the error remains in the range (+/-) 1-2 years, suggesting that further improvement in age estimation from dental development in *Pan* is limited without improved known-age samples.

Ancient introgression in Africa and the evolutionary genetics of hybrid fitness effects

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High quality whole genome sequencing has led to the discovery of Neanderthal DNA in non-African genomes and evidence of Denisovan ancestry in human genomes from Papua New Guinea. Trace amounts of Neanderthal ancestry are also found in East Africa, and ADMIXTURE plots reveal that this is due to back migration from non-African populations. Furthermore, the genomes of African hunter-gatherers contain divergent haplotypes that are most likely due to interbreeding with other unknown archaic hominin populations. Ancient introgression appears to be relevant to all global populations, and an important question is how difficult it is for introgressed alleles to persist in human genomes. Here, I extend population genetics theory to include hybrid fitness effects. Additive and epistatic models are considered, and hybrids are allowed to have either increased or decreased fitness. I find that hybrid fitness effects persist over multiple generations, and these effects are dampened over time due to repeated backcrossing. This changes the probability of fixation, and introgressed alleles effectively enter populations with either a head start or a handicap, depending on whether hybrids have increased or decreased fitness. Because of this, classic equations from theoretical population genetics can easily be modified to include hybrid fitness effects – a finding that is verified by extensive computer simulations.

Revisiting the Caries Hypothesis as a mechanism of tooth size selection

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The Caries Hypothesis of Greene, which was incorporated as part of the Selective Compromise Effect of Calcagno, accounted for decreased posterior human dental size as diets became more cariogenic. Both models hypothesized that as diets shifted to produce an

increased susceptibility to caries, individuals with smaller teeth and/or less complex dental morphology would be at an advantage. Here we explore whether the predictions of the Caries Hypothesis hold for those practicing various modes of subsistence in the Epi-paleolithic and Holocene, when caries becomes more prevalent in some populations. Specifically, we ask if carious teeth are associated with smaller posterior dental dimensions. Data were collected by Lacy from Epi-paleolithic (Natufian) and three North American samples: Ipiutak Native Arctic peoples subsisting on caribou and marine resources (Point Hope); Archaic Period 'pre-agricultural' native Americans practicing intensive food processing (Indian Knoll); and 19th century mixed ancestry St. Louisans consuming a post-Industrial diet (Second Catholic cemetery). Caries were more common in those with larger teeth among Natufians and Indian Knoll, and as expected, not closely associated as a selection factor in Point Hope where caries were exceedingly rare. Although nearly ubiquitous in the Second Catholic cemetery, caries were associated smaller teeth, though not at a statistically significant level. We suggest that, in accordance with the Caries Hypothesis, smaller teeth appear to be advantageous in more cariogenic diets, while noting in post-Industrial diets the continued selection for smaller teeth may be compromised by the need to maintain tooth size for other selective benefits.

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Secondary bone distribution in the humerus and femur of four West African cercopithecid monkeys

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The mechanical loading environment of limb bones can be assumed to vary in primates with different locomotor repertoires. Preliminary investigation suggests that behavior-specific loading regimes are reflected in the amount of secondary bone in the humerus and femur of four cercopithecid species from Taï Forest, Côte'd'Ivoire for which locomotor behavior is documented. In an expanded sample of *Colobus polykomos*, *Piliocolobus badius*, *Cercopithecus diana*, and *Cercocebus atys* femoral and humeral midshaft sections, we measured osteon density (OD, total osteons/mm^2), osteon fragment density (OFD, total fragments/mm^2) and osteonal area (OA, osteonal bone area/mm^2). These measures were compared by taxon and by region (anterior, posterior, medial, lateral quadrants). Results show no significant differences in any of the measured variables among taxa in either limb bone. However, regions vary significantly (P=0.003) for OD in the femur, with greater OD observed in the posterior femur, and for OD (P=0.006) and OA (P=0.035) in the humerus, with both measures greater in the lateral region. This suggests that greater remodeling activity is incited by tension arising from locomotor forces (although loads caused by bending of either bone in anthropoid primates are largely unknown) or muscular activity at the linea aspera, deltoid tuberosity, and/or brachialis origin. These findings suggest that gross locomotor differences between taxa are not reflected in remodeling activity in the limb bones.

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Isotopic insights into indigenous diets in early colonial Cuba

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It is widely recognized that cultural contact and colonialism had widespread and lasting impacts on indigenous lifeways including dietary and subsistence practices. Although dietary changes related to colonial encounters have been studied based on a wide range of archaeological and historical data, isotopic approaches have been underutilized to date. Here we present results of the first large-scale study of indigenous dietary patterns in the early colonial Caribbean based on carbon ($\delta^{13}C_{co}$) and nitrogen ($\delta^{15}N$) isotope analysis of bone collagen from the burial population of El Chorro de Maíta, Cuba (~AD 1400-1600). Overall the population possesses relatively depleted $\delta^{13}C_{co}$ (mean= -17.6‰; range -22.8 to -9.8‰) and enriched $\delta^{15}N$ (mean= 13.2‰; range 8.5 to 14.9‰) values with large variance. The combined isotope data are distinct from other pre-colonial populations from Cuba or the broader Caribbean, and are more comparable to certain colonial-period enslaved African populations. Comparisons with regional foodweb data indicate that dietary protein was likely dominated by terrestrial (C_3) animal protein sources. Pig (pork) consumption is the most likely candidate as their skeletal remains are abundant across the site and have even been recovered from a number of indigenous burials. Reported pig bone isotope values from El Chorro ($\delta^{13}C_{co}$= -19.1‰ and $\delta^{15}N$= 9.6‰) correspond well with dietary estimates based on expected diet-tissue fractionation. Previous strontium isotope ($^{87}Sr/^{86}Sr$) analysis of Chorro porcine teeth revealed the presence of nonlocal pigs indicating that the site and surrounding colonial settlements may have been provisioned with pigs in the context of the encomienda system.

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Gape cycle kinematic variance and occlusal topography in modern humans

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Processing foods of varying material properties requires feedback between sensory and motor controls of the masticatory system. As such, kinematic variance of gape cycles within a chewing sequence has been suggested to relate to food material properties and masticatory morphology to increase processing efficiency. Here we test relationships between kinematic variance and the topography of the occlusal surface in human subjects. Humans with larger occlusal surface area and two-dimensional area are hypothesized to have greater temporal and spatial lengths of the slow-closing gape phase, when the food is in contact with the dentition. Additionally, as there is significant variation in gape kinematics across a chewing sequence, we hypothesize that the slow-closing phase will be longer at the beginning of a sequence.

Twenty-six human subjects completed chewing trials for six foods. Reflectors were placed on each subject's face, and coordinates from these reflectors were recorded using a Vicon motion capture system. Temporal and spatial variables of each gape cycle were calculated across the chewing sequences. Occlusal topography of each subject was measured from dental casts in ArcGIS. We found that tougher foods have longer slow-closing phases and shorter fast-opening phases during vertical and lateral displacement, which increases contact time between the teeth and the food. However, chew number and food type explain higher amounts of kinematic variation than do measures of occlusal topography. We compare these results to previous chewing kinematics research in non-human primates, and we discuss the implications of gape cycle adaptation on human chewing efficiency.

***Propithecus* playing around: Does female leadership influence play?**

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The current hypothesis of Pereira and Altmann states that play functions to practice fighting skills if lifetime reproductive success of an adult male is relatively dependent on individual fighting ability. Primate play patterns

have been observed in male dominant species (e.g. baboons, vervets, macaques, gorillas). Juvenile males spend more time engaged in rough and tumble play than females in these species. We predicted that this play pattern might be reversed in a female dominant primate. In *Propithecus edwardsi*, Milne-Edwards' sifaka, females are dominant over males and yet males are known to fight other males for reproductive access. We analyzed long term behavioral data from 1988-2009 of the wild *P. edwardsi* in the rainforest of Ranomafana National Park in southeastern Madagascar, examining sex and age differences in play and percentage of individuals that engage in play. Our results, comparing 22 females and 24 males demonstrate that that there is no significant difference between sexes in play (n=46, p-value=1.00). Contrary to our predictions, both males and females including adults, subadults, juveniles and infants participate actively in rough and tumble play. This result may be explained by the fact that both males and females fight to enter or take over new groups and both sexes need to practice and hone their fighting skills.

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Plastic digestive response to variation in dietary nutrient density and energetic status

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Arguments for Cercopithecinae evolutionary and ecological success often center on adaptations selected for during periods of climate change, when shortages of energy exacerbated feeding competition. Although phenotypic adjustment is an à priori expectation under these circumstances, few specifics regarding physiological plasticity in response to variation in food availability/quality are known. We evaluate plasticity in digestion and measure how mean retention times (MRT) vary as a function of diets differing in nutrient density (ND) and digestible energy. Baseline caloric requirements of *Macaca mulatta* (9 male; 9 female) was determined for 3 months and animals habituated to 1 of 3 dietary treatments: D1 = High ND (3.8kcal/g Dry Matter [DM]) fed at 70% caloric requirement; D2 = High ND fed at 100% caloric requirement; D3 = Low ND (2.8kcal/g DM) fed at 100% caloric requirements. Animals were administered 40 inert markers over two feeding trials and all fecal samples screened for markers (6 days). A Mixed Effects model (R v 2.9) indicated no significant effect of caloric restriction on MRT (X^2=0.0001; P>0.9) when fed high ND diets (D1 MRT 64.2h SD=19; D2 MRT 69.2h SD=13.11). However, low ND (D3 vs D1+D2) reduced MRT dramatically (MRT 26.6h; X^2=19.711, P>0.001). Results suggest that cercopithecines adjust MRT in response to ND rather than caloric intake: as food quality declined, MRT shortened, presumably to maximize food intake rate. This suggests greater selective pressure for digestive plasticity in response to nutritional balance rather than energetic status.

Traumatic Injury Risk with Agriculture: Data from the Southeast and Beyond

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Human skeletal remains from late prehistoric sites in North Carolina and Virginia provide a basis for assessing traumatic injury risks associated with agriculture. Fracture data on seven postcranial skeletal elements are used to evaluate the relative frequency of traumatic injuries in three farming regions of the study area: the western mountains, the southern piedmont (Mississippian communities), and the northern piedmont (Late Woodland communities). Significant differences in fracture frequency are apparent between regions, though not as might be predicted based on differences in topography or site size. People living in relatively small settlements on the northern piedmont, outside the Mississippian cultural sphere, have more injuries than those in Mississippian communities to the south or west, raising important questions about variations in the nature of farming practices and social dynamics across the regions.

Collectively, however, the Southeast sample resembles other floodplain agriculturalist samples worldwide in exhibiting relatively low rates of postcranial fracture in comparison with a globally dispersed sampling of hunter-gatherers. These findings appear to contradict the widely recognized trend of declining health associated with the adoption of agriculture--at least with regard to this health parameter. The inclusion of a global sampling of intensive agriculturalists (showing higher rates of traumatic injury) serves to clarify that it is not agriculture *per se* that predicts increased fracture risk, but rather the mode and intensity of agricultural production, findings that have important ramifications for our understanding of causal relationships associated with the agricultural transition.

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Scapular morphology and its implications for the study of locomotor behaviors in primates and carnivorans

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The study of scapular morphology serves to accurately identify positional behavioral adaptations among extant primate taxa and has been used to address locomotion and posture in the hominoid fossil record. Among anthropoid primates, two clades evolved antipronograde adaptations from ancestral pronogrady: suspensory atelids and orthograde hominoids. Much debate has centered around the evolution of orthogrady and positional behaviors associated with it. Here, we use a convergence study between carnivorans (Order Carnivora) and primates to identify correlates of scapular morphology and shoulder mobility and use in various locomotor behaviors. We quantify and analyze five traditional scapular angles in 21 carnivoran and 24 primate species: glenoid-spinal, spinal-axillary, glenoid-axillary, axillary-vertebral and bar-glenoid angles. Photographs of scapulae in standard orientation were analyzed utilizing the image processing software *ImageJ*. Carnivoran and primate species with a pronograde posture and quadrupedal mode of locomotion are generally characterized by low glenoid-spinal angles, intermediate spinal-axillary angles and high bar-glenoid and axillary-vertebral angles (e.g., *Canis familiaris, Papio hamadryas*). Among cercopithecids, *Macaca fascicularis* exhibits glenoid-spinal angles similar to suspensory atelids, indicating a greater exploitation of the arboreal environment. Highly cursorial carnivores (e.g., *Acinonyx jubatus*) exhibit the lowest glenoid-spinal angles consistent with extremely stable shoulder joints necessary for reaching high running speeds, whereas scapular angles of ursids (bears) differ from the pattern of pronograde quadrupedal species. All seven ursid species included here display glenoid-spinal angles that fall within the ranges of hominoid taxa. Among ursids, high glenoid-spinal angles may indicate a higher degree of forelimb-dominated behaviors. Implications for hominoid evolution are discussed.

Chimpanzees and the phylogenetic origins of multi-level sociality in humans

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Human have multi-level social and mating systems, where smaller social units (e.g., bands) are nested within larger ones (e.g., the ethnolinguistic tribe), and most marriages occur between member of different bands within the same tribe. The evolution of human multi-level sociality is puzzling from a phylogenetic perspective, as closely related species should

have similar social and mating systems, with certain systems only evolving if the necessary building blocks were already present in ancestral species.

I use long-term data from the Ngogo community of chimpanzees in Kibale National Park, Uganda, to show that some of the building blocks for the evolution of multi-level sociality in humans may indeed be present in the social and mating systems of our closest living relatives. Previous research at Ngogo has shown that males and females do not utilize the entire community's territory evenly, but instead show long-term tendencies to selectively range in certain areas of the territory (i.e., neighborhoods), where they frequently associate and reproduce with preferred partners. Here I show that unlike at most other chimpanzee communities, many females remain at Ngogo to reproduce instead of dispersing to a new community. In addition, many of these females disperse from their natal neighborhood (which contains many close male relatives) to reproduce in another neighborhood (which contains few male relatives) within the Ngogo community. This phenomenon of "within-community dispersal", previously undescribed in chimpanzees, allows females to effectively reduce the potential costs of inbreeding while retaining the benefits of continued membership in their natal community.

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To Lump or to Split: Age Estimation in Forensic Anthropology

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In the early 1900's anatomist T. Wingate Todd described age-related changes in the pubic symphysis. The attributes recognized by Todd form the basis of skeletal age-at-death estimation methods used today. However, these early methods lacked a statistical foundation. Bones were seriated by age, and a descriptive phase was attributed to an age cohort of individuals with a shared suite of traits.

Many recent methods use the traits defined by Todd, but the descriptive statistical approaches have produced age categories too broad to be forensically useful. While the morphological changes in the pubic symphysis do follow a patterned progression, they do not always occur simultaneously. Furthermore, phase scoring systems are not robust to transitional morphologies. One ramification is that different practitioners may weight features differently, leading to lower observer agreement. These problem can be lessened by separating features of phases into individual components. A complicating factor to this approach lies in determining appropriate statistical treatments for multiple levels of categorical data.

This study compares a new component scoring system based on the developmental changes of the pubic symphysis to the phase-based systems commonly implemented in forensic case reports. Results of the comparison highlight the ability of a component system to allow for traits to progress independently, whereas phases require variation in developmental or degenerative features to be lumped into a single, sometimes arbitrary category. Decision trees facilitate a user-friendly and accurate method (94%), and dividing the phases into components also increases interobserver agreement relative to phase-based methods.

The foundational principles of human biological variation in forensic DNA comparisons

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The forensic sciences are often considered an applied, rather than theoretical discipline. However, this paper will demonstrate that the ability to conduct such investigations rests on a foundation of understanding normal human biological variation and therefore, evolutionary and cultural theory. Forensic DNA analyses are often viewed by the jury as infallible evidence in a criminal investigation. Yet interpreting DNA typing results is complex and can be problematic if lacking a strong grounding in the theoretical aspects of human variation. Based on the genetic analysis of a small subset of the population at large, a statistical weight is given to the probability that a reference DNA sample is consistent with a DNA sample associated with a criminal investigation. Understanding the statistics employed requires knowledge of heredity, evolution and how biological variation is patterned across geographic space. Such patterns are the result of the intersection of biological evolution and human culture. The contributions of evolutionary theory and cultural theory, specifically how relations of power, cultural ideologies, social structures and political dynamics characterize the contemporary world and impact the patterns of human biological variation will be explored. In addition to focusing on the scientific and cultural theories that contribute to forensic DNA investigations, this paper will demonstrate how the data utilized in these forensic cases can be better interpreted within these theoretical frameworks.

Longitudinal body mass variation in wild primate populations: are individuals or populations more variable?

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Since body mass covaries with many ecological aspects of a species, its estimation is a frequent objective for paleontologists. Body mass is frequently predicted using linear regressions of observed predictor variables and body masses of extant species. Individuals with associated body masses are strongly preferred for reference samples. However, body mass can fluctuate dramatically over an individual's adult lifetime. If individuals are relatively more variable than populations, associated body masses may decrease the reliability of body mass prediction equations.

To compare individual longitudinal body mass variation to cross-sectional variation within a population, we calculated coefficients of variation (CV=standard deviation/mean*100) for 18 adult *Alouatta palliata* from La Pacifica, Costa Rica and 29 adult *Pan troglodytes schweinfurthii* from Gombe National Park, Tanzania. All individuals had at least eight recorded body masses. Separate male and female cross-sectional CVs were calculated by randomly sampling an individual's body mass during a calendar year.

Longitudinal CVs for *Alouatta* individuals ranged from 5.0 to 12.0 (mean=8.5, sd=2.1). Longitudinal CVs for *Pan* individuals ranged from 4.2 to 17.1 (mean=7.5, sd=2.7). No significant differences were found between species, but females were significantly more variable than males (whether or not measurements taken during pregnancy were included). Longitudinal CVs were negatively correlated with the number of observations, but were not correlated with the temporal range. Cross-sectional CVs ranged from 7.9 to 19.1 (mean=13.0, sd=3.4), and were significantly greater than individual CVs. These results indicate that using associated masses for reference samples should improve the reliability of body mass prediction equations.

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Clavicle length and shoulder breadth in hominoid evolution

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For a given body mass, hominoids have longer clavicles than typical monkeys, reflecting the laterad reorientation of the hominoid glenoid. Relative length of the clavicle varies among hominoids, with orangutans having longer clavicles than expected for body mass and gorillas and chimpanzees having shorter clavicles than expected. Modern humans conform to the general hominoid distribution,

but Neandertals have longer clavicles than expected for their size.

Relative to clavicle length, adult and newborn humans have broader shoulders (biacromial breadths) than comparable apes, because the reduced elevation of the human shoulder swings the acromion laterally downward away from the head. Since broadened shoulders yield an increased risk of maternal and neonatal injury and/or death from shoulder dystocia during birth (Trevathan, Rosenberg), we might expect hominins to manifest (a) correlations between clavicle length and the breadth of the pelvic inlet, and (b) trends toward reduction in shoulder breadth and clavicle length. The first expectation holds, possibly due to general morphogenetic factors affecting trunk length-breadth ratios. The second does not, presumably because of countering selection pressures favoring a long clavicle. Previous authors have posited pressures of this sort related to novel behaviors in the genus *Homo* (throwing and/or endurance running). However, the available data for *Australopithecus* suggest that whatever pressures are involved antedate the appearance of *Homo.* Patterns of sexual dimorphism in clavicle length and growth in modern humans point to sexual selection for broader male shoulders.

Biological relationships of the Early and Middle Neolithic of the Taiwan Strait using skulls and teeth

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The early and middle Neolithic cultures on both sides of the Taiwan Strait share cultural similarities including ocean-centered lifeways and trade networks, foraging patterns, deep sea and lacustrine fishing, ceramic and tool manufacturing techniques, and low intensity plant cultivation. The biological relationships between these cultures and the earliest known likely precursor, the Hemudu culture, from the south shores of Hangzhou Bay, have not been previously examined due to a lack of skeletal material. This study uses roughly contemporaneous crania (c. 5,000-4,000 BP) from the Tanshishan Culture of the Min River Delta, Fujian and the Tapenkeng Culture of western Taiwan, earlier crania from the Hemudu culture of the Hangzhou Bay area (c. 7,000-6,000 BP), and crania from the Pearl River Delta area dating from 6,500-3,500 BP to examine spatial and temporal relationships. Model-bound and model-free analyses of distance are used to approximate genetic distances. This study suggests a close regional relationship of the Taiwan Strait prehistoric samples, and more distant relationships between these samples and the later Shihsanhang and modern Indigenous Taiwanese samples. The southeast coast of China and Taiwan are distant from earlier and contemporaneous groups from the central river valleys of China. The Taiwan Strait area is at the root of a phenotypic split found between East and Island Southeast Asia. Modern Indigenous Taiwanese are characterized by isolation. These findings suggest gene flow in the Taiwan Strait and Island Southeast Asia is complex corroborating direct genetic studies.

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Lemurs are not Special, but Aye-Ayes are: Primate Basal Metabolic Rates in Phylogenetic Context

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Lower basal metabolic rates (BMR) in lemurs or strepsirrhines, compared to other primates, are thought to constrain life history traits. These differences are used to support hypotheses of life history traits as adaptations to highly seasonal temperatures and/or resources (the Energy Conservation Hypothesis, ECH). Despite past tests of the effect of the ECH on life history traits, its basis in differences in BMR has never been studied in phylogenetic context.

Here, I use phylogenetic regressions and ANCOVAs, with body mass as a covariate, to examine differences in BMR among 38 primate species. To test for the proposed adaptive nature of BMR (the ECH), I fitted Ornstein-Uhlenbeck models, grouping primates by inter-annual variation and seasonality of precipitation and temperature as proxies for environmental constraints.

There are no differences between BMRs of Strepsirrhines and Haplorhines, lemurs and Haplorhines, or lemurs and non-lemur Strepsirrhines ($p>0.05$). The aye-aye (*Daubentonia madagascariensis*) has a BMR higher than the 95% confidence intervals of the Strepsirrhine regression. Models of the adaptive landscape identify a shift in the rate of evolution along the *D. madagascariensis* branch and imply an adaptive optimum different from that of other primates. Environmental constraint models fail to explain variation in the BMR:BM relationship across primates.

Differences in BMR between lemurs or Strepsirrhines and other primates that have formed the bases for numerous life history hypotheses are non-existent, and the ECH does not explain variation across primates. Lemurs do not have low BMRs, but the highly encephalized *D. madagascariensis* is unique by Strepsirrhine standards.

Does a mobile foot become more rigid when walking?

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Ardipithecus ramidus has been proposed to possess a mobile foot that could become more rigid through muscular action when walking, while the human foot is generally considered to be rigid due to the action of the medial longitudinal arch. Some people, however, have more mobile tarsal joints than do others, resulting in a lower arch. Consequently, people with more mobile feet offer the opportunity to test if muscular action produces a more rigid foot during walking. We hypothesize that individuals with a more mobile foot will experience an increase in foot rigidity during walking compared to standing

Arch Index (AI) can be used to assess foot rigidity as AI indicates the proportion of the midfoot in contact with the substrate (AI=midfoot area/total foot area). A Footscan USB plate (RSScan International) was used to obtain the unshod standing and walking footprints of 115 women and 45 men and ImageJ was used to calculate the AI. The feet with the highest quartile AI were categorized as low-arch (or mobile) compared to the others. 36 of 38 (94%) people with a mobile foot had a lower AI (indicating a more rigid foot) when walking than standing (average change = 0.05 (SD: +/-0.03)). This suggests that the modern humans with mobile feet can accommodate their foot rigidity when walking. Whether this accommodation is due to an increase in the midfoot or total foot area remains to be determined.

Phenotypic constraints on life cycle evolution in wild Verreaux's sifaka (*Propithecus verreauxi*)

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Operationally, morphological integration is measured by strong patterns of phenotypic correlation among a set of measured traits. In a multivariate context these phenotypic correlations, when multiplied by a selection gradient, can produce a selection response that is different from the optimal selection response. Thus several metrics of constraint involve the discrepancy between optimal and actual selection response. Morphological integration is widely applied to osteological elements yet rarely applied to life history traits. We develop a technique for studying integration and constraints in life history traits. Specifically, we develop individual life cycle graphs for wild Verreaux's sifaka (*Propithecus verreauxi*) residing at Beza Mahafaly Special Reserve, southwest Madagascar. These life cycle graphs capture important life history traits. The key to this method is that the values from individual life cycle graphs can be summarized just like any other statistical distribution in order to estimate the variances/covariances of life history traits. The variance/covariance matrix can then be

multiplied using a selection gradient developed from a corresponding population-level life cycle in order to measure constraints on life cycle evolution. Results show that the actual selection response is deflected by an angle of 38 degrees from the optimal response. Further, using matrix subspace projection and the first four eigenvectors (accounting for 99% of total variation in the variance/covariance matrix), the angle between optimal and actual response is 35 degrees. The major constraint on life cycle evolution in this species is variation in offspring production, which produces negative covariation between reproductive and non-reproductive life cycle stages.

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Femoroacetabular impingement: relationship to non-metric pathologies of the proximal femur

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Femoroacetabular impingement (FAI) is a clinical pathology of the hip resulting from repeated abutment of an abnormally shaped femoral head-neck junction with the acetabular rim. One form of FAI, the cam-type deformity, is thought to result from mechanical stress on the femoral head-neck junction during epiphyseal fusion and from intense, repeated loading of the anterior aspect of the hip, such as that which is common in high level cutting and pivoting sports. Recent analysis has shown that FAI is not solely a modern phenomenon, and may be related to various activities in ancient populations, though this relationship has not been extensively documented. Here, we examine whether the presence of cam-type FAI corresponds with other osseous traits such as Poirier's facet and plaque on the proximal femur, which have previously been linked to activity patterns in the archaeological record. In this study, we assessed the remains of 128 adults from the Early Christian period site of Kulubnarti, Nubia qualitatively for the presence of Poirier's facet and plaque, and quantitatively for the presence of cam-type FAI by photographically measuring the alpha angle of the femur. We present new data that supports a possible relationship between cam-type FAI and other previously described pathologies including Poirier's facet and plaque on the proximal femur. These data suggest a correspondence between Poirier's facet and cam-type FAI and provide a quantitative alternative to the primarily qualitative analysis of Poirier's facet and plaque. This may have broader implications for the use of femoral pathology in activity reconstruction.

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When Do Fathers Matter? Father Absence and Child Health in Northern Tanzania

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This study examines child health as a function of father absence in an ethnically diverse region of Northern Tanzania. In contrast to a near universal importance of mothers in successfully rearing children, existing research reports mixed findings on the impact of fathers in 'traditional' and 'developing' populations. This has lead to the conclusion that human paternal care is facultative and dependent on ecological conditions. However, existing research focuses primarily on child survival as opposed to more sensitive and less extreme measures of child wellbeing. Furthermore, variation in the importance of fathers has rarely been addressed explicitly within the same study, leading to a poor understanding of under specifically what kind of conditions fathers are likely to be important. Addressing these issues, we utilize data from ~3500 children across 56 Tanzanian villages to examine the relationship between father absence, measured both in terms of vital status and coresidence, and child anthropometric status. To address context dependency we (i) stratify our analyses by ethnic group, and explore (ii) interactions with household wealth, (iii) whether the child lives in a monogamous or polygynous household and (iv) child sex.

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Evolutionary and dietary implications of the internal structure of the dentition of *Anapithecus hernyaki* revealed by synchrotron virtual histology

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Anapithecus hernyaki is a relict 10 Ma stem catarrhine, the near-end of a lineage that predates the divergence of Old World monkeys and apes (>30 Ma.) The type specimen RUD 9 is unique among primitive catarrhines in preserving detailed evidence of its erupting dentition. It provides a window into the dental development and histology of the earliest catarrhines, revealed by synchrotron virtual histology.

Histologically, *Anapithecus* preserves the record of an adaptation to frugivory in a dentition primarily adapted for folivory. Unworn teeth of *Anapithecus* most closely resemble those of *Alouatta.* However, microwear patterns are more suggestive of frugivory. We interpret the presence of decussation in the cuspal enamel of the teeth from the EDJ to the outer surface as an adaptation to feeding on tough or hard objects, as also supported by these relatively thick-enameled teeth, and as observed in modern Pithecinae.

Concerning eruption sequence and timing, *Anapithecus* also compensates for its folivorous unworn postcanine teeth by modifying of its eruption sequence and premolar development. While the P4 and the M2 are at a comparable developmental stage, the M2 is erupting and the P4 is still deep in its crypt. This along with the persistence of the deciduous molars (without root resorption) in occlusal position may be adaptive to maintain an efficient chewing surface throughout the dentition's life (releasing one tooth at a time and keeping the P4 in reserve.) The eruption and histology of *Anapithecus* teeth may represent a previously undocumented mode of evolutionary change in dietary adaptation.

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An evaluation of skeletal fractures in an adult community from Medieval Nubia

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A sample of 216 well-preserved adult individuals from cemeteries 3-J-10 and 3-J-11 on Mis Island provides an interesting exploration of life experiences and interpersonal interactions at the Fourth Cataract. This study investigates the types and prevalence of trauma—as specifically related to skeletal fractures—among these medieval Nubian Christian individuals by utilizing both macroscopic and microscopic methods. The primary goals of this research are as follows: to evaluate which sex cohort was more frequently affected by traumatic incidents; to investigate which adult age cohort was more commonly affected; and to consider whether cemetery 3-J-10 or cemetery 3-J-11 was more grossly afflicted.

Results indicate both cemeteries had sex and age cohorts that were similarly afflicted by trauma. Crude frequencies demonstrate that males were most greatly affected followed by

females. However, probable females from 3-J-11 were more affected than probable males (5% and 4%, respectively) while the opposite was true for 3-J-10 (11% and 5%, respectively). Frequencies also reveal that middle adult cohorts were most affected in both cemeteries. Cemetery 3-J-10 had young adults second most affected (77%) and old adults least affected (36%) while the opposite was true for 3-J-11 (18.4% and 13.5%, respectively). When both cemeteries were compared, there were no statistically significant differences in either sex or age cohorts afflicted with trauma (p=0.4231 and p=0.2624, respectively). These individuals, though separated spatially and temporally, experienced trauma similarly. Thus, these findings have interesting implications as to how these individuals interacted with not only each other, but with their environment as well.

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Co-occurring extreme torus mandibularis, palatine torus, and oral exotoses: a case study

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Various oral non-metric traits, including mandibular and palatine torii and oral exotoses, are of interest to skeletal biologists in population biodistance, genetic/environmental component, and biomechanical studies. Most analyses have drawn on archaeological or historic samples. However, descriptions in modern populations of these traits come from dental clinical literature.

This case study presents a contemporary African American male from northeast Ohio. This individual presents extreme expressions of multiple non-metric traits: buccal and lingual exotoses, torus mandibularis, and palatine torus. Due to the forensic nature of the remains, measurements were taken on the cranium and mandible. The anterior lingual exotoses measure 4.5 mm. The palantine torus is expressed as four nodules, the largest of which is the left anterior measuring 16 mm AP and 10 mm ML. Both the mandible and maxilla present large lingual and buccal exotoses, bilaterally. For example, the left mandibular torus and buccal exotoses extend 56 mm and 55 mm, respectively, from the mesial edge of the anterior premolar to the distal edge of the third molar.

African American males have a slightly higher prevalence of torus mandibularis and exotoses but not of palatine torus. All trait expressions are extreme in comparison to clinical case studies. Expression of these traits in this individual contradicts studies that correlate to a potential environmental component, a high level of dental wear, by having minimal tooth wear. Interestingly, the traits were not reported in his dental records and family does not report any difficulty with speech or eating.

Multivariate asymmetry in the femur as a basis for "pair-matching"

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Livshits and Smouse showed how the difference between linear measurements on both sides of the body can be used in studies of multivariate asymmetry. Known levels of multivariate asymmetry in a reference collection can form the basis for counting the number of bone pairs within a commingled assemblage. This is a necessary first step in estimating the most likely number of individuals represented in the assemblage. Recently various authors have suggested methods for automating the counting of bone pairs using approaches that are quite similar to some of the methods used in Livshits and Smouse.

This study extends the suggested methods by giving an algorithm to form bone pairs in a commingled sample based on information from a reference collection. The reference data used here is from the Goldman Osteometric Data Set of Auerbach and Ruff with three measurements measured on both femora. The "test" sample is drawn on measurements from 75 individuals measured by the first author at the NYOCME and the AMNH. The F-test between the two samples' centroids for right minus left measurements was not significant (p=0.3152), indicating that the samples have similar directional asymmetry. The algorithm proceeds based on Mahalanobis distances (D^2). The left/right pairing in the commingled sample that gives the smallest D^2 between its vector of differences and the reference sample centroid is fused. Fusion of left/right pairs stops when the D^2 between the centroid for the paired bones in the commingled sample and the reference sample centroid becomes unacceptably large.

Infant weight growth and weaning age in free-ranging rhesus macaques (*Macaca mulatta*)

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The threshold weaning weight hypothesis posits that weaning occurs upon achieving a body weight that maximizes the chances of infant survival. In support of the hypothesis, inter-specific comparisons have shown a constant relationship between birth weights and weaning weights irrespective of species' body size differences and the time taken to reach a 'threshold' weaning weight. If weaning is optimized for individual weight and growth over time rather than set at a fixed age, intra-specific variation in weaning age may be due to differences in previous weight growth. We tested this prediction in a free-ranging population of rhesus macaques (*Macaca mulatta*) on Cayo Santiago, Puerto Rico, by assessing weight-for-age percentile of 216 pre-weaning (< 6 months old) infants. Contrary to our prediction, weight-for-age percentile during the pre-weaning period did not affect weaning age. Based on a characterization of weaning as a substantial decline in suckling, the estimated ratio of weaning weight to birth weight fell within the published haplorhine range of 3.2~4.9. Decline in suckling was significantly delayed for higher-ranking mothers and older-mothers independently. Differences in birth cohort and social group membership were found to explain approximately 12.4% and 26.5%, respectively, of the total variability in infant weight percentile. We consider recent changes in breeding seasonality pattern in this population as a partial explanation for our results. Regardless, using behavioral, demographic and weight data from a large number of infants, the present study extended the idea of threshold weaning weight generated from cross-species data to within-species variation in weaning age.

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Physical activity and anthropometry effects on bone turnover biomarkers in rural Polish women

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Bone health is assumed to decline with age in women, beginning in early adulthood, yet this research has been historically confined to a Western context. We test this assumption at the Mogielica Human Ecology Study Site in rural Poland. We hypothesize bone health corresponds to physical activity (PA) levels and that decline in early adulthood is not universal. This research is among the first to apply bone biomarkers to understand how bone turnover varies with age, PA, and life history. PA is quantified using FitBit One trackers. Bone formation is measured by a serum bone turnover biomarker (bone alkaline phosphatase (BAP)).

Participants (n=30, age 33.2(1.4) years, weight 68.4(3.6) kg, body fat 29.1(1.6)%, mean(SE)) wore activity trackers for one week, with blood collected on the last day. Preliminary results show participants travel an average of 9035(475) (mean (SE)) daily steps. Time spent lightly, moderately, and very active were measured as 351(16), 27(7.7), and 7.6(1.7) (mean(SE)) minutes, respectively, indicating these women frequently perform low-intensity PA. Percent body fat was positively associated with differences between the top and bottom BAP tertiles (unpaired t-test, mean difference 95% CI=15.8 to 0.34, p=0.04). There was no significant difference in age between top and bottom tertiles of BAP concentrations (unpaired t-test, p=0.14), providing preliminary evidence against the assumption that women's bone health declines in early adulthood. We will investigate whether the association between BAP and body fat is due to biomechanical effects of increased body weight, energetic status, or other factors associated with increased adiposity.

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Two proxies from one biomineral: AAR geochronology and isotopic palaeoaridity indices from ostrich eggshell in archaeological sites

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Eggshells of the ostrich, *Struthio camelus*, are abundant in archeological and paleontological sites in Africa. Fossil ostrich eggshell preserves both intra-crystalline peptides and carbonate carbon and oxygen isotope composition, providing the means to determine both an amino acid racemisation (AAR) age and ambient conditions. Unlike most herbivorous mammals, the ostrich's main dietary criterion is tenderness, so they select plants from all three photosynthetic pathways, and since they rely almost exclusively on plant water, carbonate $^{18}O/^{16}O$ reflects primarily evapotranspiration rates and hence humidity. Here we report results applied to archeological sites in South Africa. Chronostratigraphy is independently constrained for Elands Bay Cave (EBC) by radiocarbon, and for the older site of Pinnacle Point 5-6 by OSL and Th/U, providing robust tests for the AAR geochronology from multiple amino acids. At Wonderwerk Cave the chronology has large gaps beyond the Holocene, although biostratigraphy, cosmogenic burial ages and magnetic reversals indicate Early Pleistocene ages for the lower levels. The results show that AAR is able to identify heated samples, and to distinguish between sub-stages of OIS stages 5, 4, 3 and 1, while at Wonderwerk the results provide greater resolution for the previously undated Middle Pleistocene levels. At Pinnacle Point a muted aridification trend is observed from OIS5 to 4, while at EBC the results indicate significant humidity shifts from about 14 ka through the Holocene. The Wonderwerk OES isotope record is far more variable throughout, with significant arid episodes and a longterm aridification trend up to and including the Holocene.

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Ancient alleles and complex structural variation of pathogen receptors at the glycophorin locus

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The glycophorin locus has recently been identified in genome-wide scans for both ancient balancing selection and severe malaria susceptibility, but the underlying functional mechanisms remain uncharacterized. This locus encodes three genes, *GYPA*, *GYPB*, and *GYPE,* that result from great-ape specific duplication events, with the first two underlying the MNS blood group system and serving as red blood cell surface receptors for pathogens including the malaria parasite *Plasmodium falciparum* and several viruses. Copy number variation has been reported between humans and chimpanzees as well as within human populations, but analyses are complicated by the high sequence similarity among the three homologous copies, each about 100 kb, which makes read mapping and variant calling problematic. We sought to characterize structural variation across the region by developing a hidden Markov model to infer large copy number changes from sequence coverage data. We apply the method to worldwide 1000 Genomes Phase 3 populations and identify multiple large deletions and duplications, observing marked differences in variant frequencies across continents. In particular, we find two distinct deletions of *GYPB* reaching 5% or higher frequency in Africa and a duplication of *GYPB* and part of *GYPA* up to 2% frequency in East Asia. We assess the potential functional impact of rearrangement of regulatory elements and fusion gene products. Finally, integrating genotypes at these variants into haplotypes, we evaluate evidence for balancing selection and relate the structural variation to alleles shared between human and chimpanzee.

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A univariate approach to sex estimation for the fragmentary upper limb

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Although there are numerous reliable multivariate models for sex estimation, many scenarios, both forensic and archaeological, result in the recovery of fragmentary remains which prevents the collections of various standard measurements. The purpose of this research is to establish metric standards for sex estimation from the distal humerus and distal radius of European/American Whites (n=364; males=273/females=91) and American Blacks (n=70; males=45/females=25). Data for this research was retrieved from a sample consisting of data from the following skeletal collections: Terry, Hamann-Todd, William M. Bass, and the International Commission on Missing Persons. Standard epicondylar breadth was measured, as well as the breadth of the capitulum-trochlea and distal breadth of the radius following measurements for osteometric sorting. Data were analyzed in SPSS (v.19) using a student's t-test and descriptive statistics from which sectioning points were determined. The differences between the male and female means were found to be significant for all measurements ($p < 0.00$). Classification rates ranged from 75% for the epicondylar breadth measurement on the American Black male sample to 96.4% for the capitulum-trochlea breadth with the grouped female sample. Overall, classification rates demonstrated that significant metric differences exist between the sexes and can be utilized to estimate sex from the skeleton. The present study offers an alternative sex estimation technique applicable to unidentified individuals whose remains are fragmented or damaged.

Black-mantled pacifists: Skeletal trauma in free-ranging *Saguinus nigricollis*

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Patterns of healed traumatic injuries are described in the small-bodied *Saguinus nigricollis*. Macroscopic skeletal analysis is conducted on 30 specimens, including 14 females and 16 males from the Tappen Collection housed in the Department of Anthropology at the University of Minnesota.

Typical frequencies and patterns of skeletal trauma among free-ranging small-bodied New World monkeys are not well known to date. This project aims to depict the nature of the trauma load carried by a free-ranging population of black-mantled tamarins and discusses the patterns observed in relation to published observations of *S. nigricollis* behavior. Overall, trauma is seen in 30.0% of the individuals in the sample, including 28.0% of females and 31.3% of males. The highest frequencies of trauma by bone are observed in the ulnae (7.7%, n=26) and tibiae (4.0%, n=25) for females and metatarsals (5.3%, n=75) and femora (3.5%, n=29) for males. No statistically significant differences are observed between males and females for any traumatic injuries observed in this collection.

Small mammal insectivore carbon isotopes as environmental proxies in a South African savanna ecosystem

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Carbon isotope analysis of micromammalian insectivores holds promise for resolving questions about past environments because they have restricted home ranges, are closely tied to local habitat, are well represented in many fossil assemblages, and have the potential to act as ecological integrators. But unlike larger animals, there have been few studies of micromammalian insectivore carbon isotope compositions.

In this study, we assessed the degree to which micromammalian insectivores record habitat signals in a mosaic environment under spatially and seasonally constrained conditions. We sampled three sympatric shrew taxa in three microhabitat types within a southern African savanna. Sampling sites were all located within < 2 km of one another, but range from very open (< 5% canopy cover) to moderately closed (~60% canopy cover) habitats. We tested whether insectivore $d^{13}C$ values 1) differ between microhabitat types, 2) differ between taxa, and 3) follow predictable patterns based upon known vegetation data.

We found that insectivore carbon isotope values vary with habitat in a predictable manner within our study site. While taxonomy also influenced insectivore $d^{13}C$ values, this was largely due to differences in the habitat preferences of individual taxa and resultant variation in their relative abundance within each environment. Despite a taxonomic effect, isotopic differences between habitat types were nonetheless preserved within individual taxa where taxa occurred in multiple habitats. We also present preliminary results from analyses of fossil micromammalian insectivore enamel from the Cradle of Humankind, South Africa and discuss potential implications of the higher $\delta^{13}C$ values observed in fossil specimens.

Phylogeographic signals in an immune gene family reflect linkage disequilibrium

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It is well known that selection plays the major role in the amount and distribution of variation in the human genome, and boundaries for the distance from the allele under selection have been estimated. That is, the signal of selection is propagated some distance from the site of selection. What is less well known, is whether information concerning the signal of recent or past selection can be further elucidated with analyses of anisotropy. This study investigated the geographic distribution of variability across a gene family known to be involved in the regulation and maintenance of immune function.

The IL-10 gene family is composed of IL-10, IL-19, IL-20 and IL-24. This gene family spans more than 250 kb on 1q31-32, in an area which has a relatively high rate of recombination. We genotyped 33 SNPs in 82 samples from Chinese, Iberian, Indo-Pakistani, Basque, Middle Eastern, Russian, South African, North African and Pacific populations. We used estimates of linkage disequilibrium calculated for each population and the populations taken together in conjunction with an estimate of anisotropy—using the method of angular correlation—to assess the congruence of adjacent loci. Linkage disequilibrium analysis revealed strong patterns of LD across the IL-19 locus in most individual populations. Furthermore, a strong pattern of LD was observed across the IL-10 locus when all study populations were considered, however, the signal was not maintained in individual populations. Angular correlations were concordant with SNPs in LD blocks.

Meat or potatoes?: Re-evaluating the role of plant foods in human evolution

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Gathered plant foods are an important dietary constituent for mid and low latitude human foragers. Plants are a predictable, low variance resource, and the abundance and distribution of plant foods was likely an important determinant of hominin diet and behavior. Most evolutionary models concede that plant foods were important to early hominin diets, but the role of plant foods in shaping hominin morphology and behavior is overlooked in favor of animal foods. Meat is an energy dense resource that supplies essential amino acids and fatty acids in high concentrations, and most researchers assume that humans cannot reap the same nutritional benefits from plant foods. However, the assumption that hominins required animal foods to support increasing brain and body size receives little support from comparisons of human physiological requirements with those of our closest primate relatives. We discuss the nutritional contribution of wild plant foods to the diet of Twe-forager horticulturalists in NW Namibia. We present data on macronutrient and amino acid content of wild fruits and plant underground storage organs. Our data show that a plant-based diet can meet daily nutritional requirements with only a small input from animal sources. The plant foods discussed in this study are available throughout much of Southern Africa, and thus our results have implications for dietary composition of hominins living in similar environments.

The influence of sex and allometry on subnasal prognathism in modern humans

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Subnasal prognathism is a morphological trait that is frequently invoked to characterize and distinguish human ancestral groups. However, few studies have focused on other aspects of subnasal prognathism, including the roles of sexual dimorphism and allometry. In this study, 19 craniofacial landmarks were collected from three-dimensional skull surface scans of medieval Nubian and modern European-American, African-American, Portuguese, and Native American individuals (N=114 males and 78 females). Following a generalized Procrustes superimposition, a principal component analysis was performed. As prior research indicated that the most commonly used metric quantifier is unable to accurately reflect levels of subnasal prognathism, the principal components (PCs) that captured prognathic shape variation were identified utilizing the visual outputs of MorphoJ and Morphologika (PC1 and PC3). The effects of sex and population on these PCs were evaluated using a two-factor ANOVA. Centroid size was regressed on the PC scores to determine whether there are any allometric effects on prognathism. The results revealed significant population differences among the PCs that captured prognathic shape variation ($p < 0.01$), but no significant differences in sex (PC1, $p = 0.114$; PC3, $p = 0.455$) or in the interaction between sex and population (PC1, $p = 0.782$;

PC3, p = 0.755). PC1, which captured the main prognathic shape variation, did not show evidence of allometry in either the divided sex/population groups or the pooled sample. Although further research is required, these results indicate that subnasal prognathism is not sexually dimorphic or strongly influenced by allometry.

Not just a fallback food: Global patterns of insect consumption

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Insects as food are often viewed as a fallback resource and associated with marginal environments. In order to assess this correlation between insect consumption and non-cultivated landscapes, I used an online database reporting known insect species consumed in each country and determined the anthropogenic biome that best represents the majority of the landscape for each of the 97 countries represented. Additional independent variables include centroid latitude and population size. ANOVA analysis determined the fit of regression ($p<0.01$) and multiple regression analysis suggests that anthropogenic biome is a poor predictor of insect consumption ($p=0.73$), but that latitude and population size both significantly and independently predict rates of consumption ($p<0.01$ each). Insects are consumed more in tropical latitudes, which is consistent with greater biodiversity providing more edible insect options closer to the equator. Some of the world's most populous countries, such as China, India, and Mexico, are also some of the largest insect consumers, which may be related to food demand, but not necessarily marginality. These results suggest that insect consumption represents a dynamic human-environment interaction, whereby insects are utilized in some of the world's lushest environments and are also important in areas where people have had the greatest impacts on the ecosystem. The concept that insects are a fallback food is an oversimplification that is likely rooted in Eurocentric bias rather than actual ecological patterns.

Cold acclimation among residents of the Chicago Metro Area: Changes in brown adipose tissue thermogenesis, energy expenditure and vasoconstriction

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Humans adapt to cold temperature stress by engaging an integrated suite of hormonal, neurological and vascular responses in order to increase heat production and minimize its loss. Two physiological adaptations are integral to this process – vasoconstriction of peripheral blood vessels and an increased metabolic rate via non-shivering thermogenesis (NST). Recently, brown adipose tissue (BAT), a specialized form of fat known to produce heat in infants and other mammals, has been discovered to be present and active among adults (Nedergaard et al., 2007. Am J Physiol 293:E444). Previous work suggests that repeated cold exposure recruits BAT and facilitates greater NST (van der Lans et al. 2013. J Clin Invest 123: 3395). Additionally, groups that are acclimated to cold stress have been found to maintain higher peripheral blood flow and skin temperatures (Adams and Covino 1958. J Appl Physiol 12: 9). Few studies, however, have examined the relationship between energetic and vascular adaptations to cold stress. In this study, 27 residents of the Chicago Metro Area (14 women; 13 men) between 18 and 39 years old were exposed to a 40 minute cold challenge for four consecutive days. BAT thermogenesis was measured using infrared thermal imaging and energy expenditure was quantified using indirect calorimetry. Skin temperatures on the arm and trunk were measured using iButtons. Anthropometric measurements and blood biomarkers of metabolic health were collected as well. The results of this study describe the complex combination of energetic and vascular changes that occur in reaction to repeated mild cold exposure.

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Effects of exercise-induced loading on internal bone morphology of the mouse ilium: implications for lower ilium robusticity in primates

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Among primate species, the lower ilium is shorter and has greater cross-sectional area in taxa that experience relatively large locomotor loads. However, little is known about how *internal* ilium morphology responds to increased loading (either evolutionarily or in terms of phenotypic plasticity). Using a novel mouse model, this study presents preliminary data testing the hypothesis that properties of iliac trabecular and cortical bone strengthen in response to increased loading. The sample derives from lines of High Runner (HR) mice bred for increased running activity on wheels. For this preliminary investigation, two treatment groups of female mice were tested: mice from non-selected control lines housed without wheel access ("non-runners" N=10) and HR mice housed with wheel access for 13 weeks beginning at weaning ("runners" N=12). Each pelvis was μCT scanned and material properties were determined from a volume of interest located at the center of the lower ilium. Importantly, this study demonstrates that the mouse ilium resembles a long bone in cross-section, with thick cortex, a large medullary cavity, and virtually no trabecular struts. ANOVA was performed on ratios of cortical area, cross-sectional area (CSA), and second moments of area to body mass. As predicted, runners have greater CSA than non-runners ($p=0.002$) as a result of their greater medullary area ($p<0.0001$; no difference in cortical area). This study suggests that the ilium may respond to increased loading by increasing CSA, supporting recent findings that ilium robusticity is related to large locomotor loads among species of primates, and calling for additional investigation.

Isotopic and Genetic Analyses of a Mass Grave in Central California: Implications for Precontact Hunter-Gatherer Warfare

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A romanticized interpretation often depicts hunter-gatherers as peaceful peoples with very low rates of interpersonal violence when compared with more complex and state-level societies. Recent archaeological and anthropological research has challenged these notions. The ancient hunter-gatherers of California have played an important part in this shift in thinking. Osteological studies show that violence was clearly significant and endemic in Central California. However, these violent events took place as part of intragroup altercations or more organized intergroup warfare have been poorly characterized.

Burial 85 is an unusual mass burial included seven males fromCA-ALA-554, which is a precontact site in the Amador Valley, Central California. Archaeological evidence suggests the individuals may have met a violent end. Based on the results of our previous isotopes and ancient mtDNA studies, intergroup warfare accounts for the mass burial and the warfare was organized above the level of the matrilineal family. Future studies will have to explore the Y chromosome and autosome genetic variations to provide more details regarding the genetic affiliation and geographic origin of these seven males, and by extension, the organization of warfare.

Together, we use Burial 85 as a case study for understanding the nature of interpersonal conflicts in ancient Central California, and

speculate on factors that may have contributed to such violent events.

The embodiment of market integration: Modeling cultural consonance among Shuar children of Amazonian Ecuador

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Cultural consonance models are a powerful technique used to operationalize how psychological dissonance arises when market integration (MI) initiates a shift from traditional views of lifestyle success to Western ideals; however, limited research has used these models with children. The present study developed cultural consonance models for indigenous Shuar children of Amazonian Ecuador who are currently experiencing a range of MI-related lifestyle changes. Data for this study were collected from children aged 5-15 years in multiple stages. First, items associated with lifestyle success were elicited via free-list interviews with 37 children from a market-integrated community in the Upano Valley (UV) and 20 children from a remote community in the Cross-Cutucú (CC) region. Next, 23 UV and 28 CC children rated each salient item from the free-lists according to its importance. These results were evaluated with consensus analyses to test for regional models of lifestyle success. Finally, 21 UV and 24 CC children were asked to affirm their agreement with the items from the consensus analysis to measure cultural consonance; scores were calculated as a fraction of items to which an individual agreed. Overall, UV children had significantly higher cultural consonance scores than CC children (0.67 vs. 0.52; $p < 0.001$), suggesting that CC children maintain lower adherence to the cultural model, potentially due to limited access to items associated with lifestyle success. Further analyses will examine the relationship between cultural consonance and diurnal cortisol patterns in order to link Shuar children's experiences of MI to stress and health.

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When borders are contested: methodological and theoretical issues when mapping ranging behavior of territorial species

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Home range area is an important factor in understanding nonhuman primate behavior and ecology. While the minimum convex polygon (MCP) method was once widely used in primate ranging studies, there are concerns that MCP overestimates range size. Kernel density estimation (KDE) has been favored as a more conservative approach. However, because KDE is a predictive model, it too has the potential to overestimate home range size when border areas are used intensively, such as with territorial species.

We compared MCP and KDE using ranging data collected from two groups of territorial white-handed gibbons (*Hylobates lar*) living in Khao Yai National Park, Thailand during three two-month periods across ten years. White-handed gibbons live in relatively small (~25 hectare) home ranges and actively defend this space against intrusions from neighboring groups. This requires the group to spend a large portion of time near the boundary of the home range. Our results indicate that KDE is not more appropriate than MCP in all cases, as KDE estimates were consistently larger than MCP (25.8 ha vs. 20.6 ha; 26.6 ha vs. 24.2 ha; 28.3 ha vs. 23.7 ha; 20.6 ha vs. 14.6 ha). We conclude that KDE may be inflating area estimates due to the even distribution of points throughout the range and the relatively high amount of data points along the periphery. We suggest that this is a biologically significant issue, as territorial animals recognize and are geographically constrained by spatially distinct territorial borders that are not accurately rendered in KDE home ranges.

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Regional and extra-regional dental affinities of populations between the Late Neolithic and Copper Age in the Portuguese Estremadura

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Prior affinity studies of Mesolithic through Late Neolithic Portuguese populations have aimed to assess whether replacement or outside genetic input accompanied significant social and economic change. We expand this emphasis by calculating phenetic affinities among samples from burials dated to the Late Neolithic/Copper Age transition: Cova da Moura (3700-2300 BCE), Bolores (2800-2600 BCE), and Pai Mogo I (2800-2600 BCE). While all derive from the Estremadura region, they are useful for evaluating population variation, given their temporal, geographic, dietary, and cultural differences. To assess these samples at a regional level and identify extra-regional influence, they were compared with samples from Italy, Greece, Turkey, and northwest Africa, including: Neolithic Capsians, Canary Islanders, and two groups of Berbers.

Up to 36 traits from the Arizona State University Dental Anthropology System were recorded in each individual, and submitted to the mean measure of divergence to yield inter-sample phenetic distances. We found a demonstrable distinction among regions, as expected given geographic distances, and overall similarity within regions. However, variation within the Estremadura is evident. Northernmost Pai Mogo I is similar to Cova da Moura and Bolores, yet statistically significantly different from both; geographic divergence apparently contributed to reproductive isolation. Neighboring Cova da Moura and Bolores do not differ significantly, suggesting short term continuity in the central Estremadura. Some traits are also common in Africans in accordance with reports of population contact. Thus, overall continuity is implied within the Estremadura during this period of transition, but outside genetic input cannot be ruled out.

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Human structural variants shared with Neandertal and Denisovan genomes

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Allele sharing between modern and archaic hominin genomes has been variously interpreted as originated from ancestral genetic structure or through non-African introgression from archaic hominins. However, evolution of polymorphic human structural variants that are shared with archaic hominin genomes has yet to be studied. We identified 427 polymorphic human deletions (a type of structural variants) shared with archaic

hominin genomes. Of those, approximately 87% originated before the Human-Neandertal divergence (*ancient*) and only ~9% of which have been introgressed from Neandertals (*introgressed*). Recurrence, incomplete lineage sorting between human and chimp lineages, and hominid-specific insertions constitute the remaining ~4% of allele sharing between humans and archaic hominins.

Our analyses indicate that the genomic landscapes of both ancient and introgressed deletion variants were primarily shaped by purifying selection, eliminating large and exonic variants. Nevertheless, we found 17 exonic deletions that are shared with archaic hominin genomes, including those leading to 3 fusion transcripts. The affected genes are involved in metabolism of external and internal compounds, growth and sperm formation, as well as susceptibility to psoriasis and Crohn's disease.Our analyses suggest that these *exonic* deletion variants have evolved through different adaptive forces, including balancing and population specific positive selection.

Our findings reveal that deletion variants shared between humans and archaic hominin genomes are common among modern humans and can influence biomedically and evolutionarily important phenotypes. We are currently analyzing the function of one such shared deletion affecting a growth hormone receptor gene using the transgenic mouse model.

University at Buffalo Research Foundation

Acoustic monitoring: transforming primate conservation strategies in African tropical forest protected areas

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Anti-poaching patrols are commonly used to control illegal hunting for wild meat, the primary threat to primates and other large-bodied mammals within many tropical forest protected areas. In Africa, anti-poaching patrols have been largely unable to curtail illegal hunting due, in part, to an inability to properly evaluate the patrol's impact on hunting and wildlife abundance and to adjust patrol activity based on changing hunting patterns. To improve anti-poaching patrol outcomes, we deployed 12 autonomous recording units (ARUs), with a total detection range of 85 km^2, in Cameroon's Korup National Park (KNP) to continuously monitor gun hunting pressure for a year (June 2013 – May 2014). The ARUs recorded 2,068 gunshots. Hunters were active year round, but gunshot frequency during the dry season (December – February) increased threefold compared to the rainy season (May – September). Most gunshots were recorded at night (66%) and during the 3 days prior to local market day (57%). Gun hunting pressure was most intense on the periphery of the survey area (closer to villages). Based on the number of recorded gunshots and a kill success rate of 77% (derived from concurrent hunter surveys), we estimate that 25,384 animals (20.1/km^2) are killed annually by guns alone in KNP. Given that hunter surveys show that 13.8% of total kills are primates, the KNP primate community suffers an annual loss of 3,503 animals. We describe how this unprecedented level of spatio-temporal hunting pattern detail can be used to design and evaluate anti-poaching patrols and transform their effectiveness in tropical forests.

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Ancient Native American Exomes Reveal Immune-Based Adaptation to the Americas

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The genomic background of ancient Native Americans has been postulated as a factor for the disease-related population declines after European colonization. However, this concept has not been explored on a genome-wide level, utilizing both living and ancient individuals. Instead, most of this evidence is either indirect or based on genetic studies of living populations, making it difficult to examine the extent genetics contributed to this presumed susceptibility.

In this study, we scanned contemporary and ancient whole-exomes for signatures of positive selection to examine relevant genetic differences in a First Nation population, both pre- and post-European colonization. We identified significant changes in allele frequencies between the ancient and contemporary populations, involving genes that have been correlated with colonial-era disease. These changes may help explain aspects of the historical experiences of indigenous peoples with European-borne pathogens and help illuminate the dynamics of human adaptation to new environments, in both the context of isolation and rapid merging of populations.

Assessing Geographic Origins Using Isotope Analysis of Skeletal Remains from a Colonial Period Cemetery, New Orleans, Louisiana

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St. Peter Street Cemetery is a Colonial Period cemetery located beneath a modern city block in New Orleans, Louisiana. Salvage excavation of a section of the cemetery in 2011 yielded a sample of 15 individuals of both sexes, multiple age groups, and of African or mixed African and Native American ancestry. The remains were relatively well preserved and few skeletal pathologies were noted other than age-related degenerative changes and oral pathologies that could be associated with diet. The condition of the remains and their early date provided a unique opportunity to address questions of geographic origins for the individuals buried in this early 19th century cemetery through the use of strontium and oxygen stable isotopic analysis.

Nine individuals were selected for isotopic analysis, including six adults and three subadults. For each individual, samples were extracted from both tooth enamel and bone. Bivariate plots of oxygen ($\delta^{18}O$), which reflect water sources, and strontium ($\varepsilon^{87}Sr$), which reflect local soils, ratios were constructed for each dataset to assess possible migration between early childhood and the years immediately preceding death.

Bone values for $\varepsilon^{87}Sr$ (72.5447 to 81.6886) and $\delta^{18}O$ (-1.36 to -3.93) provide a benchmark for Colonial New Orleans. Six individuals, including one subadult and five adults, fall outside this range of values, indicating non-local regions of birth. Based on preliminary comparative $\delta^{18}O$ and $\varepsilon^{87}Sr$ data from Louisiana, Texas, and Mississippi, possible birth regions for these individuals could include parishes in southwest, central, or northeast Louisiana, as well as areas outside of the state.

Dental microwear turnover rates in a modern hunter-gatherer population

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Dental microwear holds the potential to provide important insights into the diets of human ancestors and other fossil hominins. To this point, most such studies have relied on living non-human primates as a baseline for comparative studies. Fewer have employed modern human foragers as a baseline, and none we are aware of have used *in vitro* studies of extant hunter-gatherers. Such a comparative sample would be especially valuable for interpretations of later Pleistocene hominin species. Turnover rates, for example, are documented in non-human primates, but not for human foragers. Here we present the first dental microwear study to examine turnover in a modern hunter-gatherer population, the Hadza of Tanzania. We collected repeat molds (n = 33) of molars of given adults in the wet season (with a diet dominated by tubers) and the dry season (with a diet of mostly baobab fruit) and analyzed

them using conventional microwear texture analysis protocols. Preliminary results indicate that microwear features form rapidly, with both scale-sensitive fractal analysis and ISO texture parameters changing in as little as two days. Significant differences were found between seasons in fractal complexity and heterogeneity of occlusal surface texture as well as ISO developed area ratio. These results provide important context for the interpretation of variation in dental microwear patterns within Pleistocene hominin species.

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Recent analytical developments yield new insights into the timing of tooth formation and standards for age estimation

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Tooth formation is widely used to estimate age. The aim of this study was to review developments during the last 30 years in our understanding of the timing of tooth formation, methods and standards for age estimation. We also investigate multivariate probit for age estimation using tooth stages of mandibular permanent molars as ordinal categorical data. The sample consisted of 3071 panoramic radiographs of dental patients aged 2-25 years (males 1512, females 1558). Permanent first, second and third mandibular molars were staged into crown and root stages of Moorrees, Fanning and Hunt. The analytical model was ordinal probit with age on the log scale. Tooth stages were collapsed into six stages for each molar after testing for log normal distributions for ages of attainment using a Lagrange multiplier goodness-of-fit test. Significant effects were sex and log age for all three molars, while M3 also had a significant log age by sex interaction.

The residual correlations between the teeth were significantly greater than zero, demonstrating that the assumption of conditional independence is not warranted for molar dental development. The relative eigenvalue variance of the residual correlation matrix was 0.624. In the case of conditional independence this value should be 0.0, while for complete dependence the relative eigenvalue variance would be 1.0. Given the strong residual correlations, the multivariate study of dental development should focus on the extent to which individuals are on an accelerated or decelerated developmental schedule relative to the norm, as Garn indicated long ago.

Pattern of ossification in tarsals reflects locomotor specialization in Primates

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Tarsal morphology provides meaningful insight to the locomotor behavior of many primate species. Elongation of tarsals anterior to the talocrural joint is associated with vertical clinging and leaping (VCL) behavior in small-bodied primates; tarsiers and galagos in particular are notable for elongated navicular elements. This study is a comparative analysis of ossification patterns in perinatal primate tarsals, focusing on growth of the navicular in VCL taxa. MicroCT scans from perinatal specimens representing phylogenetically and behaviorally diverse primate taxa were included: *Lemur, Hapalemur, Eulemur, Cheirogaleus, Propithecus, Nycticebus, Loris, Galago, Galagoides, Tarsius, Aotus, Callicebus, Saguinus*. Skeletal elements were reconstructed in Amira where two distinct patterns of ossification were observed. In most specimens, the calcaneus was significantly ossified near birth, and the talus was evident as a globular ossification center. No other tarsals showed evidence of bone formation. This pattern is expected to reflect the ancestral condition of tarsal ossification. In contrast, for tarsiers and galagos, the calcaneus and navicular both showed remarkable ossification, already displaying the elongated form observed in adults. The talus was minimally ossified in these specimens. Early onset of ossification in the navicular appears to be a mechanism that underwent parallel evolution in these two groups. Larger primates that adopt VCL behavior (i.e. *Propithecus*) do not appear to incorporate any changes in their pattern of tarsal ossification. This study provides evidence of different rates and timing of ossification among tarsals as a mechanism for producing morphological specialization and emphasizes the importance of ontogeny for interpreting skeletal indicators of behavior.

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Predicting the climatic niche breadth of African catarrhines

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Climate impacts organisms directly through thermoregulation and indirectly through controls on distribution of resources and suitable habitats. Studies of the climatic niche of vertebrates have sought to quantify the climatic tolerance of species and examine the relationship between climatic niche evolution, adaptation, and geographic distribution. Climatic niche breadth (CNB) has been implicated in explanations of global biodiversity patterns, yet an understanding of what predicts CNB is lacking, particularly for mammals. Here we quantify the climatic niche position and breadth of African catarrhines by extracting climatic variables from 1,530 georeferenced occurrences representing 40 taxa. We subsequently explore potential predictors of CNB within a phylogenetic context. Relative to other primate clades, Old World primates vary widely in their geographic distribution and habitat preference, making them a group of interest for understanding ecological flexibility in primates and other mammals.

Our results show a significant positive relationship between a species' CNB and its latitudinal range. Geographic variables outperform physical and behavioral variables as predictors of African catarrhine CNB. However, we cannot draw conclusions about the direction of causality between these variables, and further work is required to understand the historical factors that affect present-day species ranges. African catarrhines may share a broad fundamental niche but exhibit a realized niche that is constrained by barriers to dispersal, anthropogenic habitat destruction, and past climate change. This work is pressing in light of the extinction risk faced by many African primates and predictions that climatic niche evolution cannot keep pace with the projected rate of climate change.

Forensic Anthropology For Who? The Experience of Colombian Forensic Practitioners in a Context of More Than Six Decades of Sociopolitical Conflict

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Since 1950, Colombia has experienced a conflict resulting in approximately 220,000 deaths according to figures from the National Center for Historical Memory. Recently, the government has employed transitional justice initiatives, including programs to help search and identify victims, the scope of which has involved the work of numerous forensic anthropologists. The experience of these professional anthropologists is unique, as exhumations and anthropological fieldwork often occur in the midst of armed conflict. This reality has resulted in methodological protocols that drastically differ from those in locales where field safety is not compromised.

Colombian forensic anthropologists understand the need to apply scientific methods

not only in excavation but also in laboratory identification and are continually working to develop appropriate standards for estimation of the biological profile. Beyond their role as laboratory analysts, primary concerns involve the role of forensic anthropology in the overarching process of transitional justice and the question of which stakeholders are involved in the process. After more than 25 years of forensic anthropological casework, there is now a tendency of involving the participation of relatives of victims in technical activities such as exhumations, and providing them with psychosocial support throughout the entire process. Additionally, Colombian anthropologists have come to recognize the importance of forensic anthropology as a tool to understand patterns of violence and the discipline's contribution to the historical memory of the country. This presentation calls attention to the practice of forensic anthropology in Colombia and its role in context of transitional justice initiatives.

Paleoparasitology of 1300 year-old human mummies from Nubia

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While human parasites have historically been studied in a medical context, disease ecology now uses parasites to elucidate complex relationships between humans and their environment. Socially transmitted parasites can provide insights into human interactions and environmentally and trophically transmitted parasites reveal the ways in which humans are using and depending on their local ecologies. This paleoparasitological study examined coprolites taken from 48 well-preserved 1300-year-old Nubian mummies excavated at the villages Kulb and Kulubnarti on the Nile River in the modern-day Republic of the Sudan. This collection of mummies has been studied for over 30 years, resulting in a detailed health and life history data set for each individual. Using gastrointestinal parasitological methods, seven species of intestinal parasites were documented. We found that 54.2% of the mummies were infected with at least one parasite species, and 35.4% were infected with at least one species of schistosome. Differences in parasite prevalence among the two cemeteries are likely linked to daily routines. We also found a previously unidentified human schistosome in this Nubian community. This "Nubian schistosome" differed in size and morphology from modern African human schistosomes, and resembles those found in Asia (*Schistosoma japonicum* and *S. mekongi*). Nubia has historically been referred to as the "Corridor to Africa" as it acted as a migration route connecting Africa to the Middle East. It is likely that the Nubian schistosome originates outside of Africa thus shedding light on human migrations into the continent.

A Life History of Skeletal Trauma: Cases from a Medical Examiner's Office

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In most jurisdictions, the medical examiner is required to investigate and certify the cause and manner of all injury-related deaths. Acute trauma may pinpoint the cause of death, but evidence of remote trauma may be crucial in determining the manner of death. Moreover, when the decedent is unidentified, recognizing the biological manifestations of injury recidivism may lead to a more thorough decedent description, thereby enabling identification. Medical examiner based anthropologists are ideally positioned to identify and interpret evidence of injury recidivism and significantly impact the adjudication of cases.

The goal of this presentation is to inform the audience as to the role injury recidivism can play in the outcome of a medicolegal investigation. Three cases will be showcased, each with strong evidence of repetitive injury. In the first case, an infant homicide, healed fractures and consequential health effects of ongoing physical abuse reinforced the certification of homicide as the manner despite the diagnosis of a systemic infection. In the second case, the recognition of trauma and possible associated neurological defects painted a decedent description that led to a positive identification. The third case, a homeless male with decades of injury and disease apparent in his skeleton, provides an intimate view of injury recidivism exacerbated by life on the streets.

Physical anthropologists traditionally considered injury recidivism on a population scale to understand interpersonal relationships. The three presented cases show that in a forensic context understanding injury recidivism at an individual level may be key to the case outcome.

None

Statistical Analysis of 3D Measurements: A Look into the World of Pleistocene Hand Modeling

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3D digitalization and measurement utilizing low-cost, time efficient structure-from-motion photogrammetry has allowed researchers to collect both quantitative and qualitative data from digital reconstructions. Using a variety of landmarks on fossil hominid crania, prior research has shown that an absolute percent difference and absolute difference as low as 0.06% and .04 mm exist when comparing 3D digital measurements to those collected with precision instruments. As fossil collections expand, there is an increased need for accessibility of data, yet published measurements may be inconsistent among researchers. Accuracy in digital measurement provides a significant potential for the creation of 3D databases which will allow access to a wide array of researchers in addition to mitigating potential risks to fossil collections. By expanding previous research in photogrammetry to a concurrent study of hominid hand and forearm fossils, this paper assesses the potential for digital models of the post-cranial skeleton to produce accurate qualitative and quantitative data. A cross comparison of statistical analyses consisting of both digital and physical measurements from available hominid species and comparative collections will further develop our understanding of whether measurements collected from 3D models are viable sources of paleoanthropological data.

Offspring survivorship in wild geladas (*Theropithecus gelada*)

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Among wild primates, factors such as maternal parity, maternal death, group size, and infant sex are known to influence survival during the early life period. In addition, male takeovers can drastically diminish the prospect of survival, particularly for unweaned individuals. Yet, for offspring that are not victims of infanticide, we do not know whether takeovers influence survival after weaning. Here, we use wild geladas (*Theropithecus gelada*) (N=167) from the Simien Mountains National Park to first assess how maternal parity, maternal death (prior to 1 year of age), group size, infant sex, and male takeovers (prior to 1 year of age) predict juvenile survival to 3 years of age. We then examined the percentage of deaths that occurred both *before* and *after* "weaning" (approximated at 1.5 years of age). Our results indicate that three factors accounted for survivorship: parity ($df=1$, $p=0.022$), maternal death ($df=1$, $p<0.001$), and takeovers ($df=1$, $p<0.001$). First, contrary to expectations, offspring of primiparous females were more likely to survive to 3 years of age. Second, all infant deaths involving the loss of the mother (N=12) occurred prior to weaning. Third, 91% of takeover-related deaths (30 of 33) occurred prior to weaning. These results suggest that early life events have the greatest influence on survivorship during the pre-weaning period. However, it remains possible that takeovers influence other aspects of development (e.g., delayed growth). Finally, our results on parity

conservatively suggest that, in geladas, reduced offspring survival is not a cost associated with being a first time mother.

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Children and Childhood in Prehistoric Peru: A Mortuary Analysis of Infants and Children at Estuquiña

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The roles infants and children played in prehistoric societies have gained increasing recognition since the 1980's. Unfortunately, the number of infant remains recovered from archaeological contexts is generally small and they are often completely absent in cemetery samples. Expecting high infant mortality rates, early approaches attributed this underrepresentation to poor preservation and social factors such as differential mortuary practices. Van Gennep suggested that children who were not yet incorporated into society, would not receive the treatment typically accorded older members of the community. At Estuquiña, a Late Intermediate Period (~1000-1476 AD) site located in the Moquegua Valley of southern Peru, 245 burials across three distinct cemeteries and a large domestic area were analyzed through mortuary, material culture and osteological data. Spatial patterning indicates that infants were incorporated into the community cemetery alongside their elders. Out of 349 individuals observed, a significant 13.8 percent of the total population are infants and 28.4 percent are children under the age of six. Associated grave goods and tomb construction patterns demonstrate homogeneity across all age groups. Infant mortuary treatment at Estuquiña shows similarities with the Tiwanaku Chen Chen and Tumilaca la Chimba sites from earlier periods in the same valley. The infants recovered from all three sites received similar grave goods and were buried in smaller tombs of similar construction as those of their elders. This recognition of infants and children as biological beings who held social value shows continuity through time in societies with highland links in the Moquegua Valley.

The penalty for brawling: Patterns of healed skeletal trauma in free-ranging *Saimiri sciureus*

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To understand survivable traumatic injuries sustained by New World Monkeys, macroscopic skeletal analysis was conducted on one species (*Saimiri sciureus*) collected in the mid-1900s in Brazil. The remains are a part of the Tappen Collection housed in the Department of Anthropology at the University of Minnesota (UMN). This study aims to connect observational, qualitative data from the published literature of *S. sciureus*' behavior and social organization to survived trauma evidenced in skeletal remains. Sixty disarticulated adult skeletons of *S. sciureus* are examined for frequency of trauma by sex. Overall, trauma is seen in 1.60% of the sample (n=5947), including 1.18% of female bones (n=2970) and 2.02% of male bones (n=2977). The highest frequencies of trauma are seen in scapulae (17.39%, n=46) and femora (4.76%, n=42) in females and in radii (3.93%, n=51) and fibulae (4.44%, n=45) in males. Analysis shows that among *S. sciureus* there is a statistically significant difference in overall trauma load and trauma in caudal vertebrae, phalanges and metatarsals between the sexes with adult males sustaining significantly more trauma than adult females in each case. These results may be connected to behavioral observations of intra-species aggression among male monkeys, such as brawling pile-ups and other types of learned aggression and play behaviors.

Drift and selection in material culture on the High Plains: A quantitative analysis of inter-tribe parfleche characteristics

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Native American communities occupying the High Plains during the immediate post-contact period exemplify how cultural traits can move freely between human communities that are neither historically nor linguistically related. Indeed, the historical period of the High Plains is often cited as a resounding example of a cultural "melting pot." Here, population genetic theory and quantitative analyses are used to examine cultural patterning in artifactual products from the historical period of the region. Specifically, attributes of parfleches (rawhide bags) made by craftswomen were statistically examined within this framework. A model of "isolation-by-distance" drawn from population genetics was used as a baseline expectation. This model predicts that (in the absence of selection biases) inter-community geographic distances will correlate with inter-community patterns of artifactual variation due to the "free" interchange of ideas between communities. Linguistic affinity and known patterns of inter-tribe alliance and hostility were also examined for statistical fit to the data. Parfleche features did not fit the null model, but rather statistically correlated with patterns of inter-tribe alliance and hostility. The potential for parfleches to act as highly visible signals (group affiliation) suggests that cultural selection biases led to a nonrandom distribution of these features among different tribes. These results demonstrate that even in highly fluid cultural systems, selection biases may operate and lead to nonrandom patterning that correlates with other (selective) factors. The analyses emphasize the value of an evolutionary approach to questions concerning cultural patterning, which facilitates a quantitative and explicitly statistical approach to such questions.

Tattooing to "toughen up": Reduced immunological depression among the heavily tattooed as a signal of biological quality

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Native reports of tattooing practices cross-culturally have suggested tattoos provide protection, such as "hardening" the body against enemy arrows. Tattooing may simply stimulate the immune system toward heightened vigilance against stressors associated with soft tissues damage. We sought to investigate this "inoculation hypothesis" of tattooing. We hypothesized that the immune system adjusts to the tattooing stressor in repeatedly tattooed individuals and that immunological depression related to the physiological insult of the tattooing process would negatively correlate with lifetime tattoo experience. Participants were 25 U.S. women (aged 19-49). We measured immunological depression using secretory immunoglobulin A (SIgA) in saliva collected directly before and after tattoo sessions. SIgA is a continually produced and metabolically expensive frontline gastrointestinal and respiratory defense. SIgA production diminishes when the body is overstressed, but we predicted there would be less diminished production among those with more tattoo experience. Immunological depression was measured as the pre- to posttest SIgA difference. We regressed tattoo experience on immunological depression, controlling for tattoo session duration and years since first tattoo. Women with more tattoo experience had significantly less immunological depression ($p = 0.04$), and the effect size was large. Our data suggest that the body adjusts to the tattooing stressor. It is possible that individuals with healthy immune systems, who heal faster and exhibit less immunological depression, are more likely to get multiple tattoos than those who heal less quickly or cleanly. This interaction renders tattooing an excellent signal of underlying biological quality that may complement cultural meanings.

Hair cortisol levels in prehispanic populations of San Pedro de Atacama, northern Chile

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The Atacama oases experimented a rich and dynamic prehistory, marked by the influence of different foreign cultures across its different cultural phases. Previous studies have shown important changes in aspects of health and life-style of local groups across time, and here we contribute to this discussion by studying systemic stress of local individuals. Systemic Stress was analyzed through cortisol hair level of 19 mummified remains from the local Middle (MP) and Late Intermediate (LIP) periods. A control sample was obtained for 19 living individuals of Santiago, Chile. The comparison between prehispanic and actual samples showed that cortisol levels were similar in both. This result suggests that, in spite of different environmental and social conditions, prehispanic populations from SPA were not exposed to higher levels of systemic stress than modern populations, possibly due to their long history of occupation and adaptation to the local environment. The comparison between periods showed no significant differences between them, although there is a tendency of MP individuals having lower cortisol levels than those from LIP. This slight difference could be reflecting the differences in quality of life shown in previous studies using osteological markers, which are tied to cultural and environmental changes across time. Even though other factors can affect hair cortisol in archeological samples, our results support the use of hair cortisol analysis as a complementary analysis to other established bioarchaeological methods, and as such can contribute to the discussion about the adaption and life-style of past populations.

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Why in 3-4D? What new insights virtual imaging are revealing in dental (palaeo)anthropology

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Along the last two decades, advances in the study of tooth developmental mechanisms and morphostructural variation improved our understanding on the evolutionary, adaptive, and functional patterns characterizing the primate dentition. Given the availability of analytical tools allowing 3-4D virtual imaging and modelling, such achievements have been accompanied by an investigative shift from the 'container' to the 'content'.

We used industrial and synchrotron radiation X-ray microtomography to assess in extinct and extant hominid teeth three aspects of the 'container-content' complex relationships: (i) the still contentious matter of the correspondence in *Oreopithecus* molars between morphological features expressed at the outer enamel surface (OES) and at the enamel-dentine junction (EDJ); (ii) the degree of co-variation in Miocene (*Ouranopithecus*, *Oreopithecus*) and extant apes (*Pongo*, *Gorilla*, *Pan*), in nonhuman Plio-Pleistocene hominins (*A. africanus*, *P. robustus*), and in representatives of our own taxon (*H. erectus*, Neanderthals, modern humans) of the deciduous and permanent molar enamel thickness variation as possible taxon-specific marker expressed by the new Lateral (non-occlusal) Molar Enamel Diphyodontic Index; (iii) the extent and nature of the qualitative and quantitative differences among extant humans, Late Pleistocene modern humans, and Neanderthals in root dentine topographic thickness variation of the upper deciduous incisors.

Our results (i) prove a 1:1 OES-EDJ morphological correspondence in *Oreopithecus*; (ii) do not reveal a predictable signal, but rather a complex pattern in both 'thick-' and 'thin-enamelled' hominid taxa; (iii) suggest that, once virtually unrolled, the root dentine 'carpet', which is systematically thicker in Neanderthals, bears both a functional- and a genetic-related signature.

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First steps of bipedality in hominids: evidence from the pelvis of *Proconsul* and atelids

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Upright walking absent a bent-hip-bent-knee (BHBK) gait requires lumbar lordosis, a ubiquitous feature in all currently known hominids. Its first appearance is therefore a central problem in human evolution. Atelids, which use the tail during suspension, exhibit demonstrable lordosis and can achieve full extension of their hind limbs during terrestrial upright stance. Although obviously homoplastic with hominids, the pelvic mechanisms facilitating lordosis appear largely similar in both taxa with respect to abbreviation of upper iliac height coupled with broad sacral alae. Both provide spatial separation of the most caudal lumbar(s) from the iliac blades. A broad sacrum is therefore a likely facet of earliest hominid bipedality.

To test this hypothesis we compared the ligamentous anatomy of primates (*Ateles sp., Brachyteles, Alouatta sp., Presbytis sp.,* and *Hylobates sp.*) with free versus constrained last lumbar vertebrae. We also collected metric and nonmetric data from the pelves of 150 skeletonized primates. Finally, we reconstructed the sacrum of *Proconsul nyanzae* using a Kenya National Museum cast. All tailed monkeys have broad alae. By contrast all extant apes have very narrow sacra, which promote "trapping" of their most caudal lumbars to achieve lower trunk rigidity during suspension. The alae in the tailless Miocene hominoid *Proconsul nyanzae* appear to have been quite broad, a character state that may have been primitive in Miocene hominoids not yet adapted to suspension and, by extension, exaptive for earliest bipedality in the hominid/panid last common ancestor (LCA). This hypothesis receives strong support from other anatomical systems preserved in *Ardipithecus ramidus*.

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Patterns of joint congruence in the primate elbow

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This study tests hypotheses relating to aspects of joint surface shape to joint function by comparing humeroulnar joint congruence among primates that vary in their upper limb use and positional behaviors, including knuckle-walking, quadrupedal locomotion, climbing, suspension, or none of the above. Geometric morphometrics was employed to address degree of elbow joint congruence in flexed and extended postures. Congruence is here defined as the shape similarity between the anterior, distal, and posterior humeral trochlea and the superior and inferior ulnar trochlear notch. Two measures of shape similarity were calculated for full extension, and two measures for ninety degrees of flexion. Consistent with previous studies, weight-bearing joints were expected to be congruent to accommodate force transmission. As such, measures of similarity were expected to be correlated with body size. Results show that congruence measures do scale with body mass; generally, greater congruence is associated with greater compressive loads, or greater body mass. Outstanding hypotheses from the literature state that taxa engaging in substantial arboreal locomotion are expected to have similar elbow congruence in flexion and extension. Thus, taxa engaging in substantial arboreal locomotion were expected to exhibit less diversity in shape similarity between the humerus and ulna across postures than taxa that rely more heavily on quadrupedal locomotion. This approach discriminated taxa by broad locomotor strategy using measures of joint congruence, although some similarity measures discriminated better than others.

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Dissection Practices Observed from Analysis of Remains from the Tukthuset Poorhouse Cemetery, Oslo, Norway: Contextualization of dissection practices around the turn of the 19th century

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Remains from Tukthuset Poorhouse Cemetery were excavated in 1989 as a salvage project due to ongoing development in Oslo, Norway. Tukthuset has been described as a place for the "mentally ill, 'lazy children,' and those who simply had nowhere else to go." The cemetery was in use between ca. 1770-1850 during which time it housed individuals of both sexes and all age groups. In 1812, the local Anatomy Institute was allowed by the government to study 20 deceased individuals from Tukthuset per year. Twenty-five discrete graves were excavated archaeologically by Sellevold and many more were collected by the road crew. During Sellevold's excavation a single coffin was found with the remains of multiple individuals. These 442 skeletal elements are the remains studied by the Anatomy Institute. Only the remains from this coffin show signs of anatomical dissection. Included in those selected for dissection were males, females, old, young, healthy, and diseased. While up to 20 individuals were permitted yearly to be dissected, the coffin appears to contain the remains of 7 (MNI) individuals. Evidence of dissection is present on 171 elements (38.68%) of the remains present in the form of through cuts, snapped ends, and hesitation marks on a variety of bones with emphasis on the ribs and vertebrae. Findings of the anatomical specimens are compared with similar populations (poorhouses, workhouses, cemeteries for the poor) in the U.S.A. and Europe during the late 1700s-mid 1800s.

Bone mineral density is associated with waist circumference and blood pressure but not lipid profile among the Amazonian Shuar of Ecuador

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Obesity has been traditionally viewed as protective against osteoporosis, largely owing to increased mechanical loading, although studies are increasingly linking obesity to heightened bone loss across the lifespan. The specific mechanisms of this relationship include: 1) bone and fat cells both arise from the same mesenchymal stem cells within bone marrow, which are capable of differentiating into osteoblasts, adipocytes, and marrow fat. Obesity shifts this stem cell lineage, resulting in more bone marrow fat; 2) elevated serum lipid and lipoprotein levels (i.e., triglycerides) inhibit osteoblast formation and stimulate osteoclast differentiation; and 3) visceral adiposity dysregulates the GH/IGF-1 and hypothalamic-pituitary-gonadal axes, which are important regulators of bone homeostasis. In the current study, we test the relationship between bone density and indices of adiposity among indigenous Shuar of Amazonian Ecuador. Anthropometrics (i.e., height, weight, BMI, waist circumference [WC], blood pressure [BP]) and lipid data (i.e., total cholesterol, HDL, LDL, triglycerides) were gathered for 75 participants (18-74yo; 46 females, 29 males). Radial and tibial bone mineral density (BMD) were determined using a Sunlight MiniSonometer. Linear regression analyses demonstrate no significant relationship between biological measures and BMD in males. Similarly, among females, elevated lipid profiles are not correlated with low BMD, although higher WC and elevated systolic BP are strong predictors of low BMD (r=0.79; p< 0.0001). High WC and BP levels are known factors that precede the onset of morbidity and mortality associated with metabolic syndrome, and these preliminary findings indicate a role for WC and BP as indicators of future osteoporosis risk.

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Middle nasal *concha bullosa* in a Portuguese identified skull collection and its association with nasal septal deviation and respiratory disease

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Concha bullosa (CB) is an anatomical variation described as the pneumatization/hypertrophy more frequent in the middle turbinates. Clinical studies refer frequencies between 9-56%, while a prevalence of 38% was found in a collection from Mediaeval England. The aim of this work is to investigate its prevalence in a Portuguese skull collection (first half of the 20th century), to assess whether it is associated with nasal septal deviation (NSD) and maxillary rhinosinusitis (MRS), and to understand if can predispose to respiratory disease and death. A sample of 527 skulls was macroscopically observed, 440 with at least one middle turbinate preserved, 226 from males and 214 from females, and with age at death from 7 to 109. NSD was observed according to Mladina's classification and MRS as recommended by Boocock and colleagues.

CB was identified in 88 (20.0%) skulls, 37 (8.4%) right hypertrophies, 27 (6.2%) left and 24 (5.4%) bilateral. CB is present in 21.0% (45/214) of females and 19.0% (43/226) of males, and in 19.4% (13/67) of non-adults and 20.1% (75/373) of adults. No sex and age groups were found with significant statistical differences. When the individuals were divided by cause of death (115 from 'pulmonary tuberculosis', 42 from 'other pulmonary/respiratory origin', 279 from 'non-pulmonary/respiratory origin'), no significant differences were found for the presence of CB (25.2%, 19.0% and 17.9%, respectively). Furthermore, no statistical association was found with NSD or MRS. This work raises questions on the subject of the significant influence of CB as a risk factor for sinus disease.

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Food, fire, and free space: New tests of the Numic Expansion

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Numic people moved into the Great Basin between 1000-500BP, replacing earlier occupants at a time when the region was likely as arid as it is today. It remains unknown how these people were able to successfully outcompete the in situ populations, but many suggest these incoming populations adopted novel social and subsistence strategies that gave them a competitive advantage. We propose an alternative hypothesis that has been overlooked: the use of intentionally-set landscape fire as a strategy for increasing encounter rates with high-ranking prey. We model this strategy using a novel, multi-scale prey choice model, using ethnohistoric band territories as units of analysis, to examine how ecological variability across the region could influence the strategies employed by early Numic inhabitants of the Great Basin. We assess the importance of fire by comparing it to three alternative hypotheses proposed to explain the Numic expansion: 1) a focus on food resources with high processing costs, 2) the adoption of private property, and 3) the depression of resources in previously occupied territory. Considering each strategy independently, our model shows that the use of fire would have conferred an important advantage in some, but not all areas of the Great Basin, suggesting that spatial variation within this marginal environment may structure the relative advantage of different strategies.

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Super-ordination is a simple method to build consensus from alternative taxonomic ordinations

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Taxonomic ordinations differ when alternative traits are used for analysis. If data from alternative traits are in different units, as is frequently the case, a scaling step performed on geometrically-like data blocks can allow for meaningful data fusion and a single consensus ordination. But a different problem presents when data blocks are composed of different subjects, as is often the case in paleontology. To address this issue, a method of super-ordination (superimposition of separate ordinations) was developed. The method involves Procrustean fitting of taxon centroids (and accompanying data) and calculation of a consensus weighted by effect sizes of the component ordinations. The method was tested with morphometric data on the maxilla and mandibles of gorillas, chimpanzees, gibbons and humans. A regular (canonical variates) ordination was performed on the full dataset to serve as a baseline. Then random datasets with varied levels of specimen overlap between mandible and maxilla data blocks were formed and super-ordinations were calculated. Super-ordination consistently outperformed (had smaller Procrustes distance with respect to the true ordination) than the component ordinations ($P < 10^{-19}$). The result of this study is the development of a robust method for generating consensus ordinations from component ordinations based on different specimens. The fragmentary nature of the fossil record has previously resulted in disparate ordinations and rancor among paleontologists; whereas, now consensus can be calculated logically and subjectively even when component ordinations are discordant.

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Circumferentially drifted osteons: Detailed histology of an unaddressed modeling drift tissue and implications for general histomorphological analyses

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There has been a recent resurgence in anatomical and anthropological interest surrounding the process of bone modelling drift as an indicator of variation in growth and mechanical adaptation of long bone diaphyses. Unfortunately, little is yet known about how the considerable drifting of a cortex affects cortical bone vasculature or microstructure, particularly that of secondary (or remodelled) tissues. Previous studies have focused on the endosteal lamellar pocket (ELP) as an indicator of drift direction and type. The current investigation, however, describes a particularly difficult to categorize tissue type common in drifted cortices, using examples from the humerus and femur. This tissue is comprised of pseudo-laminae constructed of circumferentially drifted osteons. These are most often first generation secondary osteons as evidenced by the reversal line around their perimeter and surrounding primary tissue. In other cases reversal lines are only partially present, or even absent entirely. Mapping the drifted cortex using stitched polarized microphotography and comparing these tissues with drifted endocortical and pericortical primary tissue, drifted osteons, and undrifted osteons supports a working hypothesis that these osteons are the result of the drifting periosteal vascular sheath on cortices parallel to the net drift direction. Results reinforce the notion that more focused consideration of the vascular aspects of cortical drift is necessary to understand the hard tissue microstructure of bone and that, in general, cortical bone histology is more complex than often admitted.

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Osteometric Sex Estimation from Pelvis in a Thai Population

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Estimation of sex is a part of gathering a biological profile of skeletal remains. Knowing sex of unknown case can minimize half of possible individuals who may be matched with the deceased. Varieties of sexing methods from various skeletal parts can be applied. Pelvis is the most reliable. It delivers almost one hundred percentage of accuracy in estimating sex, especially using a morphological method. However, in juridical procedure, a court requires objective methods. Hence, osteometric methods are needed. Many metric sex estimation methods from pelvis have been reported. Each method is specific to its particular study group sample that it derived from. Various metric methods utilizing pelvis have been studied for Asian, but there is no standard method for a Thai population. Therefore, this study aims to develop a standard sex estimation method for a Thai population by determining six pelvic measurements and 8 indices obtained from 200 Thai samples. Independent *t*-test revealed statistical significant difference between males and females. Equations derived from discriminant analysis gave 97% and 93.5% accuracy in estimating sex. The former equation can be calculated from four pelvic measurements: ischial length, total height, acetabular diameter, and pubic length; while, the latter one required only ischiopubic index. Percentage accuracies in predicting sex from these equations were relatively high. This study provides an effective and objective sex estimation method for Thais. The high accuracy equations which require few measurements will be an invaluable method for personal identification in a Thai population.

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Biorhythms, deciduous enamel thickness, and primary bone growth in modern human children: a test of the Havers-Halberg Oscillation hypothesis

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Across mammalian species, the periodicity with which enamel layers form (Retzius periodicity) in permanent teeth corresponds with average body mass and the pace of life history. According to the Havers-Halberg Oscillation hypothesis (HHO), Retzius periodicity (RP) is a manifestation of a biorhythm that is also expressed in lamellar bone. Potentially, these links provide a basis for investigating aspects of a species' biology from fossilized teeth. Here, we tested intra-specific predictions of this hypothesis on skeletal samples of modern human juveniles. We measured daily enamel growth increments to calculate RP in deciduous molars (n=25). Correlations were sought between RP, molar average enamel thickness (AET), and the average amount of primary bone growth in humeri from age-matched juveniles.

Results show a previously un-described relationship between RP and enamel thickness. Reduced major axis regression reveals RP is

significantly and positively correlated with AET, and scales isometrically. The scaling relationship could not be explained through body mass. Juveniles with higher RPs and thicker enamel had more primary bone formation, which suggests a coordinating biorhythm. However, the direction of the correspondence was opposite to that predicted by the HHO. Next, we compared RP from deciduous molars to new data for permanent molars, and previously published values. The lowermost RP of four and five days in deciduous enamel was less than the lowermost value of six days in permanent enamel. A lowered range of RP values in deciduous enamel indicates that the underlying biorhythm might change with age. Our results develop the HHO.

Putting the X in Expression: Tooth Crown Morphology and Chromosome Number

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Researchers have noted differences in tooth size between individuals with a normal chromosomal complement and those with Turner (XO) and Klinefelter's (XXY) syndromes. Tooth size is decreased in individuals lacking an X chromosome but the effects are more variable when there is an extra X chromosome. How the number of X chromosomes affects tooth crown morphology is less well known. To evaluate the impact of sex chromosome number on morphology, observations were made on individuals with Turner syndrome, Klinefelter's syndrome, and a control group at the University of Zagreb School of Dental Medicine. Trait expression was scored following ASUDAS for a standard set of maxillary and mandibular crown traits. For the control group, sexes were pooled because crown traits show little or no sex dimorphism. Chi-square tests and Fisher's exact test with the Bonferroni correction for multiple comparisons were used to evaluate the differences among the three samples. Results show Turner syndrome individuals are significantly different from either the control sample, the Klinefelter's syndrome sample, or both for UI1 and UI2 shoveling, UM1 and UM2 hypocones, and LP1 and LP2 multiple lingual cusps. For these traits, the pattern may be related to tooth size as individuals with Turner syndrome exhibit significantly lower grades of expression. The majority of crown traits did not show significant differences among the three samples. Assessing which traits are affected by variable numbers of X chromosomes will help further our understanding of the role sex chromosomes play in the development of tooth size and morphology.

Applying Sociopolitical Theory to Better Understand Processes of Migrant Death along the Texas-Mexico Border

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Mass violence includes not only direct harm of one group of people at the hands of another, but also indirect harm caused by sociopolitical policies that put specific groups of people at risk. Conditions of neoliberalism in Latin America have fostered an environment of poverty and violence that leave thousands of people little choice but to flee. In turn, those arriving at the USA-Mexico border face additional dangers, such as neoconservative attitudes that dehumanize the migrants and force them into dangerous clandestine routes across harsh desert environments. As a result thousands of migrants die along the southern US border in counties unprepared and unable to address this humanitarian crisis. Brooks County has experienced some of the highest numbers of migrant deaths in the state of Texas in recent years. Given conditions of neoliberalism in the US, local authorities do not have the resources for proper forensic investigations into the identity of the deceased. Until 2013, migrants were buried in pauper's graves pending proper forensic investigation. For the past three years the University of Indianapolis has been working with other organizations to exhume unidentified migrants and conduct forensic assessments that may contribute to their identification and the repatriation of their remains to family members. This presentation will discuss the forensic science utilized in this process and will present these data in light of broader cultural and theoretical contexts to more holistically examine the processes of mass death along the border, thereby better informing our interpretations of empirical data and hypothesis testing.

Anthropoid grooming ungues and ancestral state estimations of second pedal unguis form

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The presence or absence of a grooming unguis (often called a grooming or toilet claw) has been accorded special significance for cladistic analyses of early primates. It is generally assumed that strepsirrhines have grooming ungues on pedal digit II, tarsiers have them on pedal digits II and III, and anthropoids have nails. However, it has recently been shown that certain anthropoids do have grooming ungues on pedal digit II. This finding challenges the traditional schema because it renders the polarity of second pedal unguis states unclear. The current study examined the polarity of second pedal unguis forms using a set of 15 measurements collected from 187 second pedal distal phalanges encompassing all major extant primate genera. Measurements were size-adjusted by the geometric mean, converted into species means, and subjected to a principal components analysis (PCA) using princomp in R. Bayesian ancestral state estimations of the first two components were used to reconstruct ancestral states for major clades using BayesTraitsv2.0. Plotting the estimations into the original PCA space showed that the ancestral conditions of Primates, Strepsirrhini, Haplorrhini, and Tarsiiformes were similar to the grooming ungues of extant taxa. In contradistinction, the anthropoid estimation plotted with extant nails, indicating that grooming ungues were independently acquired by several platyrrhine lineages. These results suggest that an absence of a grooming unguis is a basal anthropoid trait and may help indicate phylogenetic affinity to anthropoids as traditionally assumed. However, future work will evaluate the robusticity of these results by incorporating fossil data.

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Dietary correlates of gut microbe composition in white-faced capuchins (*Cebus capucinus*)

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Nonhuman primate gut microbiota composition varies in response to changes in diet composition. To better understand the influence of temporal variation in fruit consumption on the gut microbiota of primates, a group of 21-22 white-faced capuchins (*Cebus capucinus*) at La Suerte Biological Field Station, Costa Rica was followed for 12 months. Information on activity budget and diet were collected, and fruit availability was assessed at 2-week intervals. DNA was extracted from fecal samples collected during the observational study (n=170), and the v3-v5 region of 16S rRNA was amplified. Samples were individually barcoded and sequenced on the Illumina MiSeq platform. Using the TORNADO pipeline, OTUs were identified and assigned to taxa. White-faced capuchin gut bacterial communities were characterized primarily by Proteobacteria and Firmicutes. Overall bacterial community structure was not significantly influenced by fruit availability (PERMANOVA, $p>0.05$), fruit abundance was negatively correlated with the relative abundance of the bacteria of the genus *Megasphaera* (Spearman rank correlation;

p=0.007, rho=-0.208) and positively correlated with *Serratia* and *Paralactobacillus* (p=0.017, rho=0.183; p=0.033, rho=0.163). The relative abundance of *Megasphaera* was negatively correlated with the frequency of consumption of *Psidium guava* and *Inga spectabilis* (Spearman rank correlation; p=0.007, rho=-0.205; p=0.010, rho=-0.198), *Paralactobacillus* was negatively correlated with the frequency of consumption of *Psidium guava* (p=0.045, rho=-0.154), and *Serratia* was negatively correlated with the frequency of consumption of *Hampea appendiculata* and *Dipteryx panamensis* (p=0.005, rho=-0.214; p=0.041, rho=-0.157). These results increase our understanding of how primate gut microbiomes are related to diet composition and my buffer seasonal differences in food availability.

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Genetic and morphological variation in natural and anthropogenic marmoset hybrids

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Brazilian *Callithrix* marmosets are emerging as an important primate hybridization model. Natural hybridization occurs at contact points between historically allopatric distributions of the six *Callithrix* species. Human introductions have also placed exotic *Callithrix* populations within the native ranges of congeners and created artificial sympatry between multiple exotic *Callithrix* species. Consequently, a smorgasbord of anthropogenic *Callithrix* hybrid populations now exists throughout Brazil, particularly within the Atlantic Forest. Although a negative role on biodiversity is emphasized for anthropogenic hybridization, a more complex view is developing for marmoset interspecific mating. Certainly, both natural and anthropogenic hybrids serve as evolutionary laboratories that better inform us on hybridization's role in shaping biodiversity. *Callithrix* hybridization has been studied through cases of natural and anthropogenic interspecific breeding. Admixture patterns based on mitochondrial DNA and autosomal microsatellites do indeed point to a species biodiversity decline under the latter context. However, phenotypic variation of pelage and morphometric features of various *Callithrix* hybrids exceeds that of parental species, and also features striking, novel phenotypes. Notably, the phenotypic data suggest that *Callithrix* hybrids may be experiencing a loosening of evolutionary constraints present in the parental species. Currently, on-going genomic research is looking at the evolutionary forces acting on natural and anthropogenic *Callithrix* hybrid populations. Additionally, the marmoset hybrid phenotype is being studied at a wider geographical and phylogenetic scale and data are being collected on an expanded swath of morphometric and pelage features. Thus, we are gaining further insight into what we can expect from hybrid primates, both inside and out.

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Embodied foundations of stone tool use shared by humans and bearded capuchin monkeys

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Tool-assisted percussion is the most archaic human technology in the archeological record. What skills enabled early hominins to use percussive tools, and what advances led to knapping tools? We adopt an embodied cognitive perspective to address these questions. We show that when cracking nuts with stone hammers wild bearded capuchin monkeys (*Platyhrrini: Sapajus libidinosus*) modulate the kinematic parameter of individual strikes, and the organization of successive strikes, to accommodate the properties and condition of the nuts. We analyzed video recordings of seven individually recognized monkeys as they cracked two different species of nuts, which differ in their resistance to fracture, with quartzite stones. Kinematic analysis revealed that the monkeys cracked a moderately resistant nut by striking it repeatedly with moderate force, modulating the kinematic parameters of each strike on the basis of the condition of the nut following the preceding strike. In contrast, they cracked a highly resistant nut by striking it with the maximum force they could generate until the nut was cracked. Thus, the monkeys organized their percussive movements spatially and temporally to match the changing requirements of the task—a feature fundamental to skilled percussion. Stone tools of the Oldowan industrial complex suggest that this skill was present among early hominins. Continuing comparative study should reveal the boundaries of percussive skills between humans and nonhuman primates to understand the biomechanical perquisites to stone-knapping in *Homo*. More generally, an embodied approach to movements offers a novel way to address fundamental questions of human evolution through comparative study.

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Hip fractures: an investigation of perimortem criteria

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To date, palaeopathological investigations of hip fractures have been sparse, which could suggest that such fractures rarely occurred in past communities. In contemporary Western society, hip fractures are the leading cause of fracture-related health care expenditure and mortality among males and females over the age of 50. The few examples of hip fractures surviving in the archaeological record are often well-healed fractures. This research aimed to test and expand existing palaeopathological methods of the identification of perimortem fractures and question whether individuals who died rapidly from the consequences of hip fracture can be better recognized in past populations. Ten documented individuals (nine females, one male) curated in the Robert J. Terry Anatomical Collection (Smithsonian Institution) died between one and 93 days after experiencing a hip fracture. Subtle pathological bone changes, including new bone formation and small hinge fractures, were found in five individuals, having developed in two individuals after only 13 days. This rapid development suggests that eburnation at fracture margins can be added to the list of perimortem fracture criteria. Using this recording model, there is potential for recently-occurring hip fractures to be better recognized in the palaeopathological record.

Chimpanzee laterality redux

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Laterality research in wild chimpanzees (*Pan troglodytes*) is now in its fifth decade. How researchers characterize and interpret patterns of chimpanzee hand use (laterality) across, and within research sites, has grown accordingly.

Chimpanzee manual behavior has been studied in three *Pan troglodytes schweinfurthii* populations – Gombe and Mahale in Tanzania and Budongo in Uganda; in three *Pan troglodytes verus* populations – Fongoli in Senegal, Bossou in Guinea, and Taï in Ivory Coast, and most recently, in one *Pan troglodytes troglodytes* population – the Goualougo Triangle, Republic of Congo. Some reports focus on single patterns, often tool-use, while others use a more exhaustive ethological approach. Over time a set of methodological and conceptual issues has emerged that bear on research design, interpretation and usefulness of results. A framework for interpreting results is provided to make a distinction between handedness, *sensu strictu*, the *Homo* condition, and handedness, *sensu lato*, which I will argue is more compatible with the *Pan* condition. Several issues that relate directly to the results obtained and their interpretation include: bouts versus events for data collection, sample sizes, combining samples within and between chimpanzee communities, what constitutes a claim of population-level laterality, degree of lateral bias, and direction of lateral bias. Finally, closer scrutiny of bimanual tasks, but most especially those that are involved in active object manipulation, may suggest more fruitful and revealing avenues of laterality research in wild chimpanzees.

Thigh and leg remains of *Homo naledi*

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Rising Star Cave is located in the Cradle of Humankind World Heritage site near Krugersdorp in South Africa. In November 2013 and March 2014 more than 1500 hominin fossil elements attributed to a new species, *Homo naledi*, were recovered and catalogued representing at least a dozen individuals. Only 20 out of 206 bones in the human body are not in the collection as currently represented from the excavation.

The thigh and leg of *H. naledi*, which are represented by 121 femoral, patellar, tibial, and fibular elements, are marked by a mosaic of primitive, derived, and unique traits that are functionally indicative of a bipedal hominin capable of long distance walking and, possibly, running. Traits shared with australopiths include a long, tall, and anteverted femoral neck, a mediolaterally compressed tibia, and a relatively circular fibular neck. Derived traits shared with *Homo* include a well-marked linea aspera, anteroposteriorly thick patellae, relatively long tibiae, and gracile fibulae with laterally oriented lateral malleoli. Unique features include the presence of two pillars on the superior aspect of the femoral neck and a strong distal insertion of the *pes anserinus* on the tibia. The mosaic morphology of the *H. naledi* thigh and leg appears most consistent with a species intermediate between *Australopithecus* spp. and *H. erectus* and, accordingly, may offer insight into the nature of the *Australopithecus-Homo* morphological transition. These fossils also expand the morphological diversity of the *Homo* lower limb, perhaps indicative of locomotor diversity in our genus.

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Ancient pathogen genomics: a strategy for the parallel detection of multiple pathogens in archaeological samples

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Confounding factors challenge the investigation of disease in antiquity, primarily the scenario where multiple evidentiary sources (e.g., skeletal, archaeological, or historical) do not provide a consensus or indicate the association of a specific disease with a given burial assemblage. Without such *a priori* knowledge, it is critical to integrate a molecular strategy capable of screening for the presence of multiple pathogens to prioritize candidates for further analyses. Here we report results of an in-solution RNA baits set designed to capture 1,152 pathogenic species of human significance via targeted enrichment coupled with high-throughput sequencing. Previously verified human pathogen genomes (e.g., *Yersinia pestis*, *Staphylococcus* spp.) functioned as positive controls ("known pathogen") to test the specificity and sensitivity of the baits set. "Unknown pathogen" samples (n=28) comprised various tissue types (e.g., bones, teeth, mummified tissue) and diverse spatiotemporal contexts (e.g., ancient Rome, medieval Europe, North America). Analyses show excellent performance in enriching the minute pathogen fraction of the DNA constituents (2-20% alignable post-capture reads, vs. 0.001-0.5% alignable pre-capture reads in most cases). Stringent bait design, efficiency of the capture protocol, and taxonomic assessment of sequence reads using the CLiMax algorithm produced few false positive and false negative outcomes; however, resolution of the pathogen profile depended on a sample's idiosyncrasies (e.g., preservation, amount of endogenous DNA). Further work on recovering low abundance pathogens in ancient DNA extracts is crucial to paleopathological applications focused on the complexity of synergistic disease interactions in varied archaeological contexts.

"Here's Looking at You, Kid:" Analysis of Longitudinal Growth in Medieval and Postmedieval London Populations

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Precise aging standards, which have enabled decades of cross-population demographic comparisons and collaborations, remain a paramount concern for bioanthropological studies. Unfortunately, developmental standards based on modern skeletal collections have been scrutinized for their potential problematic application to archaeological populations. The current study investigates this issue through an examination of juvenile longitudinal long bone growth in Medieval and Postmedieval London populations. Medieval (N=48) and Postmedieval (N=138) diaphyseal lengths were first compared between age cohorts established from dental development. T-tests indicate no significant differences in longitudinal long bone dimensions between periods. When age estimations from long bone length and dental development were compared, these alternative aging techniques yielded significantly different biological ages, notably for individuals of postpubescent years. Long bone age estimates were regressed against dental age estimates, and slopes for all long bones were less than 1, indicating that long bones under-estimate age when compared with dental eruption times. These results emphasize the inherent problems with applying twentieth-century long bone standards to age estimates of archaeological populations. Among past populations, longitudinal long bone growth was often compromised by nutritional deficiencies and chronic disease, whereas overall dental growth experiences greater buffering from these insults. Therefore, unless long bone aging standards are adapted for specific historical populations, biological age estimates from dental development provides a less biased method for juvenile demographic estimations.

Fermentation Mechanisms and Possible Antibiotics in Ethiopian T'ej: Bioarchaeological Implications

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The production of fermented beverages is a near-universal practice in both ancient and modern cultures. Brewed beverages are valuable sources of calories, B-vitamins, and proteins; in ancient Nubia, beer was even a source of the antibiotic tetracycline. In Ethiopia, a honey wine commonly known as T'ej has been consumed for over 4,000 years and is among the oldest fermented brews still consumed in modern populations. T'ej fermentation relies on the microorganisms present in the fermentation containers, but is unique in requiring the addition of twigs from the gesho plant (*Rhamnus prinoides*); moreover, T'ej contains both alpha-amylase and beta-amylase enzymes, though yeasts only produce the latter while bacteria tend to produce the former. This study therefore identifies the dominant bacteria and yeasts present on the gesho surface in order to more accurately characterize the precise role played by this plant and/or the microbes on its surface in starch saccharification during the brewing process.

Gesho twigs were obtained from Ethiopian groceries in Atlanta, and were analyzed through a three-phase solid-liquid extraction process and tested for inhibitory properties against *E. coli* and *B. subtilis*. These results suggest that gesho acts as a growth promoter during the fermentation process, and that the stems serve as a substrate for the red yeast *Rhodotorula*. Moreover, fluorescence of the solvent phase of gesho under ultraviolet light suggests the presence of an antimicrobial compound in T'ej. This suggests that bioarchaeological research in Ethiopian contexts, similar to that in Nubia, might yield additional examples of antibiotic use in antiquity.

Heterochrony of nasal turbinal development in Primates

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This study investigates development of the nasal turbinals in select primates from neonate to adult stages. Differences in the number, size, and placement of the turbinals throughout these taxa represent morphological variation that may reflect function. Crania of lemurs (*Lemur catta*; *Eulemur collaris*), bushbabies (*Galago moholi*; *Otolemur crassicaudatus*), tarsiers (*Tarsius syrichta*), and callitrichines (*Cebuella pygmaea*; *Saguinus oedipus*) at different ages (neonate, 1-month postnatal, and adult)were analyzed using CT scans and histology to identify patterns of turbinal development. As adults, these species fall into two distinct groups representing primitive and derived turbinal states. The lemurs and bushbabies have many turbinals, consistent with the primitive state. The tarsier and callitrichines are considered to have more derived characteristics because they have fewer turbinals. During development, bushbabies display precocial turbinal development with all turbinals ossified at birth. Lemurs have delayed turbinal development, with *Lemur catta* being significantly more delayed in ossification than *Eulemur collaris*. It is also observed that secondary lamellae appear at different ages in *Lemur* and *Eulemur*. In both lemurs, posterior turbinals do not ossify until after birth. Tarsiers have a unique pattern of development that is likely related to ocular hypertrophy. Finally, the callitrichines show precocial ossification of anterior turbinals, but no evidence of posterior turbinals in the bony skeleton at these stages, suggesting a truncated growth trajectory. Comparative study of turbinal development across primate species demonstrates one way heterochrony may produce morphological variation and influence olfactory and respiratory function.

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Substitution or Augmentation: is early complementary feeding that does not reduce breastfeeding intensity really "suboptimal"?

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Numerous international health organizations recommend exclusive breastfeeding (EBF) for the first 6 months of life as optimal for infant health. However, health and developmental risks associated with "suboptimal" ages of complementary feeding (CF) introduction are generally predicated on subsequent changes in breastfeeding intensity and/or pathogen exposure. Prelacteal feedings and early supplementation are widespread in subsistence-scale populations, yet may not uniformly supplant breast milk intake. This study evaluates whether or not the age of CF introduction—defined as any non-breastmilk intake before six months of age—affects breastfeeding intensity and age at weaning among the Tsimane, an indigenous Amazonian population. Data was collected during 2012-2013.from a mixed-longitudinal sample of Tsimane infants aged 0- 36 months.

In interviews, Tsimane mothers' reported reasons for introducing CF largely generally reflected concern for infant needs, not their own time or energy constraints. As determined by survival analysis, the mean ages of CF introduction and weaning were approximately 4 and 27 months, respectively. Early CF (before 3 months of age) was not associated with weaning hazard. In behavioral observations conducted with non-EBF infants aged 2 -16 months of age, neither the frequency of CF nor the frequency of breastfeeding per hour varied with age of CF introduction. Public health messages that frame any amount of CF before six months of age as risky relative to EBF may not be appropriate for families in which CF is gradually introduced without supplanting infant breast milk intake.

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History of the study of the enamel-dentine junction and new insights using microtomography

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The morphology of teeth is integral to numerous aspects of anthropological research including: dietary functional morphology, extant and fossil primate systematics and dental development. Although the majority of studies focus on the external morphology of teeth a growing number of researchers in the 20th Century began to see value in examining the internal morphology of tooth crowns. Specifically, they focused on the interface between the dentine crown and enamel cap, a surface often referred to as the enamel-dentine junction, or EDJ. These initial studies, some of which included hundreds of teeth across all tooth types from humans and other primates, provided considerable insight into the developmental origin of structures commonly studied at the enamel surface. However, the lack of appropriate samples in which the EDJ could be imaged non-destructively stalled this avenue of research. Recently, high-resolution imaging (microCT and synchrotron radiography) has provided a means by which the EDJ can be non-destructively imaged at resolutions sufficient to study almost all aspects of crown morphology that anthropologists are interested in. In this contribution, we review the history of EDJ studies and the insights and implications for anthropological research that are being provided by new imaging techniques.

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Genetic structure of the Chilean population

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The genetic structure of Latin American populations is relatively different from one region to another, both within and outside of countries. A wide range of demographic variables explain these disparities, including: 1) size and structure of local native populations, 2) rate at which Europeans settled in the region, 3) magnitude of the slave trade introduced in the area, and 4) social stratification of colonial and post-colonial populations. The genetic structure of the Chilean population has certainly been influenced by these factors. However, we know little about them. For example, although there is growing recognition of the genetic contribution of African populations in Chile, there is no consensus as to the approximate number of slaves brought to the region. Nor is there enough archaeological or genetic data to estimate size and structure of indigenous population when Spaniards arrived to Chile. We only have data to model two of the four demographic variables described: the rate at which Europeans arrived to the region and the current level of stratification in the Chilean population. We used previous estimates of local ancestry based on high-resolution genomic data (700k) from 313 Chileans in order to assess genetic structure related to socioeconomic strata (SES) using human development index (HDI) as proxy for SES. Regression analysis shows that higher SES display higher European genomic ancestry, while low and medium SES display higher Native American genomic ancestry. The relationship between socioeconomic stratification and genomic ancestry suggests the action of assortative mating processes taking place since colonial times.

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New questions about tools raised by recent finds of fossil hominin hands

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Comparisons of human and nonhuman catarrhine primate hand morphology in our laboratory have led to the identification of several derived modern human features that are consistent with requirements for joint mobility and forceful precision pinching of objects in early hominin tool making and tool use. As predicted, these features have been found (separately or in varying combinations) in early hominin hands contemporary with Oldowan stone tools. However, surprisingly missing from these fossils are additional derived human joint surface shapes, areas and curvatures compatible with accommodating large axial loads on the joint surfaces and forces transmitted across the wrist from the thumb. The use and manufacture of Acheulean tools may help to explain the evolution of some elements of this pattern in the genus *Homo*, first apparent in a fossil third metacarpal bone from West Turkana, Kenya dating to 1.42 Ma. However, recently published reports on wild chimpanzee hand use suggest that another factor may have been the use of strong grips and hand movements incorporating the base of the thumb and index finger that would have stressed human hands as they were increasingly used for retrieving and processing underground storage organs and meat and marrow from animal carcasses. These activities of the hand will be at the focus of experimental analyses that look beyond the role of tool use and tool making to the role of overall feeding behaviors in the evolution of the human hand.

Investigating patterns of admixture in rural Mesoamerica due to Spanish colonialism: genome-wide evidence from Xaltocan, Mexico

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After the Spanish conquest of Mexico in 1521, colonialism led to the creation of new communities containing individuals who had been born in three different continents (North America, Europe, and Africa) and who came from diverse cultural and linguistic backgrounds. Extensive research has shown that these individuals interacted frequently in Mexico City and other urban areas, but the extent of contact in rural populations remains unclear. In Xaltocan, a small town in central Mexico, archaeological evidence indicates that some native residents adopted Spanish material culture. However, colonial documents suggest that Spanish newcomers rarely visited this town.

While contact between individuals from different geographic, cultural, and linguistic backgrounds does not necessarily mean interbreeding between them, patterns of admixture can help clarify the extent and nature of whatever contact occurred. To evaluate patterns of admixture in Xaltocan, we combined previously collected mitochondrial DNA (mtDNA) sequences from 47 present-day residents of this town with new data on ~600,000 genome-wide single nucleotide polymorphisms (SNPs) for these individuals. These SNPs were genotyped using the Affymetrix Axiom® Human Origins Array. We compared mtDNA and Y-chromosome diversity patterns to detect sex-biases in admixture. We also analyzed the autosomal SNPs from our dataset in conjunction with comparable data from other Native American, European, and African populations to estimate individual ancestry proportions in ADMIXTURE and create PCA plots in EIGENSOFT. This study clarifies the extent and nature of colonial contacts in a rural Mexican community and the effects of the Spanish conquest on local genetic diversity.

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The diseased, the disabled and vampires in early medieval Culmine in Poland

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Historical evidence suggests that after death, some people were thought to become vampires causing harm or death to the living. Consequently, people became afraid of vampires and tried to render them harmless using elaborate burial and anti-vampire practices. Some disabilities and diseases (especially tuberculosis, anemia and scurvy) have symptoms that are similar to some of the characteristic features of the appearance associated with vampires.

We investigated if people with such disabilities and diseases were buried in anti-vampire graves. In this way, we also analyzed the perception of the diseased and the disabled. We analyzed 653 graves, including 14 anti-vampire ones and 661 skeletons from the early medieval (10th-13th century) cemeteries in Culmine (Poland). Anti-vampire practices from Culmine include decapitation, face down burial, and placing stones on the body. Our methods of research include the quantitative and the qualitative analyses of pathological lesions and mortuary evidence.

Significantly more people buried in anti-vampire graves (N=11) had pathological lesions that indicate diseases (chi2 test, $p<0.005$). But the qualitative analysis showed that they suffered from very common afflictions such as degenerative lesions, periosteal reactions, and injuries. Most people suffering from peculiar and serious diseases and disabilities were not given anti-vampire burials. Only 2 out of the 40 disabled were buried in anti-vampire graves. We conclude that diseases and disabilities were not associated with vampirism. People were probably used to the different appearance and the functioning of the diseased and the disabled and did not perceive them as vampires.

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Injury recidivism and early mortality in the Danish West Indies: a case study from the Holy Trinity Lutheran Church

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Historical and anthropological analysis of the biological costs of enslavement in the Danish West Indies is limited, despite the islands' role as a major hub for the importation of enslaved Africans into the Americas and the utilization of enslaved based plantation economy. Historical and anecdotal research suggests enslaved populations on St. Croix experienced high disease morbidity and mortality due to the demanding physical labor, poor nutrition, and poor environmental conditions. Bioarchaeological investigations into the role of structural violence on the lived experiences and overall health of enslaved populations on St. Croix remain limited. This poster addresses this deficit by analyzing how structural violence and subjugation becomes embodied within the population. Specifically, this poster analyzes frequencies of injury recidivism of non-lethal traumas, activity related stress markers, and age at death to address the increased allostatic load associated with enslavement on St. Croix with a small case study of individuals excavated from the Holy Trinity Lutheran Church (N=29). Results of this study show a significant relationship,($p<.05$), between the high frequencies of non-lethal trauma, such as fractured fingers and toes, activity related stress markers, including degenerative joint disease, and early mortality. These relationships suggest repeated exposure to non-lethal injuries during enslavement may lead to increased physiological stress and early mortality.

Levels of Analysis: What unit is the most appropriate for understanding the effects of market integration?

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Introduction: Market integration is now pervasive among the small-scale societies often studied by anthropologists. Its effects are powerful, wide-ranging, and often fast. The rapidity and depth of cultural transformation associated with market integration offer a narrow window of opportunity for understanding evolutionary processes that would otherwise operate over longer periods; however, tracking these accelerated changes also requires methods that allow for finer resolution than are often offered by anthropological studies of small-scale societies. In this paper, we ask a question that is critical to the successful depiction of these processes: at what level should we be looking for market integration and its effects on human biology and behavior? **Methods:** We simulate the effects of market integration among the Mosuo of Southwest China, a population currently undergoing rapid market transition. We explore the effects of individual, village, and regional markers of market integration on age at first birth, an outcome canonically affected by economic development. **Results:** Preliminary results indicate that market integration is a robust and inverse predictor of age at first birth, but that putative markers vary in their service as proxies. In particular, individual indicators may reflect local opportunity structures in ways that mask larger-scale effects of market integration. **Conclusion:** Multiple levels of market integration interact in ways that are context-specific in affecting the biological and behavioral outcomes of interest to physical anthropologists.

The Forensic Anthropology Center at Texas State and Associated Texas State University Donated Skeletal Collection

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The Forensic Anthropology Center at Texas State (FACTS) was established in 2008 in San Marcos, TX with the mission to advance forensic science and anthropology through world-class education, research, and outreach. An important part of FACTS' mission is to make available to the greater scientific community the individuals that have been donated to the FACTS Willed Body Donation Program. At the time of this publication, the Willed Body Donation Program consists of N=282 individuals and is growing at a rate of approximately 70 individuals per year. Each individual has a detailed life history, living photographs, medical records, tissue samples, and blood samples available to researchers. Demographic information includes: 171 males, 111 females, 258 European Americans, 14 African Americans, and 10 Hispanics. The mean age of the individuals is 65.3 years with a range of 26 weeks to 102 years. After each individual is placed in our 26-acre outdoor decomposition research laboratory, the skeletal remains are curated into the Texas State University Donated Skeletal Collection (TXSTDSC) in perpetuity. The TXSTDSC has 100+ individuals curated with complete biological profiles, standard cranial and postcranial measurements, pathological conditions, and anomalies available for study to researchers at all levels. In addition to our TXSTDSC, FACTS also has state of the art technology available including micro-CT, digital radiography, high-resolution 3D imagery, 3D landmark data collection, 3D printing, and bone histology lab. These technologies combined with an in-house documented skeletal collection provide unique and important opportunities for anthropologists in all sub-disciplines looking to explore new skeletal collections.

The deposits of Jacovec Cavern, Sterkfontein: A high resolution application of sedimentological analyses for palaeanthropological studies

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Sterkfontein is one of the most productive paleoanthropological sites in the world. Investigations in the Jacovec Cavern, one of Sterkfontein's deepest chambers, were prompted by the discovery of an in situ *Australopithecus sp.* partial cranium. The site provides a rare opportunity to investigate well preserved, morphologically intriguing hominin fossils and stratigraphically associated fauna from a highly fossiliferous, discrete and in situ deposit. Previous works in the Jacovec Cavern provided initial hominid morphological descriptions from the original fossil and 11 ex situ specimens and placed them within a preliminary taphonomic, stratigraphic and chronological framework. This project applies high resolution sedimentological analyses (from thin sections, petrographic descriptions and facies analysis) and identifies four stratigraphic units documenting the long sequence of deposition in the cave. The units include a basal laminated, micaceous, carbonate-deficient silty mudstone erosionally overlain by a cherty gravelly horizon. These are overlain by laterally extensive, fossiliferous carbonate-rich breccias (an older 'brown' and younger 'red'). Micromorphological clastic analysis has contributed greatly to our understanding of karst development at Sterkfontein, with the presence of ghost rock structures denoting the phreatic stages of the cavern and subsequent lithification and reworking of allogenic and autogenic sediments. The uppermost breccias indicate a primary deposition of locally sourced fossilifeous sediments represented by laterally extensive, correlatable deposits. These interpretations are contrasting to that of previous work by Partrigde et al. This study demonstrates the importance of high resolution sedimentary analyses in complex palaeoanthropological studies.

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Does tooth size matter? A dental analysis of StW 252 from Sterkfontein, South Africa

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Sterkfontein West Pit, dated to 1.7-1.9 Ma, has yielded a number of fossils that are difficult to classify, such as StW 252, which comprises cranial bone fragments, and a full set of robust maxillary anterior and posterior teeth. The purpose of this study is to ascertain whether dental measurements of StW 252 more closely align with those of *Australopithecus africanus*, *Paranthropus robustus* or *Homo sapiens*. StW 252 is particularly large in its mesiodistal dimensions of I1, whereas its I2 measurements overlap those of the comparative samples. The canines of StW 252 are mesiodistally large, whereas the premolars of StW 252 are most similar to *P. robustus*, particularly P3. For M1 and M2, StW 252 is distinct from the comparative samples, and is particularly large buccolingually for M1 and mesiodistally for M2, partly resembling the dimensions of *A. africanus*, whereas for M3, StW 252 is mesiodistally and buccolingually large. StW 252 is outside of all 68% sample confidence ellipses for the molars. Significant differences, from an analysis of variance, exist between StW 252 and the comparative samples except I2 and the canine. When P4, M1 and M2 buccolingual and mesiodistal measurements are compared in a discriminant function analysis, StW 252 is misclassified as *A. africanus*. Canonical scores axes project StW 252 as extreme in terms of size and polarized from *P. robustus* in terms of shape. StW 252 is distinct from both *A. africanus* and *P. robustus*, indicating an additional hominin taxon may be represented at Sterkfontein West Pit.

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How tough is the grey-cheeked mangabey: Patterns of trauma in *Lophocebus albigena*

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This study examines the pattern of survivable trauma in a skeletal sample of *Lophocebus albigena* and discusses its potential connection to social organization and behavior. The collection derives from free-ranging populations from various locations in Uganda in the late 1950s and is currently housed at the University of Minnesota. Healed and healing skeletal trauma is described from the examination of 29 adult males and 27 adult females, totalling 10,942 bones. Across all bones, trauma is seen in 1.87% of the sample with a significantly higher frequency in males than females (M=1.95%, F=0.57%, P<0.001). The highest frequencies of trauma are seen in ulnae (10.35%, n=58), fibulae (7.27%, n=55), and metatarsals (7.17%, n=251) in males, and ulnae (5.88%, n=51), sacra (3.7%, n=27), and fibulae (3.85%, n=52) in females. No trauma is found in occipitals, temporals, parietals, maxillae, mandibles, sternums, or presacral vertebrae. In addition to the overall trauma load, statistically significant differences of trauma are observed between the sexes for ribs, phalanges, and metatarsals with adult males sustaining significantly more trauma than adult females in each case. The differences in overall trauma patterns may be related to social organization and other possible causes are discussed further.

Occupational Stress on Oaxaca's Pacific Coast, a Bioarchaeological Analysis of the Rio Viejo Weaver

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This paper provides a micro-scale consideration of the broader social processes under way during the Early Classic period (AD 250-500) in the lower Río Verde valley of Oaxaca, Mexico. Through a detailed bioarchaeological analysis, we examine a single individual from Rio Viejo who lived during the post-collapse era. This individual was an adult female who showed signs throughout her skeleton of occupational stress. While occupational stress occurs in individuals across sites in the Lower Rio Verde, here, we focus on a suite of dental and skeletal changes that, elsewhere, have been attributed to weaving. She was also buried in the fill of an abandoned ritual structure with a number of grave offerings including an undecorated ceramic disk that was likely a spindle whorl. The earliest direct evidence for cotton use in the Lower Rio Verde valley dates to the late Terminal Formative period and derives from a single fibrous wad of genus *Gossypium*; with bone needles from contemporaneous contexts documented at the sites of Yugüe and Río Viejo. Thus, it seems plausible that cotton production was taking place in the valley at least a century before the death of B81-I90. Taken together, the pathologies and burial features suggest an individual potentially engaged in two distinct forms of fiber-working: spinning and weaving, as well as basketry and/or cord. How the juxtaposition of her physical health, burial location, and grave contents reveal the complex interplay of economic, religious, and political tensions during an era of significant social change will be discussed.

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Testing models of brain size evolution in canids and primates

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Increased encephalization has been observed multiple times in mammalian evolution, including among hominins. Previous research among Primates and hominins has suggested that increased brain volume relative to body size might be an adaptation to accommodate increased sociality, or increases in behavioral complexity related to hunting, or increased endurance activity. The Canidae are an ideal group in which to evaluate whether these factors explain brain size evolution in another mammalian Family that varies in sociality, hunting and endurance activity. We used data on brain volume, social structure, limb length, and hunting method for 28 species of extant Canidae with good representation of species (n=4) that hunt cooperatively vs not (n=14) and those that are highly social (n=5) and those that are not (n=5), and those that are capable of high endurance (n=10) or not (n=6), where limb length was used as a predictor for endurance capability, to determine whether there is a statistically significant relationship between sociality, hunting technique, or limb length and relative brain volume. No such significant relationship was found and ANOVA revealed that neither sociality, hunting, nor endurance activity explained a significant amount of variation in relative brain size. Thus, unlike primates and hominins canid brain size does not appear to be influenced by social or locomotor factors and the precise mix of causes of brain size evolution is appears to vary across mammalian groups.

Too sick to have another baby: Effects of perceived health on family planning in the Bolivian Amazon

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Life history theory predicts that under conditions of high exogenous mortality, and morbidity, investments in earlier and greater reproduction are favored at the expense of investments in human capital. Preferences for large ideal family size (IFS), earlier age at first reproduction, and shorter interbirth intervals (IBI) are expected when individuals perceive their environment to be characterized by high morbidity and mortality. We explore the relationship between perceived health and fertility preferences among Tsimane, forager-farmers who experience high morbidity and infant mortality rates, and high fertility (total

fertility rate=9.1). Women's (N=127) fertility preferences for themselves and their children, and perceptions of local morbidity and mortality were collected through semi-structured interviews. IFS for self and sons was not associated with perceived morbidity or mortality. However, 33% of women stated that large families have poor maternal and child health; and, women who perceived child mortality to be high were 4.2 times more likely to have smaller IFS for their daughters (p=0.034). Preferred age at first birth for children was not associated with perceived morbidity or mortality. High perceived infant mortality rates were associated with longer preferred IBI (β(4,75)=0.487, p=0.048) for self, but only 12% of women stated health concerns as a reason for preferring longer IBI. In sum, we show no evidence that perceived high mortality or morbidity encourages preferences for higher fertility. We suggest instead that illness and mortality are increasingly perceived as modifiable given increasing healthcare access, and this may deter investments in reproduction given limited financial resources.

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Low body temperature among primates and implications for energy expenditure

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Primates expend significantly less energy than would be expected for a placental mammal of their body size, yet they show no deviation from other mammals in basal metabolic rates. Although previous explanations for this trend have focused on primates' slow life histories lowering their energy expenditure, we propose that another important variable may be primates' increased ability to escape from predators in arboreal environments, relative to ground-dwelling mammals. Much of mammalian predator escape is dependent upon anaerobic burst speed, which scales positively with body temperature. Thus, we predict that body temperature positively correlates with evolutionary dependence on predator escape bursts.

We used energy expenditure and BMR data from the Pontzer et al. 2014 PNAS dataset, data on body temperature and other physiological functions from the International Species Information System's database of Physiological Reference Values, and ecological data from the PanTHERIA database.

Arboreal mammals had lower body temperatures than terrestrial ones (F[1,273]=7.614; p=0.00618), providing support for the decrease in probable predator escape energy expenditure among arboreal primates. Primates also had lower body temperatures than expected for their relative ratio of total energy expended to BMR (t[21.519]=3.2902; p=0.003409), providing further evidence of primates' exceptionally low body temperatures among mammals. With lower than expected body temperatures, primates should have lower than expected BMRs, which they do not. Among the metabolic functions that may account for this deficit in BMR are not only the energetic demands of maintaining growth over a slow life history, but also those of maintaining strong immune function throughout life.

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Skeletal Anomalies and Paleopathology of DeArmond (40Re12), a Mississippian Site in Eastern Tennessee

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DeArmond was one of the many sites excavated by the cooperative efforts of the TVA, WPA, and University of Tennessee in the late 1930s and early 1940s. The site was located on the east bank of the Tennessee River, on bottom lands that previously joined the DeArmond and Detheridge Farms. Occupation at DeArmond dates to AD 1200-1450, which overlaps the Hiwassee Island, Dallas, and Mouse Creek phases in East Tennessee. Like most Mississippian sites during this time, the site consisted of a mound (3Re12) and a village (2Re12).

Each skeleton at the site was examined for the presence of three common markers of metabolic stress: cribra orbitalia, porotic hyperostosis, and linear enamel hypoplasias, as defined by Ortner, and Roberts and Manchester. Additional data was recorded for 10 developmental defects as outlined by Barnes. These thirteen markers were then analyzed in light of status differentiation based on mound versus village interment and by age group (infants/children, subadults, adults).

The overall low rates for porotic hyperostosis in the mound and village indicate that status had little to do with access to high protein food resources. Conversely, linear enamel hyperplasia rates were higher for individuals in the village than in the mound while rates for cribra orbitalia were mixed and moderate overall. Developmental defects were most common in the spine and sternum; however, rates overall were generally low.

Indicators of Stress within Modern Undocumented Border Crossers Along the South Texas Border

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Unidentified human skeletal remains found along the U.S.-Mexico border present a medicolegal humanitarian crisis. Many of these individuals, referred to as Undocumented Border Crossers (UBCs), have perished along the border as a result of exposure to the harsh South Texas environment. The skeletal remains exhumed from Brooks County, Texas are housed at Texas State University where they are currently undergoing identification efforts.

It is unknown whether these individuals were attempting to cross the border to seek economic opportunities or to flee from social or political unrest; however, preliminary analyses of the skeletal material indicate they display an assortment of pathological stress markers including porotic hyperostosis (PH) and cribra orbitalia (CO). The purpose of this study is to assess the degree of expression of PH and CO. This analysis will help to create a biocultural profile for the socioeconomic status of this population.

In this study, 37 adult crania were scored macroscopically and radiographically for the presence/absence of PH and CO. It was hypothesized that a moderate percentage would exhibit both PH and CO. Results indicate 100% (37/37) displayed active and healed forms of PH, and 91.9% (34/37) exhibited CO. Additionally, it was noted that 45.9% (17/37) of the UBCs displayed linear enamel hypoplasias on at least one tooth. The high prevalence of both PH and CO is significant in reinforcing the fact that the UBCs were coming from a heavily stressful environment, and is likely one of the factors that influenced their decision to cross the South Texas border.

Avifaunal contributions to the paleoenvironment of *Kenyapithecus*, *Victoriapithecus*, and other middle Miocene primates from Maboko Island, Kenya

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Kenyapithecus and *Victoriapithecus* from middle Miocene deposits on Maboko Island provide much of the fossil evidence for African ape and Old World monkey origins. Until now, the paleoenvironment of African middle Miocene primates has primarily been reconstructed from habitat-specific adaptations of associated mammals. We recovered numerous remarkably complete bird fossils from Maboko and identified many of them to family or genus. Only recently have some of these remains been studied in greater detail.

Fifteen different kinds of birds have been identified in the Maboko assemblage but only a few dozen specimens from 12 of these groups have yet been fully identified. The largely unidentified groups – for which relative abundances are not yet available - are

Anseriformes (ducks, geese, swans), Charadrii (wading birds, including ibises and thick-knees), and Galliformes (francolins, guineafowls, partridges, quails). Most of the fully identified Maboko birds are aquatic or semi-aquatic forms, including herons and bitterns (Ardeidae, 9%), storks (Ciconiidae, 6%), flamingos (Phoenicopteridae, 11%), pelicans (Pelecanidae, 6%), cormorants (Phalacrocoracidae, 18%), two species of lily-trotters (Jacanidae, 11%), gulls (Laromorphae, 3%), and river kingfishers (Alcedinidae, 6%). The remaining taxa are arboreal or terrestrial birds, including hoatzins (Opisthocomidae, 9%), turacos (Musophagidae, 6%), hornbills (Bucerotidae, 6%), and houbaras (Otididae, 9%).

The abundance of aquatic birds reaffirms that riverine woodland environments, together with open water, predominated at Maboko. Hoatzins, turacos and hornbills reflect forested environments. The presence of houbaras, in contrast, suggests that grasslands were an emerging environment during the time that African apes and Old World monkeys originated and diversified.

Mating asymmetry in the formation of the Kinda x chacma baboon hybrid zone

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Natural hybrid zones commonly show evidence of formation by sexually asymmetric mating. A previous study, by Jolly et al., of phenotypically diverse groups of *Papio kindae x P. ursinus* hybrids in the Kafue National Park, Zambia suggested asymmetric mating in their ancestry. Mitochondrial / Y-marker discordance was found in 9/17 male fecal samples from this zone. In every case, a kinda Y was combined with a chacma mitochondrial haplotype, suggesting that the hybrid groups originated by mating between (small) male kinda, and a (large) female chacma baboons.

The present study explores genetic diversity and its behavioral correlates in one of the hybrid groups previously sampled. Fecal samples from 13 males were, as before, typed by sequencing the Hypervariable Region I of the d-loop (mitochondrial marker) and genotyping the DYs576 microsatellite (Y-marker). In nine males, both mitochondria and Y chromosomes were chacma-derived. Of the four animals with mitochondrial/Y discordance, two had the usual combination of kinda Y and chacma mitochondria. Two individuals had the opposite combination, not previously observed, of chacma Y with kinda mitochondria. This observation suggests that male chacma x female kinda mating, though less frequent than the converse, played a role in the formation of these hybrid populations. Further work on multiple nuclear loci will be required to document the obvious complexity of the kinda-chacma hybrid zone.

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Thermal Benefits of Grooming in Primates

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A strong case has been made that the primary function of grooming is hygienic. Nevertheless, its persistence in the absence of hygienic demand, and its obvious tactical importance to members of primate groups, underpins the view that grooming has become uncoupled from its utilitarian objectives and is now principally of social benefit. We identify improved thermoregulatory function as a further benefit of grooming and so broaden the utilitarian function of this behavior. Deriving the maximum thermal benefits from the pelt requires that it be kept clean. Grooming is an obvious way to achieve this. In a series of wind-tunnel experiments, we measured the heat transfer characteristics of vervet monkey (*Chlorocebus pygerythrus*) pelts in groomed and ungroomed conditions. Our data indicate that simulated grooming improves the thermal performance of the pelt, offering significantly better insulation than ungroomed pelts ($t=-12.80$, $df=6$, $P<0.001$) and, hence, better protection from the cold. Groomed pelts also experienced significantly lower radiant heat loads compared to ungroomed pelts ($t=6.56$, $df=6$, $P<0.001$), providing improved protection from the heat. Such thermal benefits therefore furnish grooming with an additional practical value to which its social use is anchored. Given the link between thermoregulatory ability and energy expenditure, our findings suggest that grooming for thermal benefits may be an important explanatory variable in the relationship between levels of sociability and individual fitness.

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A stressful legacy: Childhood stress and longevity

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Episodes of physiological stress experienced during childhood are often linked to decreased longevity. While studies have often shown a positive association between increasing numbers of childhood stress episodes and correspondingly earlier ages at death (i.e. weathering due to accumulated stress), research has also demonstrated that repeated stress episodes are more likely to occur following an early age at stress onset (i.e. it is the timing of defects that is central to long term cost).

We explore these models, weathering versus defect timing, by reanalysing enamel hypoplasia and age at death in a series of individuals from Bahrain Island (Bronze age, Iron age, Hellenistic and Islamic periods, n=160).

In all four samples, more than 80% of individuals have least one hypoplastic defect. The highest frequency is amongst sub-adults e.g the 10-15 yrs in the Hellenistic sample had 3.2 defects on average compared with <2 defects for adults over 30 yrs, which might suggest a weathering effect. However, the children in this sample who died between 3-10 yrs had significantly fewer defects, which does not correspond to a simple model of weathering. In contrast, all sub-adults with LEH experienced earlier onset – suggesting that timing is important.

We argue that both timing and weathering are factors but that the relative importance of these relationships is explicitly mediated by the developmental environment of children which in this instance includes variable infection rates.

Breastfeeding and ovulatory status affect $\delta^{15}N$ values: Evidence from living Maya women from Guatemala

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Nitrogen stable isotope ratios ($\delta^{15}N$) in human tissues are often used to make inferences about past human diet, particularly about the trophic level of proteins consumed. Existing evidence suggests that inter-individual variation in $\delta^{15}N$ partly reflects inter-individual variations in sources of dietary protein, with higher $\delta^{15}N$ values associated with diets richer in higher trophic level animal proteins compared to lower trophic level plant proteins. However, the extent

to which other metabolic factors may influence $\delta^{15}N$ variation is currently poorly understood.

To assess the possible relationships between other, non-dietary metabolic factors and $\delta^{15}N$ values, we used data from living peoples with known diets and metabolic states. Specifically, we measured $\delta^{15}N$ values in fingernail samples from 92 living Guatemalan Maya women. We also measured participants' body size, diet, breastfeeding status, and ovulatory status and included these metrics in our analyses.

After adjusting for body size and diet, women that were both breastfeeding and ovulating had $\delta^{15}N$ values that were depressed relative to non-breastfeeding women. Women who were breastfeeding and not ovulating presented depressed $\delta^{15}N$ values relative to both ovulating breastfeeders and non-breastfeeders. The mean difference in $\delta^{15}N$ values between the extreme groups – non-ovulating breastfeeders and non-breastfeeders – was equivalent to half a dietary trophic level.

Our results suggest that breastfeeding/ovulatory suppression can mimic the effects of meat-poor diets with respect to $\delta^{15}N$ values. The roles of breastfeeding and reproductive status on protein metabolism should be considered when making inferences about inter-individual and inter-sex variation in past human diets from $\delta^{15}N$ measurements.

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A new *Cheirogaleus* (Cheirogaleidae) species from Ankarana, Madagascar

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Multiple individuals of the lemur genus *Cheirogaleus* (previously identified as *C. medius*) from localities in northern Madagascar (Ankarana, Andrafiamena, Analamera, Bekaraoka) were suspected to be a new species based on phenotypic variation. Samples were taken from immobilized animals for later evaluation. Subsequent analyses of these samples were conducted via a combination of wet bench and computational techniques, and included analyses of nuclear (FIBA, vWF, CFTR-PAIRB) and mitochondrial (cytb, COII, COIII, D-loop, ND3, ND4L, ND4, several tRNA genes, and the PAST fragment) loci. Results were analyzed phylogenetically via maximum likelihood (ML) and Bayesian methods. Samples consisted of *Cheirogaleus* individuals from across Madagascar representative of all known and suspected species in that genus and outgroup taxa. The results of these analyses were subjected to a series of tests to examine the strength of the results. Phylogenetic trees constructed via these analyses were then used to examine genetic divergence between lineages. Briefly, we observed that this lineage formed a distinct clade with high support values (ML= 96; Bayesian= 1.00) and notable genetic divergence across all tested loci. The full cytb loci, for instance, displayed genetic distances of 4.7-8.0% between this new species and all other *C. medius* individuals surveyed, and 11.7%±0.9% divergence from the geographically close *C. andysabini* (part of the *C. crossleyi* species group)lineage. Based on the genetic evidence we have elevated this lineage to species status as *C.* **sp. nov. 4**, with a binomial taxonomic name to be released in a forthcoming publication.

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The Relationship between Superior Calcaneal Facet Area and Achilles Tendon Length in Primates

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Modern humans have the longest Achilles tendon (AT) of all the living primates. It has been proposed that this anatomy increases locomotor efficiency and that its elongation may have played a crucial role in the origin and early evolution of the genus *Homo*. Unfortunately, determining the length of AT has been difficult as tendons do not fossilize. Several methods have been proposed for estimating the length of the AT from calcaneal morphology, but the results have been inconclusive. This study tested the relationship between the area of the superior calcaneal facet and relative AT length in extant primates. The superior facet was chosen because it holds the retrocalcaneal bursa, a soft tissue structure which helps to reduce friction between the AT and the calcaneus. Calcanei from 87 extant primates from the genera: *Ateles*, *Cebus, Chlorocebus, Gorilla, Homo, Hylobates, Lagathrix, Macaca, Pan, Papio,* and *Pongo* were photographed in posterior view and the superior facet quantified using ImageJ. AT lengths were obtained from published sources. Using least squares regression analysis, the relative area of the superior facet is strongly predictive of AT length in primates (R^2=0.72; p=0.0005). This model was applied to available *Australopithecus* calcanei to predict AT length. Preliminary results suggest that *A. afarensis* (A.L. 333-8; -55) possessed a longer, more human-like, AT than previously suggested, while *A. sediba* had a shorter AT. The presence (or absence) of an elongated AT in *Australopithecus* has important implications for the locomotor capabilities of these species, including their capacity for endurance running and climbing.

To care or not to care? Paternal and alloparental infant care in free-ranging male Coquerel's sifaka (*Propithecus coquereli)*

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Non-maternal infant care is rare among primates and other mammals and is only expected to occur when the caregiver stands to benefit either directly (e.g. increase future mating opportunities and/or reproductive success) or indirectly (shared genes). Degree of relatedness determines the indirect benefits and is therefore predicted to influence the extent that helpers help. Fathers have a high of a degree of relatedness, but risk paternity uncertainty, thus paternal care it is primarily seen in monogamous or pair-bonded species. Male sifakas have been known to exhibit infant care, ranging from tolerance to affiliative relationships with the infant despite not being a pair-bonded species. Infants who receive non-maternal care may have an increased chance of survival and also enhanced social development. I observed male infant care in a group of free-ranging Coquerel's sifaka (*Propithecus coquereli)* at the Duke Lemur Center from Jun-Jul 2015. The group consisted of the mother, her infant, and two adult males – the infant's father and her maternal uncle. Due to the composition, paternity certainty is high for the father. I found differences between the males in time spent in infant care behaviors (grooming and play) and differences in the males' overall distance to the infant (Mann-Whitney test: Z=29865, p<0.0001, n=610), with the father investing more than the uncle as predicted by the degree of relatedness. However, Hinde's indices indicated that both males were actively maintaining social relationships with the infant, suggesting both males may be gaining benefits from engaging in infant care, despite differences in relatedness.

A Study of Habituation in *Eulemur flavifrons*

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The Anabohazo Forest, part of the Sahamalaza-Iles Radama National Park in north-western Madagascar, is one of the only remaining forest fragments to house wild groups of blue-eyed black lemurs (*Eulemur flavifrons)*. The groups in Anabohazo have had little contact

with humans and were described as semi-habituated prior to this study. The aim of this study is to evaluate changes in behavior associated with research habituation over a relatively short period of consistent, but discontinuous, contact. We recorded one group's behavior with respect to our presence over a period of 17 days in April, 2015. We predicted a reduction in display and avoidance behaviors along with an increase in curiosity and, ultimately, a trend towards ignoring our presence altogether. We saw a clear change in the behavior of the group of *E. flavifrons* during this study. They were more tolerant of our presence by the end, with the majority of behavioral responses shifting from avoidance, display and curiosity, to curiosity and ignore. In addition, we found that their home range directly overlapped with that of a second group of *E. flavifrons* with the largest concurrence occurring at a main feeding tree, typical during the dry season in Sahamalaza. The conservation status of this species is critical and any research furthering our understanding of its behavior, ability to adapt, and environment, such as this study may provide, is invaluable.

The relationship between clavicle length and scapula position in living humans

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Multiple hypotheses link functional innovations in *Homo erectus* to presumed evolutionary shifts in shoulder girdle anatomy. The identification of such shifts is predicated on reconstructions of the articulated structure from the morphology of dissociated bones. The manner in which clavicle length influences the position of the scapula on the thorax is central to a recent debate over the configuration of the *Homo erectus* shoulder. However, the relationship between clavicle length and scapula position has yet to be demonstrated at the individual level.

Here, we present new data derived from 3D CT scans of living humans to assess the relationships among clavicle length, the form of the upper ribs, and *in vivo* scapula position. Our results show that relatively short clavicles are associated with a more sagittally oriented scapular blade and anteriorly facing glenoid, as previously suggested. However, when this regression is applied to the Nariokotome skeleton, the predicted orientations of the blade and glenoid fall within the human range of variation. Our findings support a modern human-like reconstruction of the *Homo erectus* shoulder. Upper rib shape does not appear to be closely related to these aspects of scapula position in living humans.

Craniofacial growth and dietary variability in an experimental model for primate fallback food use

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Morphological studies of the evolutionary and functional role of diet often emphasize the mandible, for very apparent reasons. Additionally, long-term masticatory loading is known to affect the craniofacial skeleton. As the diets of wild primates (and perhaps those of early hominins) are often highly seasonal, an experimental model was developed to assess the influence of intra-individual dietary variation on skull growth. Four dietary cohorts (n=10/cohort) of a well-established experimental species (rat) were raised from weaning to skeletal maturity and imaged longitudinally. Two cohorts were fed non-variable diets: either a "resistant" diet of solid pellets or a "non-resistant" diet of powdered pellets. The other two cohorts were fed a variable diet of either solid/powdered pellets for the first half of the study, followed by a shift to the opposite diet. Neither gross dimensions (linear and centroid sizes) of the craniofacial skeleton nor the angle of basicranial flexion differed significantly among the treatment groups at the adult stage. The size and orientation of muscular processes of the skull did vary significantly among the cohorts. The early, post-weaning diet was found to affect the morphology of the posterior region of the zygomatic arch (superficial masseter attachment), whereas variation in the anterior region (deep masseter) was related to a late, post-shift diet. Like the mandible, the facial skeleton appears to demonstrate ontogenetic and functional modularity influenced by masticatory loading. Behavioral interpretations of skeletal morphology may thus be influenced by both the ontogenetic timing of loading stimuli and the maturation rates of individual musculoskeletal units.

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Forensic Residue Analysis at Olduvai Gorge, Tanzania: Methodological Challenges in the Study of Tool Use and Diet 1.8-1.3Ma

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Several compendia have illustrated the reach of conventional approaches to exploring the evolutionary origin of omnivorous diets. Included are the cost of developing unusually large brains and bodies, tooth size, shape, enamel thickness, mechanics and wear, and the chemical signal (e.g. isotopes) from diet left on bones and teeth. Over the last decade, a new interpretation of human origins has proposed a long history of dependence on fire, suggesting that humans are biologically adapted to cooked foods. However, both the conventional and more recent approaches have not provided direct indication of plant utilization as a key dietary component, nor have they revealed which tools were used to process different types of food.

This paper introduces forensic residue analysis at Olduvai Gorge to explore tool use and diet between 1.8-1.3 Ma using ancient plant molecules and biomarkers. We tackle multiple controls to understand the preservation of organic residues while identifying sources of contamination that could lead to false positives in the field. Results include residues from natural clasts, airborne contaminants introduced by human activity such as on- and off-site residues dispersed by excavation personnel in and around work sites, and sediment and soil controls from excavation areas and off-site modern topsoil. We also present starches and phytoliths from Olduvai sites Phillip Tobias Korongo (part of the 'Zinj' palaeolandscape at 1.84 Ma) and Thiongo Korongo (1.3 Ma), and conclude that pervasive organic and inorganic contamination requires the implementation of mobile forensic clean room technology at excavations.

Development of female-dominance in lemurs coincides with androgenic development

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Female dominance over males is rare among mammals but common among adult lemurs. Due to the role androgens play in activating aggressive behavior in male mammals, they are likely candidates for organizing and/or activating elevated rates of female aggression directed at males in female-dominant species. Comparative data are generally consistent with an androgenic mechanism, but the details differ across species and remain poorly understood. Recent work in ring-tailed lemurs (RTLs) has implicated androgens in organizing female dominance during the prenatal period and activating it in adults, but the role of androgens from birth through adulthood is completely unknown. Using enzyme immunoassay, we assessed total androgen concentrations from 343 fecal samples

collected from 9 female and 27 male wild ring-tailed lemurs aged 2 to 48 months and analyzed them using GLMM to account for repeated measurements. These preliminary data indicate that immature RTLs have mammal-typical developmental profiles of fecal androgens—males and females have low, indistinguishable levels of androgens during infancy and juvenility (sex: $\chi^2 = 1.489$, $P = 0.22$), followed by dramatic androgenic increases beginning just prior to sexual maturity (age: $\chi^2 = 16.852$, $P < 0.001$). This increase coincides with behavioral changes in dominance relationships, when subadult female RTLs assert dominance over male age-mates, and with the appearance of anogenital marking by both sexes. These data are consistent with previous hypotheses regarding the role of androgens in fetal and adult life, but suggest that the postnatal, prepubertal lifespan has not been targeted during the evolution of female dominance in lemurs.

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Preliminary zooarchaeological and taphonomic analysis of FwJj70, a butchered bone surface assemblage from the Okote Member of Koobi Fora, Kenya

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FwJj70 is a zooarchaeological surface assemblage that sits atop the erosional apron of a three-meter-tall hillock of fining upward silt and clay strata. It lies below the Chari Tuff in the upper Okote member, suggesting a preliminary date of 1.39-1.53 million-years-ago. The assemblage includes 143 macromammal, fish, and reptile skeletal and dental specimens collected from a 48-square-meter area of the outcrop. Ten skeletal and dental specimens and four lithic artifacts were collected from the rest of the approximately 800-square-meter hillock. The assemblage preserves remains of aquatic taxa including *Crocodylus*, *Euthecadon*, turtle, and fish, and terrestrial mammalian taxa including suids, hippos, equids, and alcelaphine (cf. *Megalotragus*) and reduncine bovids. Over half of the assemblage displays weathering stage 0 or 1 surfaces, and only 16% of specimens have adhering matrix or exfoliated surfaces, which allows observation of bone surface modification. The assemblage includes 40 identifiable specimens from at least 21 elements and six mammalian individuals. Eight specimens that derive from a minimum of four elements and a single size three mammal preserve evidence of hominin butchery and suggest early access to meaty carcass parts. These include a cut-marked neural spine of a thoracic or lumbar vertebrae, ischial ramus, and cranial or mandibular fragment, a cut and percussion-marked humeral midshaft, and four cut-marked specimens not identifiable to element. Carnivore tooth marks occur on two refitting mandibular specimens from a size three bovid, an equid radius, and a long bone midshaft fragment. Future excavation will search for the assemblage's *in situ* origin.

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An organism-focused view of heterogeneity: the effect of landscape spatial pattern at multiple scales on the habitat use, behavior, and movement patterns of five diurnal lemurs in Betampona Natural Reserve, Madagascar

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To understand a particular species' or community's response to forest fragments, the habitat attributes and the landscape pattern must first be quantified. However, methodology that identifies the influence of landscape pattern and local habitat structural attributes on species or community viability is under-developed for non-human primates in forest fragments. Successful primate conservation requires an understanding of how environmental variability at both micro- and macro-scales affects community structure and habitat use. The objective of this research was to explore the effect of landscape spatial pattern and heterogeneity at multiple scales on the habitat use, behavior, and movement patterns of five diurnal lemurs in Betampona Natural Reserve, Madagascar. Vegetation structural analysis within forest patches, point-counts, and radio-collar aided follows, in conjunction with Geographic Information Systems, were methods used to address the disconnect that has emerged involving the importance of landscape spatial pattern and primate extinction risk. Results of this research include: (1) quantified patches in the reserve demonstrate differences in micro- and macro-habitat attributes, (2) variation exists in lemur community structure and diversity indices within defined patches, and (3) point-count data suggest that micro- and macro-habitat features affect lemur resting, moving, and feeding behaviors, whereas radio-collar-aided follows indicate that macrohabitat has less of an effect on lemur behavior. The consideration of an organism-focused view of heterogeneity is important, as the perceived quality of the habitat may act as an environmental boundary thus limiting the connectivity of the forest for some lemurs. This is particularly important with respect to connectivity and corridor projects.

The KSD-VP-1/1 postcranial skeleton from Woranso Mille, Ethiopia: brachial plexus enlargement and the capacity for fine motor skills in *Australopithecus afarensis*

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Early hominin vertebrae are extremely rare in the Pliocene fossil record. Currently known vertebral specimens are either fragmentary or isolated. Here we describe a series of 3.6 million-year-old vertebrae from the KSD-VP-1/1 ("Kadanuumuu") postcranial skeleton, representing the oldest adult cervical column known in the hominin fossil record. Surprisingly, unlike non-human apes neural canal sizes and shapes in KSD-VP-1/1 fall within the distribution of *Homo sapiens*. Moreover, like modern humans the preserved neural canals exhibit transverse enlargement for the cervical spinal cord bulge associated with the brachial plexus. Because nerves to the arms and hands emerge from the brachial plexus, the size and shape of the cervical neural canals sheds light on the neurological potential of this hominin.

Fine motor skills are unique to humans among extant hominoids; however, these new fossils appear to demonstrate that KSD-VP-1/1 had evolved a human-like postcranial neurological substrate for precision manipulation, and support the hypothesis that australopiths also possessed skillful hands. Other characters similarly indicating potential for sophisticated manual skill, such as the advent of pad-to-pad grasping, appear to have been established in the earliest phases of hominin evolution, as demonstrated by the derived pollical morphology in *Orrorin tugenensis* at ~6.0 Ma, and subsequently in *Australopithecus* species.

These new fossils add evidence to the suite of biological traits in early hominins indicating enhanced manual dexterity well before the advent of the genus *Homo*, and for the first time provide evidence for the neurological underpinnings of sophisticated arm and hand coordination as early as 3.6 Ma.

Comparison of different quantitative data acquisition methods for the bony knee joint within the same sample

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Coordinate data collected using a Microscribe digitizer has been a common method for analyzing bones in general. More recently, the progress in data acquisition methods for geometric morphometry by using structured-light 3D scanners and CT scanners allow for a new approach in accessing skeletal material and in evaluating secular trends and socio-demographic traits in skeletons. While each of these data acquisition methods are useful for knee joint analysis when used in separate projects, little work has investigated on how

these methods compare when used for the same sample. To test the feasibility of using computer generated models and coordinate data for the same sample, data obtained from structured-light 3D scans (QTSculptor®) and CT scans (Siemens Dual Source SOMATOM®) have been compared to data collected with a Microscribe. Therefore, 3D scans and CT scans of knee joints from ten macroscopically healthy individuals from the medieval graveyard in Sempach, Switzerland, were taken. Imaging segmentation was needed in order to create three-dimensional shape reconstructions from CT data, using the software Amira®. Twenty anatomical landmarks were obtained from the 3D models using the software Evan-Toolbox, while an identical set of landmarks was also collected with the Microscribe. The results show a high reliability between the three data acquisition methods and are a verification that data collected with the investigated techniques can be used in the same study. Additionally, the digital models of the portable 3D scanner are of such high quality that further unrelated morphological enquiries can be directly investigated from the models.

Dental wear and pathology at Chorro de Maíta, Cuba

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The analyses of the skeletal remains uncovered at the indigenous cemetery site of El Chorro de Maíta, Cuba, which dates to the late prehistoric and early contact period, have provided key insights into the issue of Indigenous-European interaction and processes of culture contact. This poster discusses the results of the analyses of dental wear and pathology of 73 individuals buried at the site. These results are compared to those of prehistoric sites in the Caribbean archipelago, which indicate that diet and subsistence practices changed over time due to increasing sociopolitical complexity, climate change, or adaptation to island environments rich in marine resources. Differences between the El Chorro de Maíta dentitions and late prehistoric sites in the region suggest that dietary practices at the site may have differed, perhaps related to the European colonization of the island. In addition, the dentition of one young adult female revealed Intentional Dental Modification of a type consistent with mainland Mayan modification styles.

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Obstetric pressures as a driving force of differences in trunk modularity between recent humans and chimpanzees?

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Previous research suggests that bipedality led to a different and relatively weaker pattern of integration in the hominin hip bone compared to extant hominoids, but the degree to which these changes extend to other aspects of body shape are unknown and beg the question of whether this locomotor shift—and the strong obstetric pressures faced by later members of the genus *Homo*—caused a reorganization of relationships within the hominin trunk skeleton. The current study investigates patterns of trunk modularity in humans and chimpanzees to determine the specific relationships among ribcage, vertebral column, and pelvic shape in these taxa. Using the R statistical software package, I calculated mean evolvability, conditional evolvability, autonomy, and integration in a large sample of ecogeographically diverse recent humans (n=355) and a composite sample of *Pan* species (n=103). Standard error was calculated for each evolvability measure, and all values were bootstrapped.

Results indicate that patterns of integration within the trunk differ between the two taxa only with respect to the false pelvis, suggesting that the adoption of bipedality did not affect most thorax and pelvis relationships. However, humans overall have more weakly integrated trunk skeletons—and thus exhibit greater evolutionary potential to respond to selection—than do chimpanzees. One notable exception to this trend is the more strongly integrated true pelvis in humans, which, combined with the relatively higher magnitude of integration in the bony birth canal of human females compared to males, points to greater evolutionary constraints likely related to the protection of obstetric dimensions.

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Social status, seasonality, and stress: Variation in glucocorticoid concentrations of high-ranking male rhesus macaques (*Macaca mulatta*)

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Social status and mating effort can impact hormone concentrations in male primates. In particular, dominance rank has been associated with variation in glucocorticoid concentrations, and seasonal changes in glucocorticoid concentrations have been documented in seasonal breeding primates. However, there is considerable variation in the relationship between these three factors across nonhuman primate studies. Here, we use a multi-group comparison to examine the relationship between glucocorticoid concentrations, dominance rank, and mating effort in high-ranking male rhesus macaques. More specifically, we tested the predictions that 1) alpha males have significantly higher glucocorticoid concentrations than other high-ranking males, and 2) males have higher glucocorticoid concentrations when mating effort is highest. We collected behavioral observations and fecal samples (N=224) for high-ranking males in 9 social groups (N=21) of free-ranging rhesus macaques for 5 months on Cayo Santiago, Puerto Rico. Dominance rank and month were significant predictors of glucocorticoid variation. Alpha males had consistently higher glucocorticoid concentrations than other high-ranking males (b=0.164, P=0.03, CI: 0.013; 0.314) and glucocorticoid concentrations were higher at the beginning of the mating season (when mating effort was at its peak), declining linearly as the mating season progressed (b=-0.153, P<0.001, CI: -0.200; -0.106). Male age, group size, the ratio of adult males to females, and the overall stability of the group's male dominance hierarchy throughout the mating season did not affect glucocorticoid concentrations. In sum, we show that even among the highest-ranking males in a group, alpha males experienced particularly high physiological stress, likely associated with mating effort.

Dental and hind limb development in the sifaka and ring-tailed lemur: how they get up and go

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Indriids have an accelerated schedule of tooth development, thought to be an early postnatal adaptation to folivory. Less is known about indriid postcranial development, of interest because of their specialized leaping behaviors. We investigated hindlimb bone ossification and dental development at infancy in *Propithecus coquereli* compared to another lemuroid (*Lemur catta*). A cross-sectional age sample of cadavers at late fetal, newborn and one month ages were microCT scanned and hindlimb bones were then serially sectioned and histologically stained. Using Image J, we determined peak hydroxyapatite density of the last deciduous

premolar (dp4) and first permanent molar (M1) by converting grayscale intensity to hydroxyapatite (HA) density (mg HA/cm^3) via a standardized linear calibration (R^2=0.99). Epiphyses were histologically examined for evidence of endochondral ossification. *Propithecus* has little evidence of impending epiphyseal ossification at all reference ages but has more highly mineralized dp4 and M1 at birth. HA density of dp4 decreases by 1-month of age in *Propithecus*, suggesting initial tooth resorption. *Lemur* shows greater progression toward epiphyseal ossification; dp4 HA density is markedly higher in the 1-month-old than the newborn, but in M1 the teeth are more similar in HA density. The results reveal contrasting strategies in the pace of bone and teeth development at early ages. The apparent slow pace of epiphyseal ossification in *Propithecus* may be feasible because they do not initiate leaping until 8 weeks of age. Nevertheless, they invest in highly mineralized teeth perinatally, well in advance of independent feeding and locomotion.

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A Bioarchaeological Approach to Ancient Maya Social Organization at Copan, Honduras using Biodistance and Radiogenic Strontium Isotope Analysis

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Research focused on the Copan human skeletal collection, the largest yet recovered in Mesoamerica (~1200 individuals), to explore the lives of residents in twenty-two patios from eight neighborhoods during the Late Classic period (AD 600-820). The ancient Maya site of Copan is uniquely situated to address the question of migration and biological kinship in ancient Mesoamerica using bioarchaeological techniques. Radiogenic strontium isotope and dental metric data were drawn from those who lived and were subsequently interred at Copan. Taken together these data provide insights into the complex social and biological relationships of Copan's inhabitants to each other, to their neighbors, and those beyond their borders.

The results demonstrate marked complexity of Copan's social structure as considered within two theoretical models (house and lineage). The strontium results show surprising diversity; the percentage of non-local individuals varied by neighborhood, some with only 10% in-migration while others had populations that are 40% non-local to the Copan Valley. This suggests both an increase in non-local persons who were integrated into the community and the potential for biological diversity of the Copan Valley. The results of the statistical analysis of the biodistance data (including a significant Mantel test) demonstrate that there are statistically significant differences between neighborhoods, between patios across the site, and even between patios within the same neighborhood. Overall, these results highlight that the Copan community was created within a complex system that was influenced by multiple factors. Genealogy, affiliation, and migration all affected the social structure of the ancient city.

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Basal Metabolic Rates among Rural Agriculturalists of Ngilo Ilo, East Java

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Previous research in human biology has identified variation in basal metabolic rate (BMR) as one potential avenue for adaptation to thermoregulatory stress, with populations in cold environments having elevated BMRs and those in tropical environments have blunted BMRs. However, recent work has suggested there may be methodological issues with these analyses or that conditions of poverty and malnutrition in the tropics may have inflated the degree of difference in BMR due to heat stress adaptation.

This study examines variation in BMR among an indigenous, rural population of Indonesia where chronic nutritional stress remains a problem, and compares these data to those collected from earlier studies in Indonesia. Additionally, we compare our results to those that would be expected using established BMR reference equations in order to detect differences from established norms.

Mean BMRs (+SE) were 1433+65 kcal/day in men and 1256+97 kcal/day in women. Males showed comparable BMRs and anthropometrics to those in previous Indonesian studies, while comparable data from published work is lacking for females. Basal metabolic rates in both males and females were not significantly different from those estimated from the FAO/WHO/UNU (2004) predictive equations. However, those individuals who had a body mass index (BMI) less than 18.5 kg/m^2 (underweight) had BMRs 7.6 % below predicted values, while those with higher BMIs were 8.0% above their predicted values.

These findings suggest that living in the tropics is not related to significant deviations in expected BMRs, however within-population level of nutritional status does relate to BMR variation.

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Male reproductive strategies and paternity success in the multilevel social system of gelada monkeys from Guassa, Menz Highlands, Ethiopia

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Males apply various strategies to achieve reproductive success. In multi-level societies, such as those observed in gelada monkeys and hamadryas baboons, dominant "leader" males maintain long-term, relatively exclusive mating relationships with females within one-male units (OMU), the lowest level of the multi-level society. Recently, anthropologists have looked to multi-level primate societies as referential models for the evolution of similar social systems in early hominins. Specifically, the paternity certainty resulting from such male monopolization of females has been proposed to play an important role in the evolution of paternal care in humans. However, high paternity certainty for dominant males may be compromised in geladas by (i) the presence of subordinate "follower" males within OMUs and (ii) the frequent close proximity of extra-group males when multiple OMUs aggregate. Here we genotyped 61 individuals to assign paternity to 22 offspring from 8 gelada OMUs from Guassa, Ethiopia. OMU leader males (n=14) sired 63% of offspring, within-group follower males (n=8) sired 0% of offspring, and extra-group males sired the remaining 36%. Remarkably, six of eight offspring in one OMU were sired by extra-group males (75% of extra-group paternities), in contrast to a study in another gelada population that reported no extra-group paternities. Five of those offspring were conceived during a period of high male turn-over and group instability suggesting that opportunistic mating opportunities during periods of high male turn-over may be an effective reproductive strategy for Guassa gelada males. This provides a unique opportunity to investigate the relationship between paternity certainty and parental care.

Evolutionary neurocartography: mapping sensory system organization in human brain evolution

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This work investigates the roots of human behavior and cognition by examining the evolution of sensory system organization in the primate brain. In particular, the human cerebral cortex is larger, more densely populated, and more likely to be influenced by social group dynamics and learning than would be expected based upon work in other primates and mammals. Thus, studying the evolution of sensory system organization at the level of the cerebral cortex provides important information regarding how changes in the way the brain processes information facilitates such behaviors that set humans apart, like complex tool manufacture and language. In pursuit of this goal, the authors present the first quantitative cartographies of the connectivity (myelinated axons) and cellular composition (neurons and glia) of the primary and secondary fields of the auditory, somatosensory, visual and motor systems across primates. Additional data from subsets of these regions across a larger range of primate taxa will also be discussed as they constitute the groundwork of a larger effort to comprehensively outline the evolution of primate sensory system organization. These data provide a quantitative benchmark necessary to reliably identify homologous structures across taxa, and facilitate future investigations aimed at detailing the emergence of novel neurobiological structures during the course of human evolution. Ultimately, our results provide a window through which the evolution of human cognitive abilities can be more clearly understood as a process of accumulating modifications to the organization and structure of the brain.

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Tracing Dietary Histories and Social Relationships in a Muisca Population (900-1400 AD, Sabana de Bogotá, Colombia)

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Complex, stratified societies are characterized by differentiation between groups along various, socially defined axes. Human diet is deeply intertwined with environmental-socio-political-economic relationships that may dictate the kinds and quantities of foods a person has access to. The archaeological site of Tibanica, part of the Muisca culture from the Sabana de Bogotá, Colombia (900-1400 AD), is an ideal population to study how social roles and identities are intertwined with human diet. Here I present stable isotope data from 200 individuals (tooth and bone data) to investigate the complexity of human diets across the life course in order to understand how access to particular foods may be mediated by an individual's age, sex and social status. The Muisca have often been characterized as strongly hierarchical, particularly between social classes such as elites and commoners. Access to certain foods has been hypothesized to relate to social status. However, my isotopic data ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$ from collagen and apatite) show that while there are no significant differences between the diets of high and low status individuals, there are significant differences between the diets of Tibanica females and males. Additionally, these dietary differences between the sexes began in childhood and continued over the lifetime. For Tibanica peoples, food consumption practices, revealed through stable isotope analysis, provide evidence of deeper social relationships and indicate that a person's sex was a significant and salient social differentiator.

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The effect of dental impairment on food digestion in wild ring-tailed lemurs (*Lemur catta*) using fecal nutritional content

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Ring-tailed lemurs of the Bezà Mahafaly Special Reserve exhibit extensive tooth wear and loss related to fallback consumption of *Tamarindus indica* fruit. Such impairment may limit capacity to masticate and digest foods, resulting in greater residual fecal nutritional content. Neutral (NDF) and acid detergent (ADF) fiber, acid detergent lignin (ADL), nitrogen (e.g., protein), and ash content were determined for 154 samples from the dry (June-July) and wet (January) seasons for 14 *Lemur catta* (10♀/ 4♂) of known tooth wear and loss status. Relationships between tooth loss and fecal content were assessed using Wilcoxon's tests, while the impacts of wear were examined using Spearman's correlations. Overall, tooth loss was associated with, and wear correlated with, reduced ADL but increased protein and ash. During the dry season, tooth loss was associated with reduced NDF, ADF and ADL but greater ash and protein, while wear correlated negatively with NDF and ADL, but positively with protein and ash. Wet season NDF, ADF and ash were greater among individuals with tooth loss; for wear only a trend ($p = 0.061$) towards a positive correlation with ash was observed. Higher ratios of hemicellulose and cellulose to ADL were associated with tooth loss and correlated positively with wear, overall and for the dry season. During the wet season, cellulose to ADL correlated positively with wear. Our data indicate dental impairment may reduce fermentation of structural carbohydrates and digestion of protein-rich resources (e.g., leaves). Associations of ash with impairment suggest silicates contribute to tooth wear among Bezà lemurs.

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Incorporating all of anthropology into forensic anthropology graduate programs

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While all forensic anthropologists are trained in anthropology at the graduate level, not all programs place emphasis on a balanced anthropological education. This presentation looks at the utility of incorporating a holistic anthropological approach in graduate training specifically geared towards forensic specialization. The value of a graduate education is in part measured by how well it prepares the recipient for life as a professional in the field. This is particularly true for those specializing in forensic anthropology where job opportunities are often found outside of academia.

Two aspects of the Master's program in Physical Anthropology at California State University, Chico were examined: the research topic of the cumulating thesis of successful graduates of the program and the career trajectories of graduate alumni. The study found that most successfully completed theses (>90%, n=46) under the years included in the study (1978-2015) have incorporated both biological and cultural theory. Specifically, a majority of the theses utilized a bioarchaeological approach to the research. Likewise, a majority of graduates (>70%) that continued careers in anthropology upon graduation did so in job contexts outside of academia. The last decade of program history has shown a significant increase in the number of graduates actively engaged in forensic research. It has also shown an increase in the number of graduates who successfully continue in anthropology Ph.D. programs and post-doctorate careers. The diversity in forensic anthropology applications of graduates supports the need for both education in anthropological theory and practical experiences in laboratory and field settings.

Estimating Age from Adult Skeletons: New Directions in Transition Analysis Using a Wide Array of Traits

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Accurate and precise age estimates, with individualized prediction intervals calculated for each skeleton, are essential in medicolegal and paleodemographic investigations. Unfortunately,

such estimates, especially for adults, are one of the greatest challenges facing researchers who examine archaeological and forensic skeletons. Standard methods produce biased age estimates with fixed prediction intervals derived from original reference samples, and they fail to yield useful information beyond about 50 years of age.

Fortunately the situation is not altogether bleak. Work with thousands of known-age skeletons from American, European, and African populations shows that assessments of the overall appearance of the skeleton by experienced osteologists are far superior to estimates produced through existing formal procedures. Producing such experience-based estimates requires training on hundreds of known-age skeletons, and the process does not permit quantitatively rigorous estimates of certainty. Therefore, we are focusing on disaggregating what goes into expert assessments, defining age-informative features, collecting data to estimate ages-of-transition in those age indicators, refining Transition Analysis to utilize that information, and developing a computer program to facilitate analyses.

This work will be completed in two years. Here we illustrate progress to date with newly collected data from over 800 American and South African skeletons. Many skeletal traits hitherto overlooked as age indicators are valuable in age estimation, with tight ages of transition. The performance of currently used age-estimation procedures, including existing Transition Analysis, is not as good as what can be done with the new suite of traits analyzed within a Transition Analysis framework.

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Biological Stress Status and Survivorship in Historical Populations

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Current research suggests that skeletal indicators of childhood stress are associated with an increased risk of death in adults. Furthermore, females in their reproductive years with a stress marker may be at an increased risk of death, over males. This project investigates survivorship among select, Native American skeletal samples from South Dakota (AD 1600-1832). Three-hundred and seventy-four individuals were analyzed for the presence of skeletal stresses, including porotic hyperostosis/cribra orbitalia, linear enamel hypoplasias and short stature. Survivorship was investigated using Kaplan-Meier estimates with log-rank tests in SPSS version 22. A two step analysis was performed. First, survivorship differences between the sexes, with and without any stress markers, were analyzed. The log-rank tests were not statistically significant. The survivorship curves suggest that male individuals without a stress marker exhibit increased survivorship over females without a stress marker, early and later in life. Females, with a skeletal stress, exhibit increased survivorship over males with a skeletal stress after age 40. Next, survivorship for a subsample of individuals in their reproductive years (15-40) was analyzed. The log-rank tests were not statistically significant, although, the survivorship curves indicate that males, with or without a stress marker, generally maintain increased survivorship over females in this subsample. Taken together, the two steps of this analysis indicate that females with a biological stress exhibit decreased survivorship until age 40. However, if they live to at least this age, they maintain increased survivorship over males. This project contributes to current research concerned with selective mortality and survivorship.

Cultural and Demographic Influences on Native American mtDNA Diversity in the Southern United States

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To date, studies of indigenous genetic variation in the Americas have focused largely on South, Central, and northern North America. Few studies have included indigenous participants from the continental U.S., and patterns of indigenous genetic diversity in the southern U.S. remain particularly poorly understood. Furthermore, because most studies of indigenous genetic variation have investigated the origins of Native Americans, less attention has been given to more recent population history and indigenous cultural traditions that may have shaped contemporary genetic patterns. In virtually all indigenous communities in the southern U.S., for example, kinship is defined by matrilineal clan membership, and this tradition might have influenced mitochondrial diversity patterns. Historical events like European contact may have also had a genetic impact, as native communities in the southern U.S. experienced declines in population size, forced migrations, community reorganization, and genetic exchange with non-native peoples following European contact.

In this study, we investigated how indigenous mtDNA diversity in the southern U.S. has been shaped by matrilineal clan affiliations and demographic history. This project was developed in collaboration with members of participating communities, and it was designed to address questions important to research participants. We collected saliva samples from 55 Native Americans in the southern U.S. and sequenced the mtDNA first hypervariable region. Almost all individuals exhibited founding Native American haplogroups, indicating low non-native maternal ancestry. A range of novel haplotypes were identified, and we analyzed haplotype diversity patterns together with cultural and demographic data to evaluate the factors shaping mtDNA diversity in this region.

This study was funded by the National Science Foundation (SPRF grant SMA-1408876) and the University of Texas at Austin

Femoral bone remodeling comparisons between adult males and females from medieval England

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Differences in bone metabolism between males and females in extant populations provide a basis from which to reconstruct gender divisions in labor for ancient humans. However, little is currently known about bone microstructure variation with sex in ancient English societies. Here, we access cortical bone remodeling using histological methods to compare males and females from the medieval period in Canterbury, England.

Following standard anthropological guidelines, sex and age-at-death were estimated for a total of 445 human skeletons, yielding 49 young and 180 middle-aged males, and 77 young and 139 middle-aged females. Static histomorphometry parameters were recorded in thin sections removed from the posterior femoral midshaft. Osteon population and osteocyte lacunae densities were compared between the sexes within each age category using univariate statistics.

Significantly higher remodeling was observed in males when compared to females. For example, osteon population density was higher in young (p = .044) and middle-aged (p. = .000) male groups when compared to females. Osteocyte lacunae were also denser (p = .001) in young males than females. Changes in cortical remodeling remained consistent when our analysis was adjusted for femoral robusticity to account for sexual dimorphism in bone size.

Our findings agree with bone physiology principles, and are congruous with previous histological studies of other archaeological populations. We link higher remodeling in males to greater mechanical loads. Medieval lifestyle differences that include gender specific labor divisions are inferred. Results are discussed in a hormonal bone physiology framework, and bone mass attainment variation with age and sex.

Multiple perinatal burial from the 2nd to 1st c. B.C.E. at Kopila, Korčula Island, Croatia

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The aim of this preliminary study is to present the minimum number of individuals yielded from the multiple perinatal burial from Kopila, determine the age range of the individuals, and determine the nature of the mortuary behavior at this locality.

In recent excavations (2013-2014) of the Kopila necropolis mounds, one burial location yielded hundreds of human, mostly perinatal, skeletons. Associated grave goods included Hellenistic drinking cups (skyphoi) and hundreds of glass and amber beads. Change in skyphoi style indicates that the perinatal skeletons were interred on different occasions during 2nd to 1st century B.C.E. The skeletons were separated from each other by a thin layer of small beach pebbles. Due to difficulties in separating and following pebble layers and perinatal remains, the sample has been excavated as a whole and is being analyzed as a single commingled sample.

All the skeletal remains of buried perinatal bodies are represented in similar ratios suggesting primary and complete skeletal interment. Preliminary skeletal analysis of the Kopila dental sample indicates presence of at least 37 infants buried within the grave. Postcranial elements indicate presence of at least 42 individuals. Metric study of the intact skeletal elements indicates presence of 2 neonates, 2 preterm babies, 13 perinates, and a child aged approximately 3. Compared with other penecontemporary multiple-infant burials from the Eastern Mediterranean region, Kopila example shows different mortuary behavior, revealing different treatment of the deceased infants.

Developmental control and stabilizing selection in the human cranium: a novel morphometric approach

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The human cranium is composed of multiple bones, which vary in both size and shape, and comprises different functional units. Because of the numerous spatial constraints and functional relationships, the cranial bones can neither develop nor evolve independently. Does developmental control – enforced by stabilizing selection – act at a local level, i.e., on the separate bones, or instead at a larger spatial scale, such as the overall form of the entire cranium? In the first case, individual bones may be more constrained than overall cranial form, whereas in the latter case individual bones may vary considerably among individuals and populations while keeping overall cranial form constrained. We present a morphometric approach to study variation in size and shape of composite structures at different spatial scales. In an application to 30 CT scans of human crania, digitized with 65 midsagittal landmarks each, we show a considerable excess of size variation at larger spatial scales over smaller scales, indicating strong size integration in the cranium. For shape, by contrast, we found overall cranial shape less variable than the shape of the separate bones, presumably resulting from canalization and stabilizing selection at larger spatial scales to maintain functional integrity. We discuss the manifold implications of these findings for studies of human evolution.

Iterative Closest Point (ICP) Algorithm Application for Intentional Cranial Modification Determination: Developing an Automated Classification Method to Assess Cranial Shape from Fragmentary Remains

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Certain biological markers, such as intentional modification to the crania and dentition, have the unique potential to provide information about ethnicity, kinship, and social identity. Cranial modification in particular offers a rare glimpse into intra- and inter-population dynamics because of its physical and permanent impartment of identity on the skeleton during childhood; however data collection of culturally modified crania in pre-Columbian populations is commonly limited by poor preservation, inhibiting visual assessment of cranial shape. Cranial shape determination of fragmentary remains can increase sampled individuals and thus enhance analyses of mortuary datasets.

This study investigates the application of an Iterative Closest Point (ICP) superimposition algorithm in quantifying the shape of cranial fragments for automated classification. Our research focuses on cranial shape assessment of fragmentary remains within the Mississippi Period cemetery of Bull Creek (9ME1)—a population that exhibits fronto-parieto-occipital flattening of the crania as well as individuals with unmodified crania. The cranial modification categorization assessment within this study is a two-fold process— modification is visually categorized, then laser surface scans are assessed with an ICP algorithm. Complete skull prototypes are used to classify normal and modified crania for the algorithm categorization. Individuals with diagnostic cranial bones were assessed for modification presence/absence (N=17); visual assessments permitted classification of 9 individuals while ICP algorithm application allowed for the classification of all 17 individuals. The application of this technique has the potential to increase the identification of cranial modification in fragmented assemblages. Better evaluation of such remains facilitates the bioarchaeological exploration of cultural identity.

The ontogeny of pelvic sexual dimorphism: Age, parity, and pelvic form in *Macaca mulatta*

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Among primates, females commonly give birth prior to reaching skeletal maturity. It is likely that the demands of pregnancy and labor among older juveniles influence adult pelvic form and dimorphism patterns. However, discovering the ontogenetic underpinnings of dimorphism and pelvic form is difficult, as age of specimens is often unknown or secondarily derived, and parity is usually completely unknown. In this study, I examine pelvic dimorphism among 153 free-ranging *Macaca mulatta* for which both age and parity (for females) are known. I collected 55 3-dimensional landmarks from the true and false pelvis of each specimen and conducted Principal Components Analysis on the scaled and rotated coordinates. As a group, females have rounder birth canals and relatively wider interacetabular distances and sacra compared to males ($p<0.001$), whereas males have relatively longer ischia and ilia and a relatively longer sacrum. However, 80% of females for which age at first labor is known gave birth to their first offspring before reaching skeletal maturity. Skeletally mature females exhibit relatively wider birth canals and sacra compared to immature females ($p<0.001$). However, pelvic form is not different between mature and immature males ($p=0.388$). Furthermore, female pelvic form is correlated with both age ($r=0.658$; $p<0.001$) and total number of offspring ($r=0.684$; $p<0.001$), whereas age is not related to pelvic form in males ($r=0.154$; $p=0.183$). These results indicate that significant bone modeling occurs in females due to the demands of pregnancy and labor during late ontogeny, and this modeling explains a large proportion of pelvic dimorphism among macaques.

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Expensive tissues and gestation length in primates

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Because brain tissue is energetically expensive to produce, it has been proposed as an important pacemaker of life history traits such as

gestation length. More recently, gut mass and dental material have been suggested as additional expensive tissues. This could explain why some primate taxa with dietary adaptations for folivory, such as precocial dentition and large gut mass, have longer gestation lengths than predicted by neonatal brain mass and maternal mass alone. Here we examine if expensive tissues other than the brain might account for these deviations of gestation length. Data on gestation length and neonate brain size were compiled for 34 species from published sources. We used postcanine eruption schedules at four months of age to approximate the amount of dental tissue developed in utero. All data were log-transformed. We controlled for maternal body mass, diapause, neonatal state, and litter size. The positive correlation between neonate brain mass and gestation length was confirmed (P<0.01) in a phylogenetic GLS analysis, although some groups, such as Asian colobines, had longer gestation lengths than predicted. This deviation of Asian colobines was confirmed posthoc with a phylogenetic ANCOVA (P<0.01). Including dental eruption in the phylogenetic GLS improved the fit of the model. This confirmed our prediction that dentition is an expensive tissue. Whether the inclusion of gut mass would further improve the model can only be addressed when more data on primate gut mass become available.

Phenotypic integration of the cranium and face in fossil Cercopithecidae with implications for interpreting species in the Old World Monkey fossil record

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Craniofacial variation has been used extensively in the taxonomic classification of fossil primates. To test the discriminating power of craniofacial variation for identifying fossil baboons and their relatives, we collected 16 standard cranial measurements on 93 specimens of fossil cercopithecid. Fossil specimens were measured at University of the Witwatersrand and at the Ditsong Natural History Museum and classified according to the most recent published taxonomic identifications. Maximum cranial length, palate length and rostrum length show the greatest range of variation in the sample, but none of the measurements discriminate between taxa. Overall, many of the cranial measurements are significantly intercorrelated. Maximum cranial length and muzzle width are each significantly correlated with 10 of the 15 other cranial measurements (p<0.0004). In contrast, orbital height and orbital width are not significantly correlated with any other cranial trait, including each other. As cranial length and breadth are proxies for overall size, many of the perceived variations in fossil papionin craniofacial morphology are likely significantly correlated with body size. These data suggest one of two things: 1) the covariation and lack of discriminating power in these traits indicates that taxonomic designations must be reevaluated, or 2) these taxa cannot be discriminated using craniofacial measurements and must be identified using other traits. Phenotypic covariation of craniofacial traits likely reflects genetic covariation. Further evaluation of craniofacial integration in extant papionins will help us better understand these phenotypes and provide a basis for investigating the evolution and development of the cranium and face in primates.

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Accelerated evolution of marmoset genes implicate potential candidates for reproductive suppression

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In common marmosets, subordinate females fail to reproduce, and recent research suggests that reproductive suppression may be self-imposed, consistent with a restraint model of reproductive skew. If non-breeding adult females suppress ovulation and inhibit sexual behaviour, then genetic mechanisms may have evolved specifically to limit reproduction in a rapid and reversible way, depending on the dominance status of the female within her social group. To explore this question further, we sought to understand the evolutionary history of marmoset genes relative to other primates in order to illuminate any molecular adaptations involved in the evolution of reproductive suppression. First, we identified 14,766 genes with one-to-one orthology shared between primate taxa and a mouse outgroup. Test groups contained orthologous genes from marmoset, human, and mouse, as well as combinations from the following primate taxa: baboon, bushbaby, chimpanzee, gibbon, gorilla, rhesus macaque, mouse lemur, orangutan, tariser, and vervet monkey. We identified a total of 380 marmoset genes that underwent rapid evolutionary change during the diversification of the Callitrichidae relative to other primate species. A subset of 36 known genes revealed evidence of strong positive Darwinian selection along with a significantly predicted impact on the biological function of the protein. Three of these proteins, including a pregnancy-associated plasma protein, were implicated in either female infertility in human or anovulation in mouse models. We speculate that observed accelerated evolution in these genes putatively points to a neuroendocrine mechanism underlying anovulation in marmosets.

Frontal Sinus Development and Juvenile Age Estimation

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Development is an important component of age estimation in juveniles. One area that has not been fully investigated as a possible aging method is the development of the frontal sinus. The predictable growth cycle of the frontal sinus could make it a useful parameter for age estimation. The frontal sinuses form when the ectocranial table of the frontal bone separates from the endocranial table forming an air pocket in the bone. The endocranial table ceases growth with the brain, while the ectocranial table is displaced anteriorly as the facial bones continue growth.

In order to examine the utility of the frontal sinuses for age estimation, 387 radiographs were examined (♀=154 and ♂=233) from the Juvenile Radiograph Database at North Carolina State University and the Patricia Database from Mercyhurst University. The sample included individuals who range in age from 0 to 18 years old. Anteriorly positioned radiographs were examined and were then grouped based upon their presence or absence of the frontal sinus. Individuals were divided into four age categories.

A one-way ANOVA was run, and then a Tukey adjustment was used to examine the differences in age range between the four groups. Results show that only three of the four groups were significant (p<.0001): individuals with no development (0-5 years), individuals who showed the first signs of sinus development (6-8 years) and individuals with fully developed frontal sinuses (9-18 years). These results indicate that the development of the frontal sinuses can be utilized as a potential method of estimating age.

Comparing the spatial dimensions of gorilla and chimpanzee sleeping sites: Nearest-neighbor nest distances of sympatric apes along a conservation gradient

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One of the unique behavioral aspects that distinguish great apes from other primates is the consistent construction of night nests. Variation

in nest building has been well-documented among apes, with the most consistent difference being between gorillas and other apes. Gorillas show a greater propensity to select terrestrial nesting locations, while other great apes tend to build arboreal nesting platforms. Comparisons between sympatric ape species can aid in identifying specific factors that modulate inter-individual spacing in the context of sleeping. In this study, we examine the spatial dimensions of nesting by western lowland gorillas (*Gorilla gorilla gorilla*) and central chimpanzees (*Pan troglodytes troglodytes*) in Republic of Congo. From 2001 to 2012, a total of 12,467 ape nests were encountered along line transects in the Goualougo Triangle study area. 2D and 3D nearest neighbor distances were calculated between individual nests within a site. We encountered 4,745 sites with multiple nests which represents a social group of nesting apes. Thirty-five percent of the nest sites were attributed to gorillas, with the remainder being chimpanzee nests. Nearest neighbor distances were lower among gorillas than matched chimpanzee nest groups. Distance between ape nests was related to group size, habitat type, nesting materials, and risk of predation. We also examine nest spacing along a gradient from pristine forest to regions being actively logged to determine the effect of anthropogenic disturbance on ape nesting. Flexibility in the construction of these vegetative "artefacts" provides compelling evidence of the technological skill of our closest living relatives.

Evolutionary consequences of learning, culture and complex behaviors

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Mathematical modeling offers a way to test evolutionary hypotheses and investigate evolutionary dynamics, and so can contribute to an understanding of human evolution. However, although evolutionary relationships between hominin genetic and cultural change are widely discussed, the use of mathematical models to explore these ideas is relatively uncommon. Here, rather than delve into the mathematics, we present the results produced by a series of models investigating interactions between genetic change, culture and learning in human evolution. First we show that the genetic response to learned behaviors, such as language or tool making, facilitates the acquisition of these behaviors and that the extent of the response is related to both the fitness value and complexity of the behavior. Second, we show that learning can redirect genetic change away from high fitness behaviors and towards behaviors that are easy to learn. We use this result to offer an explanation for the rarity of intelligence across species. Third, we show that the cultural transmission of behaviors can accelerate, but ultimately reverse, the genetic response facilitating their acquisition. Finally, we show that when complex cognition evolves alongside increasingly complex behaviors, interactions between genetic and cultural evolution produce long-lasting periods of stasis in genetic and cultural evolution. We apply this to the observed stases in stone-tool making. Collectively, these results support the importance of evolutionary interactions between genes, learning and culture and exhibit the value of evolutionary models in understanding human evolution.

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Serum leptin, anthropometric phenotypes and epigenetic programming across 7 Leptin (LEP) core promoter CpG sites in two diverse populations: The Western Buryat of Siberia and the Mennonites of Central Kansas

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Current research demonstrates epigenetic influences on early developmental plasticity and phenotypic variation into adulthood. The epigenetic mechanisms provide for a rapid, flexible, and heritable yet potentially reversible adaptive response on DNA sequences. Genes regulating metabolism are vulnerable to nutritional programming over the life course and experience alterations in DNA methylation density. The gene leptin (*LEP*) involves regulation of energy homeostasis. Synthesized by adipocytes, leptin influences adipogenesis, energy storage, lipid and glucose metabolism, as well as reproductive endocrine function. Variation of DNA methylation in the *LEP* core promoter correlates with dietary intake; however, phenotypic significance of that variation is unclear. We hypothesize that evidence of epigenetic programming would be identified through differential DNA methylation and biomarkers reflecting leptin's metabolic signals.

We examined DNA methylation patterns across seven *LEP* core promoter CpG sites in 237 individuals from two semi-isolate populations inhabiting diverse environments: Western Siberian Buryat and Central Kansas Mennonite. To account for differential methylation between serum leptin and anthropometric phenotypes, linear mixed effect models were applied. To account for environmental confounders the following variables were included as fixed effects: sex, smoking, diet, ethnicity and CpG sites. Batch effects were accounted for as random effects in the model. Fat intake correlates positively with DNA methylation in sites 4, 6, and 7, carbohydrate negatively in sites 4-7 (all $<p=0.05$). Serum leptin levels were significant with sites 5 and 7 ($p=0.0456$; $p=0.0031$ respectively) in males only: Significance with weight/kg, males site 5 ($p=0.0413$), females site 7 ($p=0.0493$). These findings suggest nutritional programming through epigenetics.

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Comparison of maternal investment in two troops of wild olive baboons (*P. anubis*) at ecologically different sites in the Laikipia Plateau, Kenya

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This project used long-term behavioral data to investigate the effects of ecological changes on maternal investment in a wild primate. Two troops of olive baboons (*P. anubis*) on the Laikipia Plateau, Kenya, were followed over the course of 12 months and focal data collected on 40 mother-infant dyads. The troops had distinct ranges more than 10Km apart differing in the density of a calorie-rich invasive cactus species (*Opuntia stricta*), which has spread since 2000 in one area and since 2005 in the other. The cactus' fruits now comprise an important part of the animals' diet, and females in the troop with longer exposure and higher density of *Opuntia* plants have earlier age at first birth and shorter inter-birth intervals, with values similar to those of captive or crop-raiding baboons. We used behavioral data to compare the two troops, and to investigate how these ecological changes have influenced mother-infant relationships. In particular, we focused on whether females in the *Opuntia*-rich area had reduced the amount of maternal investment in their infants because of their faster-paced reproductive schedule. As expected, females in the enhanced food environment spent significantly less time carrying their infants. However, infants in the two troops did not spend significantly different time nursing. This suggests that some aspects of maternal investment might be more flexible and responsive to rapid ecological changes than others. It also highlights the importance of embedding behavioral data within the broader ecological context and the value of long-term studies of wild primates.

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Mechanisms of collective action in transitioning economies: A case study from the Peruvian Altiplano

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Models of cooperation show the importance of assorting with similar others to avoid exploitation by defectors. In societies with flexible residence patterns, mobility affords opportunities for assortment. However, in sedentary societies where land inheritance is important for subsistence, assortment options are limited both within and between generations. We examine how collective action is organized in a sedentary Andean agro-pastoralist community in four locally important domains; 1) agricultural production, 2) community meeting participation 3) ritual feast sponsorship and 4) mutual defense against theft (e.g. of livestock). We use two analytic strategies. First, we analyse real world case studies of norm violations that occurred in these domains over the course of more than a year of ethnographic fieldwork. Second we analyse structured interviews with 79 participants who were asked about their own participation in collective action, and about third parties' responses to hypothetical norm violations. Results reveal a surprising lack of consensus in several important domains – e.g. regarding the acceptability of opting out of being a festival sponsor if one were poor or belonged to an evangelical religion. We discuss these results in light of changing orientation towards the market economy and the consequent variation in beliefs about communal obligations.

Is entheseal change a marker of activity?

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Morphological changes to muscle attachment sites (entheses) are often used in physical anthropology to reconstruct activity patterns. Based on 'Wolff's Law', stating that bone adapts to mechanical loading, muscle pulls are expected to induce changes to the associated enthesis' appearance. However, Wolff's law has only been sufficiently validated for microarchitectural adaptations, while the use of entheseal change (EC) as activity marker relies on macromorphological changes. The present study therefore attempts to validate the presumed relationship between mechanical loading and EC by comparing EC scores for the right Achilles tendon enthesis of 50 individuals from postmedieval Middenbeemster, the Netherlands, with their respective microarchitectural parameters as assessed by microCT.

Osteolytic lesions were not observed. Parametric values were not significantly different between different levels of either robusticity (RO), osteophytic growth (OF), or their composite (CO). Moreover, there was no score-dependent trend noticeable in parametric values. EC did consistently increase with age, this being significant for OF and CO scores. Between the group of 18-25-year-olds (n=10) and that of the 36-49-year-olds (n=23) this difference was significant at a 0.05 level, and between the 26-35-year-olds (n=17) and each other age category these differences were significant at a 0.10 level. These results imply that successive stages of EC do not represent successive levels of activity, and that the Achilles tendon enthesis cannot be used for activity reconstruction. Combined with previous failed attempts to validate EC theory, this urges for further research into EC etiology and caution in the application of EC as activity marker.

Identity in an historic cemetery from Ignacio, Colorado

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In 2013, an unrecorded cemetery was discovered during construction in Ignacio, located in southwest Colorado. Mortuary practices and artifacts associated with the burials suggest that the cemetery was in use between the late 1890s and 1910. Twenty-one individuals were present in the cemetery, including 8 adults and 13 infants that were mostly segregated by age. Biological analysis of dental traits and craniometrics indicate that individuals interred in the cemetery include those with Hispanic and/or Native American ancestry. Material culture includes Euroamerican, Native American, Hispanic and Christian influences. Multicultural influences were observed even for individual interments, likely reflecting the blending of traditions within families. Mortuary practices and material culture suggest that despite the range of cultural items, the Christian religion and specifically the Catholic denomination is the common connection among the individuals buried in this cemetery. Pathological indicators suggest involvement in heavy physical labor by males and episodes of physiological stress in females. This biocultural study provides insight into individual and group identity in the Ignacio population at the turn of the century, a time when people of diverse biological and cultural backgrounds were merging into a single community.

Testosterone, musculature, and development in Kanyawara chimpanzees and Tsimane forager-horticulturalists

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Considerable evidence suggests that the steroid hormone testosterone mediates major life-history trade-offs in primates, promoting mating effort at the expense of parenting effort or survival. In many species, chronic shifts in testosterone production over the life course correlate with investment in male-male competition. Chimpanzees and humans represent interesting test cases, because although closely related, they maintain divergent mating systems. Chimpanzee males do not invest in pair bonds or paternal care. Consequently, across the lifespan, their testosterone levels are expected to track changes in (1) behavioral investment in dominance striving, and (2) investment in sexually dimorphic musculature employed in male-male competition. Humans, by contrast, are expected to show weaker associations between testosterone and musculature, because the latter is important not only for male competition, but for men's work provisioning wives and children. We assayed >7000 chimpanzee and >3350 Tsimane urine samples for testosterone, creatinine, and specific gravity, in the same laboratory using the same assay methods. Male chimpanzees showed peak acceleration in testosterone increase at age 6, peak velocity at age 10, and peak deceleration at age 14, reaching adult levels by 15-16, when they began to challenge other adult males. Adult levels of testosterone were achieved 3 years later than in captivity, likely reflecting energetic constraints in the wild. Indirect measures of muscle mass followed a similar pattern, and were highly correlated with testosterone. As predicted, Tsimane men exhibited a weaker correlation, with testosterone accounting for half as much variance in the muscle mass measure as in the chimpanzee sample.

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Maternal body composition predicts prepubertal fat mass accrual in female offspring

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Lifespan health begins in the womb, with substantial epidemiological evidence that excess maternal adiposity is associated with increased body fat among adult offspring. The physiological mechanisms that explain this relationship are less clear, when these phenotypes emerge. Beginning at 21 months of age, we prospectively measured body composition at 6-month intervals across pubertal development using dual-energy X-ray absorptiometry among 18 female Rhesus

macaques (*Macaca mulatta*) at the Yerkes National Primate Research Center, investigating associations between maternal weight and body fat, birth weight, and age at menarche with developmental outcomes. Further, we examined the role of leptin and osteocalcin as mediators of body composition trajectories. Dam weight and being in the highest tertile of adiposity during mid-pregnancy predicted increased offspring fat mass accrual from age 21 to 39 months ($F=2.05$, $p>0.003$ and $F=1.03$, $p>0.032$, respectively). Birth weight also predicted fat mass accrual across adolescence ($F=2.16$, $p>0.002$). These effects were not significantly modified by offspring age at menarche or circulating levels of osteocalcin or leptin at any time point. Our results support previous research that maternal overweight and obesity has implications for offspring body composition, specifically that such effects emerge as early as the prepubertal period. These results reinforce the importance of overweight and obesity prevention among women of reproductive age as a strategy with potential intergenerational benefits for reversing recent trends of chronic disease morbidity.

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Phylogenetic history of tarsiers: Uncovering the history of a deeply rooted family

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While extensive phylogentic research has largely resolved the placement of the tarsiers as the sister taxon of anthropoids, the relationships among tarsiers and implied taxonomy remain unclear. Previous, work on tarsier morphology, behavior, and ecology has recognized between one (*Tarsius*) and three tarsier genera (*Tarsius, Carlito, and Cephalopachus*). To date, little genetic data have been used for these distinctions. To address this, we aligned mitochondrial genetic sequences from public databases for the three proposed tarsier genera and the Malayan colugo (*Galeopterus variegatus*) as an outgroup. Calibration was based on dates from *Tarsius eocaenus*, dated to ~34 million years ago. We used MCMC for phylogenetic reconstruction and divergences. Our results show a very old separation between the *Tarsius* and the *Carlito-Cephalopachus* group. There are also deep rooted separations between *Carlito* and *Cephalopachus*,with an estimated divergence time of 10mya. Within *Tarsisus* there are splits as old as 3 million years between some of the species. We consider this important support for a taxonomic division of tarsiers into three genera. These results emphasize the underappreciated diversity within tarsiers, and stress the importance of research exploring their variation with genetics.

Assessing the fracture patterns of thermally altered stone: Experimental evidence for distinct fracture patterns

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The controlled use of fire is widely recognized as an important hominin behavioral adaptation, yet determining its presence in the Earlier Stone Age archaeological record (>400 Ka) remains difficult. Here we report on the analysis of experimentally determined patterns of fracture termed 'thermal curved-fractures' (TCF), generated when knapped lithic material is exposed to temperatures at-or-above 500° Celsius. Continued experimental work is necessary to identify the diagnostic features of these fractures. In particular experimental work was focused on distinguishing features of thermally altered stone from other forms of conchoidal fracture, from hard hammer percussion, as well as exfoliated materials from weathered rocks. Here we focus our investigations specifically on rock types that were available to hominins that produced the archaeological record of the Okote Mbr. of the Koobi Fora Fm. (1.6-1.5 Ma). Experimentally produced TCFs are compared to a variety of experimentally produced assemblages. Details of the three dimensional morphology of these distinct fracture patterns (evenness of width; evenness of thickness) show statistically significant differences from other experimentally produced curvilinear fragments (e.g exfoliation, burned unknapped materials and others). Univariate and multivariate investigation identify the full morphometric variation within major classes of materials and highlight the distinctive nature for these materials remains. This suggests that TCFs have potential as valuable indicators of human-controlled fire in the archaeological record, even in sites without "expected" fire remains such as hearths, charcoal, ash, and burned bone.

Variation of skin in recent human evolution: Loss of function and structural variation affecting *filaggrin* gene

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Filaggrin (*FLG*) gene is essential for natural skin-barrier function in humans. Multifaceted functions of *FLG* include natural moisturization of the skin, UV photoprotection and defense against ingression of pathogens and allergens into the body. Multiple *FLG* loss-of-function (LOF) variants have been associated with complex skin diseases such as ichthyosis vulgaris, atopic dermatitis, atopic asthma and comorbid allergies including food allergy. A recent study claims that *FLG* LOF variants have been positively selected to reach higher frequencies among northern Europeans to enhance vitamin D production by allowing more UV light penetrance. This idea parallels, but complicates the notion that skin color is the primary driver determining UV light penetration. Same study argues that the frequency distribution of LOF variants should follow a latitude gradient, increasing with distance to the equator. To further investigate and validate this argument, we have analyzed genetic variation in *FLG* among 2,504 samples. Strikingly, we found that the frequency of LOF variants do not correlate with latitude and the trends observed in previous study that suffered from ascertainment bias. We further genotyped copy number variation in the intragenic repeats of *FLG* among 100 samples, including an indigenous Alaskan population, using long-range PCR methods and revealed recurrent and population specific evolution of *FLG* size variation. Based on population genetic analysis, we concluded that the observed variation is best explained by reduced purifying selection, rather than directional positive selection.

Evidence of adaptation? Human tooth size and sexual dimorphism covary with elevation in India and Pakistan

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Biological adaptation to high-altitude environments is a classic example of evolution among modern human populations. While various physiological processes have been explored, little research has investigated if dental variation covaries with elevation.

We hypothesized that due to restricted gene-flow in mountainous regions, populations living in higher altitude environments would show greater heterogeneity in tooth size. Our study included n=2,599 living people categorized into three elevation groups: low, intermediate, and high (Indian villagers living below 500 meters, and those in Pakistan living between 500-2000m, and above 2000m). We analyzed mesiodistal crown lengths of four mandibular teeth (central incisor, canine, fourth premolar, and second molar).

Our analyses demonstrate that heterogeneity increases with altitude, in support of the hypothesis. We performed exploratory

univariate and geometric mean-scaled principal component analyses to probe the possibility that elevation covaries with biological processes influencing dental variation. We find that smallest pooled-sex arithmetic mean tooth sizes are found in the high altitude groups. The first two principal components explain 94% of the variance and differentiate the three elevation categories. When we performed the same PCA on male and female samples separately, males roughly approximate the pooled-sex pattern, but females instead appear more homogeneous.

Dental variation is likely influenced by numerous genetic and non-genetic factors, many of which may be the result of pleiotropic or concomitant physiological phenomena. We are hesitant to conclude a direct, causal relationship between tooth size and altitude, but our results suggest that dental variation may provide an interesting new way to explore human adaptation.

Time to kick the treadmill habit? How self-selected walking speed and minimum cost of transport differ between treadmill and overground walking during load carrying

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One of the ways anthropologists make inferences about the metabolic cost, speed, and movement patterns of early humans is to measure these aspects of gait in modern humans. Because these measurements are easier to assess while people walk "in place," many studies in this area use a treadmill rather than a free-walking methodology. We designed a study to determine within-person differences in self-selected walking speed and metabolic cost of transport in 6 females and 6 males walking under both situations while carrying a load. We measured speed (video) and metabolic cost (portable indirect calorimetry unit) as participants walked around the perimeter of a gym or on a treadmill while performing 12 walking tasks in a randomized order. Tasks consisted of all combinations of 3 loading conditions – carrying an 11kg toddler-proportioned manikin on the shoulders or hip, or 11kg evenly distributed around the waist – and 4 walking speed directives ("slowest", "walk-all-day", "brisk", and "fastest" walks). For each individual, we developed cost of transport (CoT) equations (cost vs speed) for each of the three loading conditions and from these determined the minimum CoT (MinCoT). In response to the speed directives, people chose significantly slower ($p<0.0001$) walking speeds for each loading condition while treadmill walking as compared to free-walking, yet the MinCoT was 8% higher ($p<0.0001$) for treadmill walking. Different control strategies in the two walking situations may underlie the observed differences in the speed-cost relationship. Regardless, studies modeling the mobility of early human populations should use a free-walking paradigm.

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Skeletal Development with Reference to Ontogeny and Phenotypic Plasticity; A Cross-Sectional Study of Primate Limb Bones

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How skeletons achieve their adult form can be ascribed to the influence of two primary mechanisms: genetic development and plastic adaptation. Here we consider in tandem, the influence of locomotor behavior and growth on primate long bone morphology. The sample includes male and female skeletal specimens from Pan (48), Gorilla (46), Pongo (41), Hylobates (45) and Macaca (53). Because bone apposition is more active during adolescence, structure is assessed across infancy, juvenility and adulthood. Three-dimensional models of the humerus, ulna, femur and tibia were generated using a NextEngine laser scanner and combined with standard metric measurements. The 3D models were sectioned to produce two-dimensional images at the mid-proximal (70% length), mid-distal (30%) and midshaft sections of each diaphysis. Geometric properties indicative of shape and rigidity were then calculated to compare structure across limb location and developmental stage among the taxa. The cross-sectional dimensions of the infant sub-sample suggest that bending and torsional rigidity are relatively high in relation to body size. This configuration may serve to mitigate the chances of injury during the most vulnerable years. As primates mature and locomotor competence improves, bone length is prioritized over robusticity, which may subsequently improve agility and energy expenditure during adulthood. The limb elements also reveal that dimensions do not necessarily scale isometrically but with negative allometry, though growth trajectory fluctuates with developmental stage and locomotor repertoire. Cross-sectional analysis also makes it possible to interpret plasticity and constraint along diaphyses, including whether phylogenetic and mechanical signals are distinguishable throughout the skeleton.

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Archaeological application of three age-at-death estimation techniques to the Medieval site of La Granède, France: cementochronology, new life tables and Caussinus-Courgeau bayesian procedure

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Estimating age-at-death distributions and beyond paleodemographic parameters has been regularly improving in the past ten years with the international recognition that Bayesian statistics ought to be used to correct intrinsic biases linked with traditional biological age indicators. The Caussinus-Courgeau method was specifically developed within this trend and is one of the most accomplished approaches for archaeological population analyses. It allows the use of any indicator to estimate population age-at-death distribution. Furthermore, the publication of new preindustrial life tables from world-wide reference populations by Séguy and Buchet, dedicated to archaeological samples, offers new options to estimate paleodemographic parameters. More recently, the development of cementum annulation analysis, i.e., cementochronology, proposes an alternative option to independently evaluate individual age-at-death.This study compares these three methods in order to evaluate age-at-death distribution and demographic parameters to the carefully contextualized early medieval site of La Granède in southern France, occupied from AD 400 to AD 1300. The entire funerary area of this low-density, rural cemetery, undisturbed since its abandonment in 1300, revealed 160 skeletons of excellent preservation. Half of the skeletons were categorized as adults with a 1.18 sex ratio. 46 adults were scored for cranial suture synostosis and 60 permanent teeth were extracted for cementum analysis.The three methods resulted in comparable unimodal (around 50-69 years) age-at-death distributions, characteristic of an attritional mortality pattern.The concordant results from 3 independents age-at-death techniques support the development of paleodemographic studies with renewed methods in order to explore historical demographic hypotheses.

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The evolutionary history of the hominin cervical vertebral column

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While many studies have focused on the thoracic and lumbar regions of the spine to investigate primate postural and locomotor behavior and infer behaviors in fossil taxa, the cervical spine has been largely ignored. This study investigates fossil hominin vertebral morphology within a comparative framework of a phylogenetically broad sample of extant primates (25 species, n = 205) to establish the evolutionary history of hominin cervical vertebral morphology and reconstruct postural behavior of the last common ancestor. The extinct sample consists of cervical vertebrae from 14 individuals representing seven fossil taxa: *Australopithecus afarensis*, *A. robustus*, *A. sediba*, Homo sp., *H. floresiensis*, *H. ergaster*, and *H. neanderthalensis*. Univariate results demonstrated a great deal of overlap among taxa, indicating that single features can rarely be described as specifically "monkeylike" versus "apelike." Multivariate results indicate that Plio-Pleistocene hominins generally fall outside of modern human ranges of variation. The modern human morphological pattern was not present in *Homo erectus* or earlier hominins. For example, these taxa are similar to apes in having larger neural arch cross-sectional areas and longer spinous processes than modern humans. Recent work has demonstrated a function-form link between these cervical vertebral shapes and more horizontal head and neck postural behaviors in primates. Overall, our characterization of early hominins suggests that head and neck postures in these fossil species may have been more horizontal than in modern humans and the evolution of a vertical neck occurred relatively recently.

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Validation of Urine Test Strips to Measure Relative Ketone Body Levels in Wild Bornean Orangutans, *Pongo pygmaeus wurmbii*

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The use of urine test strips (e.g. Roche Chemstrip®) has become the standard for quickly assessing the physiological condition and health of wild primates. These strips have been used to examine ketosis and fat catabolism in a number of taxa in their natural environments, including macaques, gibbons, gorillas, orangutans, and chimpanzees. However, the use of urine strips for determining ketosis has only been validated in human studies, and thus it remains unclear if these test strips accurately detect and quantify ketone bodies in non-human primates. We examined variation in ketone body concentration in samples collected as part of the Tuanan Orangutan Research Project that had tested positive (small, moderate, and large) and negative in the field using urine strips. The accuracy of this field method was tested using an enzyme-linked assay to determine the concentrations of acetoacetate and beta-hydroxybutyrate in stored urine samples. Preliminary results showed that there was significant variation among the qualitative levels (negative, small, moderate, large; $p<0.0001$) in the lab-based assay. Post-hoc tests revealed that although strips that tested positive for ketones in the field had significantly higher levels of ketones in the lab-based assay compared to those that tested negative ($p=0.003$), there were no significant differences between samples that tested "small" compared to "negative" ($p=0.25$). We conclude that urinary test strips provide a useful method for determining ketotic state in wild orangutans and likely other primates, but caution should be taken when interpreting results from samples within the "small" category.

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Stable Isotopic Study of Modern and Fossil *Tragelaphus*: interpreting the range of dietary signals within a single genus

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Understanding the dietary adaptations of mammalian fauna has implications for inferring their habitat preference. As bovid remains dominate most Pliocene and Pleistocene fossil sites in East Africa, stable isotopic studies of bovid dental remains helps us infer paleodiet and assess paleoenvironments. However, bovid isolated teeth are not often taxonomically identified below the tribe or genus level. Thus, it is crucial to explore the range of variations observable within a single tribe (or genus). To achieve this, we studied stable carbon isotopic composition of tooth enamel from contemporaneous modern and fossil *Tragelaphus* species. Modern *Tragelaphus* is represented here by four species (with a total of 21 specimens collected from five national parks in Ethiopia): *Tragelaphus buxtoni*, *Tragelaphus imberbis*, *Tragelaphus strepsiceros* and *Tragelaphus scriptus*. Overall, the four modern species of *Tragelaphus* analyzed show a constrained adaptation to C_3 dominated diets**.** Contemporaneous fossil *Tragelaphus* sampled here consist of two species: *Tragelaphus nakuae* (31 specimens) and *Tragelaphus gaudryi* (21 specimens) from Members E to G in the Shungura Formation, Omo Basin, Ethiopia. In general, although it can be said that both species cover mainly the mixed C_3/C_4 spectrum, differences are observed in the different geological members. From this study it can be suggested that although modern species may not be very good analogues to infer the diet of fossil species, contemporaneous modern and fossil species within the same genus, at a given time, have similar dietary preferences. Larger sample size of species belonging to different genera might provide a better insight.

"I don't have any friends": Narrative Self-Reports of Social Support and Resource Management, and Assessments of Nutritional Status in Jamaicans Across the Lifespan

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High reliance on support from non-biologically related individuals is a well-documented aspect of our evolutionary legacy. Members of prosocial species that fail to maintain these relationships face a higher risk of poor psychological and physical health outcomes than their well-supported peers. Using a mixed methods approach, this study explores the connection between friendships and nutritional status for adults and children living in Manchester Parish, Jamaica. I collected interview data detailing the quality and quantity of friendships, and quantitative anthropometric assessments of nutritional status from 120 children and 85 adults. I predicted that self-reports of the nature of these relationships would correlate to variability in assessments of health and nutritional status. Thematic analyses of the interview data highlight the correlation between self-reports of quality and quantity of these friendships and self-assessments of wellness. Both adult men and boys were more likely than their age-matched female peers to report having no or few friends, corroborating earlier findings on the gendered dynamics of vulnerability in this population. Despite correlations between participant descriptions of friendships and feelings of wellness, there were no significant statistical correlations between reports of the nature of these friendships and z-scores for height for age, weight for age, body mass index, or subcutaneous fat measurements for children or adults. These findings suggest that while the existence of supportive friendships may account for feelings of wellness, the presence or absence of these relationships do not translate into nutritional benefits or effectively buffer individuals experiencing limited resources in this developing country.

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A large-bodied ape canine from middle Miocene Napudet deposits in the Turkana Basin, Kenya

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Middle Miocene deposits at North Napudet, West Lake Turkana Basin, Kenya, are tentatively dated to less than 12.8 mya. A female canine, KNM-NP 23112, discovered at Napudet by the Koobi Fora Research Project in 1990, is thus the first hominoid recovered from African deposits dated between Fort Ternan /Maboko Bed 12 (14.7-13.7 mya) and the Chorora/Nakali /Samburu Formations (10.5 -9.5 mya). The absence of female hominoid lower canines from the later sites, however, limits comparisons of NP 23112 to other Miocene and extant hominoids. Mesiodistal and buccolingual dimensions of NP 23112 overlap with females of *Proconsul* sp. (MW 160), *Kenyapithecus africanus* (MB 5 and 24767), *K. wickeri* (FT 3636), *Hispanopithecus* (ISP 18), and *Pan paniscus*. NP 23112 is smaller than female canines of *Pan troglodytes,* moderately larger than other female specimens of *K. africanus*, *K. wickeri*, and *Hispanopithecus*, and significantly larger than female canines of hylobatids, *Dendropithecus, Mabokopithecus* and *Oreopithecus*. The Napudet canine morphology is most consistent with *Kenyapithecus*. It differs from *Mabokopithecus* (and male *Nacholapithecus*) in having a straight and fairly vertical rather than recurved distolingual marginal ridge. Its buccal profile resembles *K. africanus* (MB 35979), and its low lingual cingulum is higher mesially than distally, as in *K. africanus* and unlike *K. wickeri* (FT 3318). The lingual cingulum, however, is discontinuous between its mesial and distal ends, as in FT 3318, and unlike the continuous cingulum of MB 5. The generic attribution of the Napudet canine awaits further fossils.

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Reproductive History and the Pace of Aging in Women

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Life history theory (LHT) predicts an energetic trade-off between reproductive effort and the pace of biological aging. Energy invested in reproduction is not available for tissue maintenance, thus having more offspring should lead to accelerated senescence. Studies conducted in a variety of non-human species are consistent with this LHT prediction, but the evidence available for humans is equivocal. We tested LHT's prediction by assessing the effects that two key components of women's reproductive history, namely parity and child mortality, have on the pace of telomere attrition, a marker of cellular aging. Contrary to expectations, higher parity was associated with a slower pace of telomere attrition and child mortality with a faster one. We argue that the nature of the association between reproductive history and the pace of aging is likely to differ among species that utilize cooperative breeding strategies and those that do not. We hypothesize that in cooperative breeding species, such as humans, greater parity may attract a higher level of support or more allocare providers (including older offspring), which may free energy that can be devoted to somatic maintenance, hence explaining the negative link between parity the pace of telomere attrition. Within this framework, child mortality would have had a logistic cost: the loss of an allocare provider, in addition to its emotional cost. An exploration of this novel hypothesis in humans as well as non-human species that engage in cooperative breeding may lead to a reformulation of the original LHT prediction.

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Covariation and modularity in the human dentition

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Modularity within the dentition may allow for mosaic evolution of the teeth. Of consequence for human evolution, the reduction of one class of teeth, such as the incisors, could occur independently of morphological changes to other teeth. Recent studies have explored the genetic and phenotypic covariation of the dentition in primates, but it is difficult to compare results across these studies as they utilized different measures of size and shape. In the current study, dental size and shape covariation are investigated simultaneously in a sample of South African human adults (n=44). Based on previous empirical and genetic studies, I predicted that the greatest covariation was expected within a single tooth class or between adjacent teeth. Geometric morphometric analysis of 3D dental landmarks was used to assess the shape covariation in the dentition. The 3D crown and root landmarks were converted to standard linear dental metrics to assess size. The coefficient of determination of pairwise comparisons of maxillary teeth was used as the estimate of phenotypic size covariation. To quantify multivariate shape covariation between paired teeth, the eigenvalue variance, RV coefficient, and correlation coefficients for each paired singular axes from a partial least squared analysis were assessed. Results indicate size and shape integration within tooth classes and modularity between tooth classes such as the incisors and molars. Analyses of adjacent teeth and teeth within the same tooth class display increased integration relative to non-adjacent teeth and teeth in different classes, respectively. These results suggest the semi-independent evolution of individual tooth classes.

Endocranial asymmetry and brain-lateralization: a comprehensive geometric morphometric approach

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Functional brain lateralization is reflected on different morphological levels from cytoarchitecture to gross anatomy. Aspects of the latter can also be studied from endocasts. The pattern of endocranial asymmetry in recent humans differs from the pattern in apes: humans display a typical combination of right frontal and left occipital protrusions, and a larger left Broca's cap, whereas apes do not display a consistent population-wide pattern. As the characteristic human pattern is thought to relate to handedness and language, a better understanding of asymmetry patterns is critical for understanding the evolution of cognition and behavior in our lineage.

Previous work has focused on qualitative descriptions, and quantitative attempts were problematic as they relied on the definition of an idealized midsagittal plane. Here we present a comprehensive geometric morphometrics approach to quantify endocranial asymmetry without requiring the definition of a midline. Based on computed tomographic scans and landmarks and semilandmarks on curves and surfaces, we explore the pattern and the amount of asymmetry in an adult sample of 36 humans, 31 chimpanzees, 36 gorillas and 43 orangutans. Semilandmarks were allowed to slide according to a symmetric landmark configuration to remove asymmetric shape variation related to their initially arbitrary location. We discuss symmetric and asymmetric shape components based on relabeled reflections of the landmark

configurations. We demonstrate that our quantitative multivariate approach captures relevant asymmetries and adds to our knowledge about the variation of the amount and the pattern of brain asymmetries that is essential for the interpretation of hominin fossil endocasts.

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Glucocorticoid mediated responses to calorie restriction, sleep deprivation and wheel running in the mouse brain and its evolution among placental mammals

LISA NEVELL. NA.

Objectives,

This study tests for changing evolutionary rates among mammals in genes implicated in the brain's response to physiological stress.

Materials and Methods,

The paper utilizes microarray data to identify genes which are differentially regulated in the brain under calorie restriction, sleep deprivation, or wheel running stressors. A Likelihood ratio test (LRT) is performed to determine if a significant change in the rate of evolution occurred during human, ape, primate, or elephant evolution in PAML, and the dN/dS ratio for each branch is calculated.

Results,

Three genes are differentially regulated in response to both calorie restriction and sleep deprivation with BH adjusted p value<0.05: *SGK1, GILZ,* and *P21. P21* has a premature stop codon and evolved under neutral selection on the branch leading to elephants (w=1.01; p=0.000000001) but did not face changing rates in primates. *SGK1* experienced relaxed negative selection during primate evolution compared to other mammals (w=0.11 vs w=0.56; p=1 E -20). Finally, *GILZ* experienced strong positive adaptive evolution during primate evolution (w=1.6; p=0.003).

Discussion.

SGK1, GILZ, and *P21* are known to respond to glucocorticoid signaling and regulate neurogenesis, neuronal plasticity, neuronal death, myolination, and inflammation in the brain. During mammalian evolution there has been experimentation in the brain's response to physiological stress. This diversity provides models by which future studies may dissect how GCs signaling pathways respond when they are disregulated in human diseases.

Comparison of the vaginal, fecal, and rectal microbiome in captive Pigtailed Macaques (*Macaca nemestrina*)

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Bacterial communities in the non-human primates' (NHP) vaginal and gastrointestinal tracts are key factors of a multidimensional mechanism that functions as the first line of defense against disease, supports immunity development, and supplements the host metabolism. Understanding the microbiome in NHPs can shed light on the complex relationships between humans and their microbial communities. Many microbial studies are cross-sectionally designed and report the community structure at a single instance in time. However, the temporal dynamics of the microbial community is vital in understanding the stability of a community, exogenous effects, as well as detecting disruption events indicative of an abnormal condition. In this study, we examine the temporal dynamics of the bacteria communities in 39 healthy female macaques (*Macaca nemestrina*) by analysing matched vaginal, rectal and fecal samples obtained weekly over a 4-week period. We show how the vaginal, rectal, and gut microbiomes vary both within and between individuals, and how the microbiomes vary temporally over the course of the study. Our results show that the rectal and gut microbiomes are stable across time and tend to be stable both within and between individuals. We found that the vaginal microbiome, on the other hand, can vary more within an individual than the variation of the rectal or gut microbiomes between individuals. Although the vaginal microbiome shows large variation, we were unable to detect a consistent relationship between the changes in the vaginal microbiome and the estrous cycle. This highlights the need for more long-term studies of the microbiome in NHPs.

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Spatial analysis of mitochondrial genetic diversity across the genus *Pan*

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Extensive research has been conducted to characterize the mitochondrial diversity of chimpanzees and bonobos. However, few studies have examined the landscape distribution of mitochondrial lineages across Africa. Here we assess the relationship between geographic location and population sub-structure among chimpanzees and bonobos using a large set of published mitochondrial genome data (mtDNA). We obtained 833 HVR1 and 93 whole mtDNA geo-referenced sequences from all *Pan* species and subspecies. In addition, we obtained 268 HVR1 and 2 whole mtDNA sequences of individuals from unconfirmed locations; 186 of which are previously unpublished HVR1 sequences. Preliminary median network analyses indicates there are distinguishable local clusters of mtDNA lineages within all chimpanzee subspecies as well as bonobos. Some clusters are restricted to geographic locations within wider subspecies ranges. Mismatch distribution analyses as well as estimates of Tajima's D and Fu's F suggest historical population expansion in *P.t.schweinfurthii* but not in the other subspecies. These results corroborate previous findings from published literature. These preliminary insights will be expanded by addition of Spatial Principal Components analyses and Bayesian inference on both the HVR1 and complete mtDNA datasets. In addition, samples of unconfirmed geographic origin will be added to these analyses to determine if the structures observed remain unchanged. If successful, this research may allow us to estimate the geographic area of origin of individuals with unknown histories beyond a simple sub-species classification. This is the first attempt at a genus-wide spatial analysis with a large sample size across all members of the genus *Pan*.

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Comparative morphology of the glottis in the hylobatids using a high-resolution MRI

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Hylobatids are lesser apes inhabiting the canopy of the tropical forest in Southeast Asia, and they are usually classified into the four independent genera, i.e., *Hylobates*, *Hoolock*, *Nomascus*, *Symphalangus*. They produce characteristic loud species-specific calls, which are referred to as "songs", which comprise a sequence of loud and pure-tone-like voices changing melodiously in fundamental frequency, i.e., pitch. The pitch location principally depends on the elasticity of the vocal folds (VFs), which is modified by varied movements of laryngeal cartilages. We here use the high-resolution MRI scans of the embalmed specimens of extracted larynges, to examine the morphological variation of laryngeal architecture in the four genera. Some features characteristic and common to hylobatids among hominoids are found: the arytenoid cartilage has a bifurcated vocal process which extends into VFs and vocal membrane respectively; VFs are thin and long; the first tracheal cartilage is located inside the cricoid cartilage, and the elastic cone and vocal ligaments are thick. These features are suggested

to underlie their high-pitched and flexible phonation.

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Isotopic variability in chimpanzee and baboon plant foods at Gombe National Park, Tanzania

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Paleoanthropologists increasingly rely on stable isotopes when characterizing the ecological niches occupied by extinct hominins. Such reconstructions are hampered by an incomplete understanding of the isotopic variability of the mixed woodland habitats favored by these hominins. Here we report on the isotopic variability in the plants consumed by two species frequently used as referential models in reconstructions of hominin behavioral ecology - chimpanzees (*Pan troglodytes*) and baboons (*Papio anubis*) - of Gombe National Park, Tanzania. Prior studies suggest that in forested environments their diets largely overlap, though this has not been tested in a mixed habitat.

We collected and analyzed 110 samples from 35 key dry season food sources (wet season foods have been collected but not yet analyzed). C3 plant $\delta^{13}C$ ranged from -34.03‰ to -22.23‰. C4 plants, including one regularly consumed in small amounts by chimpanzees (*Andropogon schirensis*), had a $\delta^{13}C$ range of -14.12‰ to -12.23‰. $\delta^{13}C$ was significantly different ($p=0.017$) between chimpanzee resources (-28.69‰) and baboon resources (-27.27‰). The C3 landscape had diverse $\delta^{13}C$ and $\delta^{15}N$ signatures. Tree species $\delta^{13}C$ (-28.32‰) differed significantly from lianas (-26.53‰, $p<0.01$), as well as shrubs (-31.44‰, $p<0.001$) and herbs (-31.32‰, $p<0.001$). Significant differences were also found for both $\delta^{13}C$ ($p<0.001$) and $\delta^{15}N$ ($p<0.01$) between the leaves (-30.04‰, 1.86‰) and reproductive parts (-27.30‰, 2.63‰) of C3 species.

These findings confirm that these two similarly-sized omnivorous primates nonetheless exploit foods with different isotopic signatures in a mixed habitat like Gombe NP, providing a living referent for the carbon profile of sympatric hominins.

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No role for strong purifying selection on *MC1R* in populations from Northern Island Melanesia

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Variation in human skin pigmentation evolved in response to the selective pressure of ultra-violet radiation (UVR), with purifying selection maintaining darker skin color in high UVR regions. Genetic evidence cited in support of this is the reduced diversity observed at the pigmentation gene *MC1R* in high-UVR African populations compared to low-UVR non-African populations. However, investigations into the extent of *MC1R* diversity in non-African populations evolving under high-UVR conditions have been limited. In order to address this, we report on *MC1R* coding variation in 188 individuals from Northern Island Melanesia. Diversity levels are reduced in this sample (π = 0.0075, θ = 0.00081) relative to non-African populations sequenced as part of the 1000 Genomes Project (π range = 0.00056-0.00171; θ range = 0.00089-0.00323). We observe five polymorphisms, three of which are non-synonymous. Using a modified McDonald-Kreitman's test, we demonstrate that this pattern is inconsistent with a model of strong purifying selection ($p = 0.275$). Further, we do not observe extensive haplotype sharing between Melanesians and African populations from the 1000 Genomes Project, as one might expect if variation at this locus has been constrained across high UVR populations. One nonsynonymous polymorphism, rs2228479, is common in the sequenced sample (15%) but is not significantly associated with quantitatively assessed variation in skin or hair color in a larger sample of genotyped individuals, possibly due to epistatic interactions with other pigmentation loci. These results suggest that a reinterpretation of the strength of selection on *MC1R* in high UVR populations may be necessary.

Dietary trends in early medieval Croatia as evidenced by stable isotope analysis

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Little is known about the diet of early medieval Croatian populations. Written sources talking about this topic are scarce, so most of the data are available from paleodontological studies or, in rare cases, from stable isotope analyses. The main aim of this study is to reconstruct the dietary patterns of the early medieval Croats based on nitrogen and carbon stable isotopes analysis, but also to examine if there are significant differences between the sites and between the sexes.

The series includes 30 human and one animal (sheep/goat) bone sample from five EM (6th-12th c. CE) sites located on the eastern Adriatic coast. The majority of individuals had $\delta^{13}C$ values between −19.7‰ and −17.6‰ and $\delta^{15}N$ values between 8.6‰ and 10.5‰, which is consistent with a diet based primarily on terrestrial C_3 resources with little or no marine or C_4 input. Higher $\delta^{15}N$ values in two adult individuals suggest the consumption of large amounts of high-trophic level protein, or of freshwater fish. Two other individuals, an adolescent and a 1.5-2.5 year old child, had high $\delta^{13}C$ values, indicating the consumption of either marine foods or a C_4 resource such as millet. The young child also had an elevated $\delta^{15}N$ value, so was probably consuming a C_4 or marinebased weaning food whilst still breastfeeding. No differences were apparent between sites or between males and females in the analysed sample. These results provide us with new information on diet and lifestyle of individuals inhabiting eastern Adriatic during the Early Middle Ages.

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Male migration, family structure and children's health in a seasonal agricultural community in Veracruz, Mexico

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Family structure is widely known to be associated with children's health and wellbeing. Controlling for a range of backgrounds factors, children experiencing family stability are most likely to have healthy outcomes on most measures. The aim of this study was to determine the effect of prolonged father absence due to economic migration on the nutritional status and health of his children. Research was conducted in Ocotepec, a small mestizo subsistence agricultural community with very low human development indices and high marginalization in Veracruz, Mexico. Families in Ocotepec rely, to a large extent on maize milpas for its year-long staple food supply, and on relatively small government cash transfers and variable remittances to pay for agricultural inputs and other purchased goods. Although women and children typically participate in agricultural activities, crop-management decisions and strenuous heavy workloads are men's traditional responsibility. However, in

nearly half the households, young men out-migrate in search of paid employment and are gone for most of the agricultural year with adverse consequences for their milpas' productivity. Data on household food security, anthropometric indices (weight-for-height, height-for-age and weight-for-age) and acute illness frequency were compared for children aged 5-12 years in female vs. male-headed households. Results show complex associations between migration-related male absence, food production and children's nutritional and health status. Higher purchasing power and relatively higher standards of living in households receiving male-earned remittances do not always compensate for the negative effects of male absence on food security in this community. Findings are discussed within a biosocial framework.

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Shining Evolutionary Light on Human Sleep: Sleep Intensity and Human Cognition

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Scientists have made substantial progress in understanding the evolution of sleep across the Tree of Life, including in primates. Remarkably, our understanding of human sleep is less complete, which is surprising given our unique mental capacity and the importance of sleep for human cognitive performance. We used new phylogeny-based methods to investigate the evolution of human sleep in comparative context, focusing on sleep duration and rapid eye movement (REM) sleep relative to other primates. Analyses revealed that humans are exceptionally short sleepers relative to other primates: human sleep duration is substantially below the 95% credible interval of predicted sleep duration, based on a Bayesian analysis that predicts sleep duration from phylogeny, body mass, activity period, endocranial volume, diet, interbirth interval, and group size (only 0.2% of the predicted distribution is less than the observed value for humans). Analyses of REM reveal that humans have a substantially higher proportion of REM sleep than expected (only 0.4% of the predicted distribution was greater than the observed human value). Combined with other findings that humans show more flexible sleep than other primates, we propose that human sleep is shorter, deeper, and more flexible than expected in a typical primate. Several factors likely served as selective pressures for more efficient and flexible sleep in humans, including increased predation in terrestrial environments and threats from intergroup conflict. Less sleep would enable longer active periods to acquire and transmit new skills and knowledge, while deeper sleep may play a critical role in consolidation of those skills.

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Intestinal parasites of wild orangutans in Gunung Palung National Park, Borneo, Indonesia

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Parasitology is increasingly employed by field primatologists to better understand the ecology and health of wild primate populations. This study examined the intestinal parasites of wild Bornean orangutans in Gunung Palung National Park. Gunung Palung is relatively pristine orangutan habitat, while many other orangutan sites consist of degraded secondary forest. As habitat disturbance and contact with humans are known to increase parasite infection in wild primates, the Gunung Palung population was predicted to have low overall parasite prevalence. Using direct smear and fecal concentration techniques on-site at the research camp, fecal samples were analyzed and parasites identified based on morphological characteristics viewed through a light microscope. At least one type of parasite species was detected in every sample (N=152) from every individual (N=38) that was tested. No other wild orangutan study thus far has reported 100% parasite prevalence. Strongyle-type eggs, *Balantidium sp*. and *Entamoeba sp*., each show remarkably high prevalence, approaching 100%. Also of note is the high prevalence of *Trichuris sp*. in Gunung Palung compared to reports from other wild orangutan populations (20% at Gunung Palung, while never higher than 7% at other wild study sites). We discuss these surprising results and the potential influential factors, including methodological considerations and conservation issues. Various orangutan behaviors, including socializing and ground travel, may help explain these results as well, highlighting the importance of long-term monitoring of parasite infection.

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Use of Standard Perikymata Profiles to Estimate Chronologies of Linear Enamel Hypoplasia (LEH)

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Studies estimate the time between LEHs (generalized indicators of physiological stress) in non-human primates by counting perikymata (enamel growth increments) between adjacent defects. Using average time between defects, it has been suggested that LEH recur cyclically, influenced by seasonal environmental factors. However, a more direct approach would be to determine whether individual animals form LEH cyclically. Doing so would require perikymata to be observable between all visible LEH. Unfortunately, teeth often undergo surface wear which obscures perikymata. A tooth with 6 LEH (5 pairs) may be excluded from a study because perikymata were only visible between one LEH pair. This makes it nearly impossible to evaluate cyclical stress because there are few individuals with continuous perikymata between LEH. This project creates standard perikymata profiles (SPP) from average crown height and perikymata counts for *Pongo* as part of a larger study. The distance from each LEH to the CEJ is scaled and superimposed on the SPP so perikymata counts can be estimated for the entire sequence of LEH. When tested for accuracy in *Pongo pygmaeus* females (n=13) with 71 LEH pairs, the SPP was consistently accurate: expected perikymata between LEH pairs differed from the actual number by an average of only |2.28|±2.10 perikymata. For males (n=7) with 28 pairs, the difference was 1.39±1.47 perikymata. This project identifies the potential SPPs have for primate species which lack reliable dental development charts. Additionally, bioarchaeologists interested in repetitive LEH could generate population-specific SPP rather than relying on the limited number of chronologies currently developed.

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Nutritional composition of plant foods consumed by the chimpanzees of Gombe National Park, Tanzania

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Chimpanzees (*Pan troglodytes*) are considered ripe fruit specialists- yet like most living apes, including humans, they consume a variety of plant and animal foods. Both chimpanzees and bonobos exhibit considerable variation in dietary breadth between populations in different habitats, as well as seasonal variation within populations. Though often used as referential models for understanding the behavioral ecology of early hominins, comprehensive nutritional data on wild *Pan* foods are lacking from all but a few long-term

research sites. We collected representative samples of 145 different plant food parts consumed by Kasekela chimpanzees of Gombe National Park, Tanzania over 11 months (June 2014 – April 2015) to determine their energy content and macronutrient composition. Moisture content varied from 4.8-88.6%. On a dry matter basis (DMB), values ranged as follows: gross energy (32.3-81.3 kcal/100g), neutral detergent fiber (NDF) (0.3-86.0%), acid detergent fiber (ADF) (0.2-66.1%), crude fat (0.3-70.1%), crude protein (corrected for fiber-bound N) (1.8-31.3%), and ash (0.9-22.0%). On a DMB, the overlap in macronutrient values between broad food part categories (e.g., crude protein content in "fruit" versus "leaves") was high, suggesting that assessments of chimpanzee dietary niches based on such categories can obscure important variation in dietary quality. Values for replicates of the same food parts collected from different locations or at different times suggest that geographic and temporal variation in macronutrient composition is generally low. We discuss our results in comparison to published datasets from other long-term sites, and highlight applications and directions for future research.

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Dietary adaptations and variability in occlusal surface shape of mandibular dentition in hominin and non-hominin primates

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Dental occlusal outlines in hominins, non-hominin primates, and other mammals have been used for assessments of taxonomic significance, with variability often considered as being primarily phylogenetic. Few studies have attempted to assess how diet might influence the pattern of variability in closely related species, and thus potentially confound phylogenetic signals. Here, we measure occlusal variability in posterior mandibular dentition in primates with different diets to assess whether the relationship between diet and variability is consistent. Data were collected from five non-hominin primates in a range of dietary categories, as well as several sympatric hominin species.

Occlusal surfaces were outlined by mapping a series of 50 semi-landmarks based on 2-D photographs using tpsDig2 software. Thereafter, outline shapes were quantified using Elliptical Fourier Functional Analysis, and principle components and linear discriminant analyses were preformed to both explore the pattern of variability in occlusal outline as well as assess the validity of that pattern for grouping taxa.

Preliminary results suggest that there is a clear relationship between dietary feeding adaptations and variability in the occlusal surfaces of the mandibular posterior dentition. Additionally, differences in the pattern of variability exist when comparing the first, second, and third molars. While occlusal outline shape clearly has a strong phylogenetic component, the influence of diet and other behavioral variables on the pattern of variability in shape outline should be considered when occlusal shapes are being used for taxonomic assessments.

Pelvis shape and hominin walking: Insights from the three-dimensional mechanics of the lesser gluteals and hamstrings in human and chimpanzee bipedalism

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Since the human-chimpanzee last common ancestor, the three-dimensional shape of the hominin pelvis has been dramatically modified, especially that of the ilia and ischia. In humans, the iliac blades have evolved a more lateral orientation and the ischia a more dorsal orientation. These traits make the human pelvis distinct from all known fossil and living apes, as well as some early hominins. Here, we compare the actions and roles of the lesser gluteals and hamstrings during bipedal walking in chimpanzees and humans to better understand the impact of pelvis shape on hominin locomotor mechanics.

Marker and force platform data from bipedal chimpanzees (N=3) and humans (N=3) were integrated with three-dimensional musculoskeletal models to calculate lesser gluteal and hamstring muscle forces via static optimization. An induced acceleration analysis was then performed to compute the contributions of these muscles to the angular accelerations of the hip joint (action) and the linear accelerations of the center of mass (COM) (role).

In chimpanzee bipedal walking, the lesser gluteals induce medial rotation and abduction of the hip joint, as well as medially-directed and forward acceleration on the COM. This differs from human walking in that the lesser gluteals induce a vertical acceleration on the COM. The action and role of the hamstrings in accelerating the hip joint and COM was similar in chimpanzees and humans. These results provide new insight into how hip muscle function during bipedal walking may be influenced by differences in pelvis shape.

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Phylogenetic analysis of *Paradolichopithecus*: Fossil baboon or macaque?

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Paradolichopithecus is a large, terrestrially-adapted Pliocene fossil cercopithecine from Europe and Central Asia. While many previous studies have noted that *Paradolichopithecus* shares a number of craniofacial features with *Macaca* (e.g., rounded muzzle, lack of facial fossae, lack of anteorbital drop), a few others have instead suggested it shares greater similarities to *Papio* (e.g., relatively large molars relative to premolars and lacrimal fossa position within the lacrimal bone). The present study tests the broad phylogenetic relationship of *Paradolichopithecus* to a number of other fossil and extant cercopithecine primates within a cladistic framework. A parsimony analysis of 140 craniodental characters suggests that *Paradolichopithecus* is best regarded as the sister taxon to *Macaca* (bootstrap values >85, decay index= 6). In this analysis, *Victoriapithecus* and *Parapapio lothagamensis* were constrained as successive outgroups, and extant African papionins were constrained as monophyletic, as suggested by molecular analyses; fossil taxa were unconstrained and free to float within the ingroup. Character state transformation analyses reveal potential synapomorphies of the resulting *Paradolichopithecus-Macaca* clade, including the absence of maxillary fossae and ridges in males. The presence of a maxillary sinus in some *Paradolichopithecus* specimens has also been argued to strongly support the grouping of *Macaca* and *Paradolichopithecus*. While this feature has been coded as polymorphic in this study, intergeneric heterogeneity in this character is still unclear among other extant and fossil anthropoids. A better understanding of the presence/absence of the maxillary sinus in other cercopithecoids, especially among stem macaques, will be important for better comprehending the phyletic position of *Paradolichopithecus*.

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The effect of context on visitor responses to the question "What does it mean to be human?"

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The question "What does it mean to be human?" is the central theme of the Smithsonian's Human Origins Program and has played a key role in our interactive approach to presenting human origins to our diverse audiences. This research project focused on understanding how the context of the question might shape visitors' responses. We examined 5,116 visitor responses from four different contexts: the digital kiosk in the permanent Hall of Human Origins in the Smithsonian's National Museum of Natural History; sticky notes on a large board at the 2014 Smithsonian Folklife Festival; sticky notes at the first 3 of 19 sites on the Exploring Human Origins traveling library exhibit tour; and short oral interviews in the Hall of Human Origins. We sorted the responses into 7 categories: Behavioral, Cognitive, Ecological, Emotional, Physical, Social, and Spiritual. Within each sample, subcategories were also identified during data analysis (e.g. "to dance" as a subcategory of Behavioral). Chi-square and Spearman's rank order tests indicate that while context had some effect on visitor responses (for instance, there were more Physical responses in the Hall of Human Origins kiosk which displays a wealth of physical evidence for human evolution), they were largely consistent across all four contexts; Cognitive and Emotional responses were most frequent. This can inform future content development for our website, social media, public programing, and displays in the Hall of Human Origins by connecting scientific evidence to the things visitors most often think about when it comes to being human.

Troubled Times in Late Prehistoric Wisconsin: Violent Skeletal Trauma Among the Winnebago Phase Oneota

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In 1991, Milner et al. published a groundbreaking article that showed the Native American Oneota culture in a new light. Their research at the Norris Farms #36 cemetery in west-central Illinois indicated that the Oneota living there were plagued by intergroup violence and small-scale tribal warfare. Milner et al. examined 264 skeletons and discovered evidence for trauma on 43 of them (16.29%). He also noted that at least one-third of the adults at the Norris Farms #36 cemetery died violent deaths. However, the group at Norris Farms #36 was part of an Oneota expansion southward and may not be representative of the archaeological culture as a whole. It appears that the Norris Farms #36 population was actually intruding on the local Mississippian culture, which may explain the high levels of conflict and violence. To test the hypothesis, we examined the skeletal remains of 126 individuals from five Oneota sites in eastern Wisconsin, the Oneota heartland. Within the sample, 26 individuals showed evidence of trauma. This comes out to an overall rate of trauma of 20.63% of individuals, which is not statistically significantly different from that documented at Norris Farms #36. This suggests that the high rates of violent trauma documented at Norris Farms #36 may not be an anomaly, but rather that violence was widespread among the Oneota.

Longitudinal Variation in the Gut Microbiota of Free-ranging Capuchin Monkeys (*Cebus capucinus*)

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Gut microbiome research offers new insights into primate dietary ecology. However, our understanding of free-ranging primates microbiomes is limited to single points in time. Given that laboratory studies have demonstrated the possibility of rapid turnover of microbiota, it is critical to understand how environmental and dietary variation affect the microbiomes of free-ranging primates. We have undertaken a long-term, longitudinal study of the intestinal microbiota of primates inhabiting the tropical dry forests in the Sector Santa Rosa, Área de Conservación Guanacaste, Costa Rica.

We collected monthly fresh fecal samples from eight individuals in each of three social groups of capuchin monkeys (*Cebus capucinus*) between April and December, 2014. All samples were flash frozen in liquid nitrogen in the field then stored at -80°C before bead-beating phenol chloroform microbial DNA extraction. 16s V4 rRNA metabarcode sequencing on an Illumina MiSeq, generated 13,128,026 2x250 paired-end reads. 26 of these DNA samples also underwent whole metagenomic shotgun sequencing on one lane of an Illumina HiSeq 2500, generating 201,531,863 2x125 paired-end reads. 16s Operational Taxonomic Units were called with 97% similarity using mothur with greengenes taxonomy. Analyses were conducted in phyloseq, MetaPhlAn, and HUMAnN. Rainfall patterns and fruit biomass during this time period were atypical due to a strong El Niño drought. Variation in the gut microbiota of *C. capucinus* over time was not strongly correlated with sporadic rainfall patterns or habitat-wide fruit biomass estimates. Our study takes initial steps in understanding proximate factors influencing the microbial adaptations and limitations influencing dietary ecology.

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Carpal kinematics and morphological correlates of ulnar deviation mobility in anthropoids

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Extant hominoids share a derived condition of the wrist in which the ulnar styloid does not articulate directly with the proximal carpal row. It is sometimes asserted that this provides apes with greater ulnar deviation (UD) mobility (presumably to facilitate vertical climbing), but this is based on an insufficient understanding of the carpal motions. Here, serial computed-tomography of cadaveric specimens is used to compare carpal kinematics during ulnar deviation (UD) in *Pan troglodytes* and *Pongo pygmaeus* versus Old and New World monkeys to test hypotheses about the morphological correlates of UD mobility.

The pattern of carpal rotations during UD in chimpanzees does not share special similarities with that of orangutans; rather, the pattern in *P. troglodytes* is most similar to that observed in large-bodied, terrestrial cercopiths (*Papio* and *Mandrillus*). Although both orangutans and smaller monkeys exhibit higher total UD range of motion (ROM), orangutans produce UD via a unique carpal kinematic mechanism. In *Pongo*, a hypertrophied lunate permits greater ulnar rotation of a diminutive triquetrum, which acts alternately as a proximal and distal row carpal during different phases of the motion. Across taxa, there is no correlation between distal projection of the ulnar styloid and overall ROM, indicating that this is not the functional significance of styloid withdrawal in hominoids, which is more likely related to increased forearm supination. However, overall UD ROM is correlated with the orientation of the hamate's triquetral facet (with more ulnarly-oriented joints facilitating greater ROMs), thus offering some potential to reconstruct UD mobility in fossils.

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Each one the same: performance, demography, and violence at Sacred Ridge

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This poster examines the demography of the Sacred Ridge assemblage and how this demography is important to the performance of violence. The Sacred Ridge assemblage is an

excellent example of extreme processing, with the remains of at least 33 individuals of both sexes and all ages found commingled and processed within the same pit structure. Over 14,000 bone fragments and conjoins were analyzed over a 3-year period for taphonomic indicators of violence and processing. During this analysis, it was found that there were no differences in how an individual was processed based on age or sex. Everyone was processed in the same manner, including facial fracturing, blunt force trauma, fragmentation and commingling. Facial fracturing was universal, with only one instance of a refit between facial bone and the cranial vault.

The lack of differential treatment in the assemblage suggests that all the individuals that were massacred were essentially viewed the same, without respect to age, sex, or status. This lack of discrimination is itself performative, as women and children are rarely seen as appropriate targets for violence in many situations. That women and children were scalped, dismembered, and tortured alike suggests that the personal identities of the victims were not recognized by the aggressors. Aggressors were instead more interested in how the bodies of the victims could be used in the negotiation of power.

The Financial Hunter-Gatherer: How do Foragers Diversify their Dietary Portfolios?

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Homo sapiens' effective dispersal across the Old and New Worlds prior to the end of the Pleistocene was likely in part due to our flexible capacity to forage for nutrient-dense foods in diverse environments. Optimal Foraging Theory (OFT) provides a framework for understanding human foraging strategies, particularly with respect to foraging returns and foraging risk. Optimal foraging models are often questioned, however, because 1) models focus on maximizing foraging returns of a single resource; a potential limitation because human foragers are omnivores with mixed diets, and 2) foraging risk calculations often do not account for correlations between the expected returns of multiple resources. Human foraging behavior is undoubtedly influenced by the expected returns of multiple resources, and foraging risk is affected by the covariance between different resource returns. Here, using multivariate optimization tools derived from financial-portfolio theory, we investigate the expected foraging returns and foraging risk of Venezuelan Pumé and Malaysian Batek foragers who "invest" in multiple food resources. We demonstrate that risk can be mischaracterized when correlations between returns are ignored. When correlations are incorporated into optimization models, we find that the two foraging populations converge on similar expected foraging returns and risk reduction strategies. In times of plenty, foods with high caloric returns that are also highly risky, are targeted. During seasons when food encounters are lower, foragers focus on low-return and low-risk foods. This strategy maximizes overall energetic return certainty, ensuring biological maintenance and survival when food is scarce, and windfall returns when food is plentiful.

Ancient dental calculus as a reservoir of whole human mitogenomes

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Until recently, one challenge of ancient DNA research has been the necessary destruction of skeletal material in order to extract human genetic information. Calcified dental plaque (dental calculus) can be removed from dentition without damaging the underlying teeth or surrounding bone and it has been shown to be an excellent reservoir of microbial and dietary biomolecules and microfossils. Here, we examine the preservation of human mitochondrial DNA in dental calculus by performing high-throughput mitogenome sequencing of material from six individuals from Norris Farms #36, a Mississippian period Oneota cemetery in Illinois dating back to 700BP. DNA was extracted in a dedicated ancient DNA facility at the University of Oklahoma and built into shotgun libraries. Following library amplification, each sample underwent a mitochondrial DNA capture and enrichment protocol at Arizona State University and was sequenced on an Illumina MiSeq platform. Medium coverage (7-34x) whole mitogenomes were successfully recovered from all six samples from Norris Farms #36 including three which were previously unsuccessful for HVRI sequencing using traditional PCR-based methods. In one calculus sample, the proportion of endogenous mtDNA increased from <0.0001% in unenriched shotgun to 0.34% using mitochondrial capture and enrichment. This research demonstrates that calculus, an abundant and ubiquitous archaeological substrate, contains sufficient host information for whole mitogenome reconstruction. These findings have important implications for the use of dental calculus as an alternative material in archaeological studies of maternal ancestry.

An analysis of factors affecting surili (Genus: *Presbytis*) population densities

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Many factors affect non-human primate population densities, including; phylogeny, body size, life history strategies, zoogeography, habitat, natural and anthropogenic successional changes, seasonal and inter-annual fluctuations, intra- and interspecific competition, resource availability and diet, and disease and predation, among others. In this study, the population densities of 17 species of surili (Genus: *Presbytis*) were examined. Surilis are diurnal and aboreal non-human primates, with adults weighing between 5 to 8 kg. They inhabit some forested areas of Sumatra, Borneo, Java, Malaysia, and Thailand, as well as a few surrounding islets. All known population densities of *Presbytis* were taken from published literature and compared. Preliminary results indicate that surilis live solitary or in groups of 3 to 21 individuals (mean = 10), typically consisting of one adult male, several adult females, and non-adults. Surili densities ranged from 1 individual/km^2 to 100+ individuals/km^2. Densities seem to be most affected by habitat type, the quality and availability of preferred foods, and hunting. Understanding the variables affecting *Presbytis* densities is imperative as most of the species are classified as Vulnerable or worse, with a few species being Critically Endangered. In addition, a handful of *Presbytis* species are either Data Deficient or have not been evaluated.

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Bioarchaeology of Cremated Human Remains from the McQueen Shell Ring (9Li1648) on St. Catherines Island, Georgia

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Fragmented osseous remains were recovered from the center of McQueen Shell Ring (9Li1648), a Late Archaic period site on St. Catherines Island, Georgia. Recovered remains consisted primarily of calcined, fragmentary commingled bone fragments. Approximately 34,000 fragments, weighing 9,095 grams, were

analyzed. About 9.5% of this assemblage consisted of identifiably human bone fragments (863.5g, n = 933). Human remains were macroscopically documented pertaining to Minimum Number of Individuals (MNI), osteobiography, and pre- and postmortem treatment. Interpretation of the osseous evidence depended on a detailed understanding of the three-dimensional provenience of bone fragments via GIS analysis. Spatial assessment revealed two clusters of cremated remains, including upper and lower concentrations.

This investigation reveals the MNI presence of seven individuals, including five adults, one adolescent, and one juvenile. Among the adults, there were at least one male and one female. Perimortem cutmarks were identified on cranial fragments, suggesting trophy-mutilation or postmortem excarnation. Evidence suggests that cremation consisted of prolonged exposure to temperatures exceeding 800°C followed by intentional pulverization. Interment also included a wide range of animal species. Due to lack of ash or thermal alteration of soil matrix surrounding the cremated remains, the deceased were likely cremated at a separate location. Thorough destruction of the remains and patterned placement suggests that body treatment was a familiar mortuary practice. However, there is no prior evidence that cremation was the cultural norm for this setting or any other Archaic-era mortuary site in the Georgia Bight or general region of the American Southeast.

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Cooperative breeding among Agta foragers: How reproduction, health and transition intersect today

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Transition from foraging to agriculture, since the Neolithic and continuing to the present, has been associated with both a severe health depression and an increase in fertility. While these two lines of evidence appear paradoxical, Darwinian perspectives reveal the adaptive nature of human behaviour as health is disregarded for reproductive success. By conducting blood composition analysis with 339 Agta foragers from the Philippines we find that viral, helminthic, and nutritional disorders as well as child mortality rates are significantly increased with sedentarisation. Despite this, age-specific fertility and overall reproductive success are both positively affected. Our results suggest that sedentarisation allows women to increase investment in fertility without depressing overall fitness. However, these relationships are mediated, in part, by alterations in childcare behaviour. Hunter-gatherers, such as the Agta, are well known for their extensive cooperative behaviour, particularly in terms of allomaternal care. Recent research has focused on the importance of distant kin and non-kin as allomothers, however these structures are highly plastic and context dependent. Thus, we find that as Agta settle and begin to accumulate wealth and resources, allocare networks are reduced to primary kin who have a larger influence of child health outcomes, including anthropometrics. As health is depressed with settlement, childcare occurs increasingly within the household, perhaps due to higher quality care, alongside household-specific healthcare knowledge and increased risk buffering via material wealth rather than social relations. These results inform our understanding about how disease ecology, subsistence and behaviour interact throughout our evolutionary history.

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Exploring C_4 plant foods: the nutritional properties of South African savanna vegetation

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Isotopic analyses of hominin fossil material have demonstrated that after ~4 Ma, hominins began to incorporate significant amounts of C_4/CAM resources (tropical grasses, some sedges, and succulents) into their diets. Additionally, the proportion of C_4 foods consumed by australopith species is positively correlated with molar size, suggesting that increasing reliance on these resources may have selected for the robust craniodental features traditionally viewed as adaptations for hard object feeding. Grasses and sedges are often portrayed as offering little nutritional benefit to most primates and thus, there have been few systematic efforts to determine which C_4 plants (grasses and/or sedges) and plant parts (e.g., leaves, seeds, underground storage organs) were potential food resources for early hominins.

To begin addressing this gap our project explores the interplay between C_4 food availability/abundance, mechanical/nutritional properties, and consumption by savanna primates. We analyzed the macronutrients (protein, fat, non-structural carbohydrates) and structural carbohydrates (NDF, ADF, Lignin) of C_4 and C_3 plants from within the Cradle Nature Reserve in the Cradle of Humankind, South Africa. Our transects spanned wetland, woodland, and open grassland microhabitats with collections made during wet and dry field seasons in order to capture temporal and spatial variation. Within each transect the dominant grass, sedge, tree, and forb species were collected, and their relevant parts were isolated for analysis. Our results indicate that within these environments, variation in wild plant nutrient content exists within and across sites, species, plant organs, and seasons, illuminating a complex nutritional landscape.

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Quantitative Occlusal Surface Complexity Metrics and Dental Wear in *Alouatta palliata*

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Continuing efforts to link mammal dental morphology with diet have recently seen a proliferation of quantitative metrics aimed at assessing surface complexity. Among these new techniques are: Orientation Patch Count (OPC) which counts the number of discrete faces or facets on an enamel surface; Relief Index (RFI) which is a ratio between the three-dimensional and two-dimensional surface areas of a tooth; and Dirichlet's Normal Energy (DNE) which is an integral measure of orientation variability on the tooth surface. Two underexplored aspects of their implementation (particularly for OPC and DNE) are the degree to which these measures are affected by dental wear, and whether upper dentitions yield new and unexpected information. We compared OPC, RFI, and DNE, to percentage of occlusal surface enamel loss on upper and lower first molars of free-ranging sympatric mantled howling monkeys (*Alouatta palliata*) opportunistically collected from seasonal dry forests at Hacienda La Pacífica, Cañas, Costa Rica. Preliminary results show occlusal enamel loss has a weak positive correlation with DNE (p=0.02), and a weak negative correlation with RFI (p= 0.06) consistent with their reciprocal nature. This suggests that these metrics are more sensitive to gross dental morphology than to lifetime enamel attrition, suggesting their usefulness in assessing morphology of teeth possessing varying degrees of wear. While further work is certainly needed, these nascent techniques may offer new insights and opportunities for reconstructing diet in the

fossil record—where available material is often composed of worn teeth.

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Sex and site based differences in subsistence procurement and daily activities amongst the Ipiutak and Tigara of Point Hope, Alaska

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The objective of this study was to assess the potential sex and site differences between the Ipiutak (100B.C.-500A.D.) and Tigara (1300-1700A.D.), two different American Eskimo populations that subsisted and thrived in the challenging circumpolar environs near modern-day Point Hope, Alaska. As part of a larger study involving *The Backbone of History: Health and Nutrition in the Western Hemisphere*, data collection, in part, consisted of skeletal analysis for indicators of infection, trauma, nutritional stress (linear enamel hypoplasias (LEH)), and degenerative joint disease (DJD). For this study, ordinal logistic regressions were applied to each variable in order to take into consideration the multiple explanatory variables (sex and site) and categorical response variables (degree of severity). The results of this statistical analysis indicate the frequencies of skeletal infection and childhood nutritional stress were significantly higher for the Ipiutak who subsisted by the procurement of land and sea resources. Conversely, the Tigara, a whale-hunting and coastal population, had statistically significant higher frequencies of DJD in the upper arm joints, thus suggesting habitual upper arm biomechanical stress. In terms of sex-based differences, males had significantly higher frequencies of skeletal infection and LEH prevalence. Findings such as these provide insight into how different modes of subsistence and sex-based activity patterns reflect in the bioarchaeological record of populations living in the circumpolar region. Furthermore, this study provided an opportunity to synthesize osteological analyses, bioarchaeological protocols, statistical assessment tools, and information from the ethnoarchaeological record.

Seasonal influences on gelada social networks

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In modular social systems, primates exhibit flexible association patterns to balance the costs and benefits of group-living. How and why some associations persist and other dissipate is not well-understood. Here, we use 6 years of association data from a well-habituated population of gelada (Theropithecus gelada) living in the Simien Mountains National Park, Ethiopia. We used social network analysis to characterize the changes in gelada social structure across "wet" and "dry" seasons over the study period. Network analyses revealed pronounced differences in the nature of direct and indirect connections among gelada reproductive units between seasons and year-to-year. In "dry" seasons, direct connections predominate while in the "wet" season indirect connections are stronger. We propose that variance in network position and structure is related to food availability and group size. Furthermore, we discuss how changing network structure influences male-male competition among gelada bachelors and dominant "leader" males.

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Unambiguous assignment of male sex to a human tooth: use of proteomics when DNA is unavailable for sex assignment

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Sex determination is necessary for full bioarchaeological analysis of humans. Visual determination can be difficult or impossible for subadult or incomplete skeletal assemblages. When DNA is present in these samples, amplification of the sex-linked amelogenin gene can be performed to determine the karyotype of sex chromosomes. Unfortunately, DNA is not always available due to chemical instability that causes degradation in the environment below the limit of detection. Protein is chemically more robust than DNA, persists in the environment for longer periods, and has the potential to allow sex determination in the absence of DNA. We conducted a feasibility study on 10 year old male wisdom teeth. A 20 mg block of enamel, that included the dentino–enamel boundary, was removed from each tooth, milled in the presence hydrochloric acid, and neutralized with ammonium bicarbonate. Proteins that were liberated from the enamel were then reduced, alkylated with iodoacetamide, proteolyzed in the presence of the surfactant Protease-Max with trypsin, and finally analyzed by liquid chromatography tandem mass spectrometry. Sex-specific peptides unique to the male and female isoform of the amelogenin protein were detected, 5 from the Y-isoform (AMELY_HUMAN; 26 ± 4 spectral counts) and 26 from the X-isoform (AMELX_HUMAN; 64 ± 14 counts). This allows unambiguous assignment of the tooth as male. We anticipate that analysis of amelogenin protein isoforms can be used for sex assignment when nuclear DNA is unusable or absent in bioarchaeological and forensic samples.

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Cranial Bone Mineral Density as a Possible Age Indicator

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Age estimation is traditionally calculated through the macroscopic observation of skeletal degenerative changes. Cranial thickness has been found not to be sexually dimorphic until the onset of *hyperostosis frontalis interna*. Though typically used as an indicator of osteoporotic risk factor, bone mineral density (BMD) may provide a method for age estimation based upon minute changes in mineralization that occur as a result of the aging process. Age changes in BMD was explored in a combined male and female mixed ancestry autopsy sample (N = 32). The sample age range was 17-84. The DEXA scans were performed using a Hologic ® QDR Discovery 4500W scanner. Composite BMD scores for the frontal and parietal bones were calculated. The relationship between age and the frontal and parietal bones was examined using a Kernel smoother or Loess regression, which finds a locally weighted fit of a simple curve. Results show a distinct pattern of BMD and age between the frontal and parietal bones. In the frontal bone, there is a steady increase in BMD until age 35 with a steady decline until age 50 when there is a steep increase in BMD until 58 years of age followed by a steep decline until 62 years of age when BMD scores appear to stabilize. In the parietals, BMD scores are stable until approximately age 33 when there is a steep increase until age 45 followed by an abrupt decline in BMD until age 58 when there is a steady increase in BMD.

Biological health as a possible factor in the estimation of biological parameters from the human skeleton

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Forensic anthropology, and the broader discipline of physical anthropology, have traditionally focused attention on developing and testing methods for estimating biological parameters from unknown human skeletal remains. Less attention has been given to understanding the underlying biological processes and associated variation assessed by these methods. During life, the skeleton is not only structural tissue but a living organ that functions as part of the endocrine system. As such, anthropologists must consider the influence of lifestyle factors including diet, activity, drug use, and overall health when analyzing skeletal morphologies.

Commonly used methods are largely derived from anatomical collections where lifehistory information is limited or suspect. Recently, we have seen an increase in generating contemporary skeletal collections for research, as well as use of clinical imaging (e.g., CT; MRI) on living individuals to obtain digital datasets more applicable to current populations. These initiatives have been enhanced by compiling better detailed lifehistories of donors as well as interviewing the clinical subjects regarding their lifestyle.

This presentation discusses the potential for drugs and alcohol to affect the estimation of biological parameters from the human skeleton by taking a holistic approach: reviewing clinical literature, considering the potential for analyzing documented skeletal collections, and collecting data from the living subjects through clinical imaging. We focus primarily on skeletal impacts of insults to biological health, specifically in regard to alcohol and drug use and their potential to influence the estimation of age-at-death, as well as expressions of secondary sexual traits, and stature.

Subchondral bone radiodensity patterns in the glenoid fossa of the scapula in humans and non-human primates

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Mineralization patterns of subchondral bone underlying healthy articular surfaces reflect its loading history. Areas of higher concentrations of denser bone indicate more expansive areas of higher or more frequent compressive joint reaction forces. Computed tomography osteoabsorptiometry (CT-OAM) can be used to estimate *in vivo* joint loading history, as functional morphology studies have demonstrated for several joints in the primate post-cranial skeleton. In human orthopaedic studies, CT-OAM has been applied to the glenoid fossa (GF) of the scapula on individuals lacking shoulder pathology and results consistently demonstrate bicentric radiodensity concentrations on its antero-superior and posterior margins, with the former tending to be larger in area. High radiodensity values in both areas have been associated with the humeral head compressing against the GF when rotator cuff muscles contract. When a tear occurs, high radiodensity concentrations typically move in the direction opposite the injured muscle (e.g., a supraspinatus tear results in more central and anterior shifts in concentration of high radiodensity). Here we evaluate this finding by examining GF radiodensity patterns using CT-OAM in primates that have different rotator cuff recruitment patterns. Most individuals had bicentric high radiodensity concentrations, but unlike humans, quadrupedal apes and monkeys showed larger areas of high radiodensity posteriorly, reflecting documented stereotypic activity of supraspinatus during support phase. In contrast, gibbons have higher concentrations anteriorly on the GF, reflecting documented recruitment of subscapularis in both support and swing phases during brachiation. We conclude that subchondral bone radiodensity patterns are a useful tool for assessing specific muscle function in primates.

The 'Paleo' diet in the United States: Why, how, and what now?

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Individuals living in Western societies are rapidly adopting ancestral diets, commonly referred to as the Paleolithic or 'Paleo' diet. The ancestral dietary movement is inspired by the idea that genetic adaptations are being outpaced by cultural changes. Whether this dietary movement is a "fad," or a diet based on scientifically sound principles is under debate by much of the popular and anthropological communities. Further, there is a wide array of variations to the Paleolithic type diet that individuals adopt. The degree to which these variations result in disparities in health outcomes is largely unknown. As preliminary research for a multi-phased project, this study explored how individuals define, interpret, and practice the ancestral diet movement in the United States. Interviews, surveys and media analysis were used to examine what the ideals and possible health outcomes of the Paleo diet are for those who are following it. This study revealed a series of paradoxes with regard to the definitions, ideals, interpretations, and the actual practice of this dietary movement. The data also illuminated new parameters for inclusion in controlled Paleo diet trials that seek to quantify emerging health trends.

Hominin behavioral landscapes: merging stable isotopes, zooarchaeology and ecometrics for insights into hominin ecology at East Turkana, northern Kenya

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Placing hominin evolution within an ecological framework that is well-resolved both spatially and temporally has been a longstanding goal of paleoanthropology. However, understanding how ecological dynamics and hominin adaptation are linked has been challenging. This study focuses on the paleoecosystem of East Turkana in northern Kenya between 2 and 1.4 million years ago. These fossil-rich deposits, which document the evolution of hominins and other African mammals, provide a rare opportunity to examine ecological adaptation within the context of a dynamic paleoecosystem. By combining large stable isotopic (n=600), zooarchaeological (n=13 sites) and ecometric (n=323) datasets, our analyses provide several multiproxy insights into the dietary evolution of the mammalian community during this important period. First, we find that certain mammalian taxa (e.g., suids) record subtle differences in localized vegetation at East Turkana. Second, our analyses suggest different patterns of dietary evolution in East Turkana mammals- many taxa show little change over time (e.g., *Kolpochoerus*, *Hippopotamus*), while others experience dietary transitions through time (e.g., Antilopini, *Homo)*. Lastly, we find that East Turkana archaeological sites are dominated by grazing (i.e., carbon-enriched) taxa, which presents the possibility that consumption of these resources contributed to the previously documented isotopic enrichment of East Turkana hominin taxa during this period.

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History of Exercise, Cross-sectional Geometry, and Bending Mechanics: Inferences Based on Three Strains of Mice

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Analyses of bone cross-sectional geometry are frequently used to predict the loading histories of past populations. We investigated the interplay between genetic background and exercise, as well as the relationship between bone cross-sectional geometry and bending mechanics, in three mouse strains: high bone density (C3H/He), low bone density (C57BL/6), and a high-runner strain homozygous for the *Myh4*^{Minimsc} allele (MM). Each strain was divided into exercise (wheel) or control (no wheel) treatment groups. After seven weeks, morphometric and mechanical loading analyses were conducted on dissected femora. Comparisons of exercise versus control treatments revealed no significant differences within any strain, despite exercising MM mice running significantly more than their C3H/He and C57BL/6 counterparts ($P < 0.001$). Thus, predictions that exercise would alter bone phenotype were not supported. Results of cross-sectional geometry predicted MM femora to be most resistant to bending forces and C3H/He femora to be least resistant. Mechanical tests, however, showed that C3H/He mice had significantly stiffer bones than both MM ($P < 0.001$) and C57BL/6 ($P < 0.001$) mice. Thus, predictions of low bending strength in C3H/He femora, made without factoring in their high mineral content, were not supported. Overall, we did not find the expected associations between exercise, cross-sectional geometry, and mechanical properties. Accordingly, our results suggest that predicting loading response from cross-sectional geometry alone only partially informs such hypotheses. Our study questions common paleoanthropological conventions in which bone mineral composition is assumed to be constant, and differences in cross-sectional geometry are interpreted as indicative of differential loading regimes.

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I C(T) Dead People

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The use of imaging techniques has a long history in bioarchaeology, and the merits of the various methods are impressive. This study will focus on the use of micro-computed tomography (micro-CT) in paleopathology, and more specifically, in studies of arthritis. A total of six vertebrae were scanned at the Bone Imaging Lab at the University of Calgary; three vertebrae with a visible presence of arthritic lesions, and three 'normal' vertebrae, which were used as controls. The scans were compared to macroscopic evaluation, conventional radiography, and histological methods. Micro-CT technology has regularly been used to study clinical arthritis, however, its use in the anthropological literature is extremely limited. The micro-CT scans provide a unique insight into the micro-architecture of bone, including cortical and trabecular structures, as well as providing a 3D reconstruction of the bone as a whole. This, along with its non-destructive nature makes it a valuable and sustainable weapon in the paleopathologist's arsenal.

Ecogeographical adaptations of Tanzanian skeletons from the German colonial period

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Recent publications portray East Africans as having a more linear physique and smaller epiphyses relative to length than African Americans. We revisit these relationships using data derived from colonial-era descriptions of skeletons from Tanzania by Reid and Reinecke. Reid presented data for Turu (4 males, 2 females), Isanzu (10 males, 9 females), Burunge (9 males, 2 females), Sandawe (5 males, 4 females), and Hadza (described as “Kindinga,” 1 male). Reinecke described postcranial skeletons of Shambaa (1 male), Masai (1 male, 1 female), Pare (1 male). The combined sample for East Africans totals 32 males, 18 females. Data on the limb bones from both reports and pelvic data from Reinecke are compared to measurements by OMP of pre-contact Khoisan, Zulu, and African Americans. The results underscore the prevalence of a linear physique in East Africa. Plots of femoral head diameter versus maximum femoral length show the Tanzanian skeletons tend to have proportionately smaller epiphyses than the sex-matched samples of African Americans and Zulus and are similar to or less slender than the Khoisan. The sample of Cushitic-speaking Burunge have particularly slender skeletons. Reinecke presented data for bi-iliac breadths, which are generally narrow (3 males: 215, 232, and 186 mm; 1 female: 190 mm). Brachial and crural indices confirm that the Tanzanians have more elongated distal extremities on average than Zulu, African American, and Khoisan samples.

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Gender differences in Diet and Health During Eastern Zhou

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Millet agriculture was the dominant subsistence strategy for the Central Plain communities of northern China throughout the Neolithic. Wheat and barley were introduced into this area during the Late Neolithic; yet their impact on human diet during the Neolithic and subsequent early dynasties is not well understood. Using stable isotope analysis of human and animal bone collagen samples, we examine diet variation during the Neolithic and Eastern Zhou dynasty and discuss how contribution of millet and other crops changed during in early dynastic china and the consequences of these new diets on oral health.

We found statistically significant differences in $\delta^{15}N‰$ and $\delta^{13}C‰$ isotopic values between Neolithic and Eastern Zhou human bones samples. Eastern Zhou bone samples display significantly more negative $\delta^{13}C‰$ and lower $\delta^{15}N‰$ signatures implying a dietary shift towards C3 plants, possibly wheat and barley. When isotopic values between male and female samples were compared, it became apparent that these differences are driven by the change in female diet only. Whereas isotopic signatures in male and female samples overlap completely for Neolithic assemblages, there is a sharp contrast between male and female isotope values during Eastern Zhou, suggesting gender specific diets. Males appear to retain diets focused on C4 plants with considerable contribution of animal products. In contrast, female samples are characterized by highly negative $\delta^{13}C‰$ and fairly low $\delta^{15}N‰$ values. We discuss possible explanations for observed differences and their impact on oral health of individuals during Eastern Zhou.

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Analysis of Humeral Trochlear Angles As Possible Biological Sex Characteristic

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Previous research suggests the presence of dramatic variation between the angular traits of female and male humeri. In some populations, this difference is significant enough to accurately determine biological sex. Using the geometric morphometric software TPSDig2 as a new technique, this paper evaluates trochlear angles from photographed dry humeri as a possible determination of biological sex within populations of varying subsistence practices and time periods. The samples include 40 (17 female/23 male) individuals from the archaic population of Windover, Florida and 66 (27 female/39 male) individuals from various collections housed at the University of Tübingen,

Germany. Preliminary results on the Windover population, a hunter-gatherer group, have shown that female left trochlear angles are on average greater than both male right and left angles, but are not statistically significant. These results will be compared to the remains of iron age, bronze age, gothic and middle age individuals from Tübingen to see if this methods accuracy is dependent on factors such as, occupation, time period, robusticity, or handedness. This method, if proven useful, will aid biological anthropology in identifying individuals when other crucial areas of sex determination are missing or too fragmentary.

Reassessing Sexual Dimorphism in Early and Middle Eocene Notharctine Adapiforms

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Sexual dimorphism in body and canine size is a feature of many extant anthropoids, but is largely absent in strepsirrhines. Therefore it is surprising that early adapiform primates – generally considered to be strepsirrhines with lemur-like morphology – have been described as having highly dimorphic canines. Previous studies have not compare observed ranges in notharctine fossil canines to maximum ranges in large intraspecific samples of extant species, and potential molar size dimorphism in notharctines has not been tested. We examined these issues using a sample of extant anthropoids (n=77 species with ≥20 individuals/species) and an adapiform sample of North American *Cantius* and *Notharctus* from the early and middle Eocene. Results agree with previous findings that intraspecific ranges of canine size in *Cantius torresi* and *Notharctus venticolis* are significantly higher than observed in non-dimorphic extant species, and fall within ranges of dimorphic species such as *Cercopithecus cephus* and *Cebus apella*. Most notharctine samples show molar area variance more consistent with monomorphism. One exception becomes evident when treating middle Bridgerian (Br2) *Notharctus* as a single species: the canine and molar dimorphism is matched only by *Pongo*. However, the presence of at least two non-metric characters correlating with molar size and the stratigraphically abrupt appearance and disappearance of this dimorphism are more easily explained by the presence of two species during Br2, *Notharctus tenebrosus* (smaller) and *Notharctus pugnax* (larger). In summary, our study strengthens evidence for moderate canine dimorphism in all examined notharctines, and supports a two species interpretation of for Br2 notharctines.

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The effect of selection for lower relative encephalization on cranial base morphology

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The spatial packing hypothesis that selection for increased encephalization during primate and human evolution was accommodated developmentally by increased cranial base flexion has been largely supported in the literature. Here, we test whether the previously described positive linear relationship between cranial base angle and index of relative encephalization holds across three inbred mouse strains to further explore how strongly changes in relative encephalization might stimulate changes in basicranial angle.

Endocasts were extracted from micro computed tomography images of two moderately sized strains of mice with smaller brain size (A/J, n=18) or larger brain size (C57, n=19), as well as a strain that had been selected for obesity, resulting in large skull size (NZO, n=17). Measurements of cranial base angle and the index of relative encephalization (IRE) were calculated from craniofacial landmark coordinates.

While we found a strong correlation between relative encephalization and cranial base angle for A/J and C57 strains, NZO had a smaller relative encephalization than expected by cranial base angle. Although strong artificial selection on NZO for obesity has resulted in a skull with significantly larger dimensions than in A/J or C57, the total brain volume and cranial base angle of NZO mice is similar to that of C57 mice. Effective selection for lower relative encephalization in this mouse model, the reverse of likely selective pressures on hominin ancestors, did not led to a reduction in cranial base flexion. This indicates that a change in relative brain size does not automatically lead to a change in basicranial flexion.

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Can marginalization be politically and economically beneficial? A case study from Late Ottoman-period Hesban (Jordan)

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Throughout the early centuries of the Ottoman Empire (16th - 18th c. A.D.), the Madaba plateau of western Jordan was occupied primarily by partially or completely nomadic tribes. During the late 19th century, the Ottomans began encouraging agricultural development of this environmentally marginal region. While small settlements were established in the area around Hesban, the immediate environs of the site continued to support entirely nomadic tribes and semi-nomadic farmers, who seasonally resided in caves or ruined structures. The main argument for the lack of a permanent settlement at Hesban during the 19th century has been the economic and political benefits of fluid residential patterns to avoid taxation and other administrative hassles. Paleopathological analysis of a communal burial from the late 19th century (MNI = 45), recovered from the ruins of a 14th century building at Hesban, can reveal the health and disease effects of this adaptation strategy. This small sample has demonstrated that, at least for this segment of the population, a semi- or completely nomadic residential strategy was not more successful than settlement in small agricultural communities. Almost half of the sample included fetuses, perinates, or infants up to 18 months, and of these, 88% show evidence of infectious disease or metabolic conditions. These values rival the high rates of infectious diseases seen in other Late Ottoman children from the southern Levant. Thus, while political and economic marginalization may have helped this community avoid Ottoman interference, it did not result in better diet or health for this small group.

Isotopic evidence for weaning timing among Formative populations of Caleta Huelén, northern Chile

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Advances in Bayesian statistical analysis of stable isotope data derived from human skeletal remains have made the reconstruction of ancient breastfeeding practices, and in particular the quantification of weaning timing, a reality. In this study we consider the timing of breastfeeding cessation, and its effects on female fertility, among Formative Period (1500 BC-AD 400) populations from the hyperarid Atacama Desert of northern Chile.

Recent bioarchaeological research on skeletal populations from a series of sites located near the mouth of the River Loa (in the Caleta Huelén region) has found evidence supporting notably elevated rates of female fertility. Such high fertility is typically correlated with early cessation of breastfeeding, as lactational amenorrhea otherwise serves to limit female fertility. In this work, we present the results of

stable isotope analysis of bone collagen ($\delta^{13}C_{co}$ and $\delta^{15}N_{co}$) from a series (n=23) of known age Caleta Huelén subadults (perinatal to 14 years), results that we compare with complementary isotope data derived from our earlier analysis of 28 adults from the same sites. The use of Bayesian computational modeling (the open-source R package WARN) allows for the quantification of weaning age, and a comparison with the previously estimated rates of Formative Period fertility in this region.

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Social Network Analysis of Stone Handling and Object Manipulation Among Long-Tailed Macaques (*Macaca fascicularis*) in Bali, Indonesia: A Preliminary Analysis

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Navigating complex social interactions is an important part of life for most primates. Gregariously social behaviors including allogrooming and observational learning are frequent foci for studies of sociality. However, purportedly solitary behaviors exhibited individually may also have social implications. Stone handling is a common behavior in one long-tailed macaque (*Macaca fascicularis*) population near Ubud in Bali, Indonesia, which is thought to emerge among well-provisioned populations with reduced foraging pressures. Although stone handling occurs at the individual level, stone handling bouts themselves may include several individuals engaging in the behavior in close proximity. The present study explores potential social aspects of stone handling. Preliminary results indicate that social stone handling is particularly important for sub-adult males and juveniles, who engage in stone handling with an average of 0.79 and 0.42 "same behavior" neighbors within three meters per scan sample, respectively. An ANOVA shows significant differences in the average number of "same behavior" neighbors between focal sub-adult males, juveniles, adult males, and females ($p < 0.001$). We compare these results with similar analyses for object handling (including a broader range of edible and nonedible items) as well as allogrooming at two sites in Bali (Ubud and Uluwatu). We also analyze the social context of foraging at Uluwatu to compare with patterns of allogrooming in that group, as well as stone handling at Ubud. Our findings suggest that certain solitary behaviors facilitate social experiences for group members and that focusing on them can help us better understand primate social networks.

Segregation of burial areas in the Riga Dome Church cemetery (13th-17th centuries) in Riga, Latvia

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This research investigates the medieval-post medieval cemetery of the Dome Church in Riga, Latvia (RDC). A total of 324 burials were uncovered during reconstruction work in 1986-1989. It was noted that individuals with weapon-related trauma and infectious diseases were buried in two separate areas. The main hypothesis of this research was to verify that particular areas of the RDC could have been reserved for certain population groups.

Adult age was estimated by observing degenerative changes in the auricular surface and pubic symphysis of the os coxae. Sex estimates were based on assessment of the morphology of the pelvis and skull. Dental formation and eruption, as well as long bone length was used to estimate age in non-adults. All individuals were observed for the presence of weapon-related trauma and infectious diseases.

There were 108 males, 80 females and 86 non-adults in this skeletal population. Four separate burial areas were identified according to archaeological date, and three of them contained particular burial groups. Fifteen individuals with weapon-related trauma were buried in Area I (13th – 15th centuries AD), six individuals with venereal syphilis and one with possible tuberculosis were buried in Area IV (17th century), but area III (16th – 17th centuries) contained six mass graves.

According to the results of this research, it is possible that certain groups of the population, such as fallen soldiers, victims of epidemics and/or famines, as well as people with specific infectious diseases were buried in dedicated areas of the RDC.

A 2D Geometric Morphometric Analysis of Changes in the Basicranium in Relation to Trunk Posture in Mammals

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Mammals with a habitually orthograde trunk posture possess a more anteriorly-located foramen magnum than those with non-orthograde trunk postures, and Russo & Kirk showed that bipedal orthograde mammals possess an even more anteriorly-located foramen magnum than those that are just habitually orthograde. This finding has encouraged paleoanthropologists to use foramen magnum position as a predictor of trunk posture in early hominins. We investigated whether other landmarks on the cranial base were influenced by trunk posture. In this study, landmark data were collected from 125 mammalian basicrania spanning 41 species of primates and diprotodonts that sampled a range of habitual trunk postures. Using Procrustes and Principal Components Analysis (PCA) we evaluated the influence of trunk posture on the location of the foramen magnum and the carotid and jugular foramina. The results confirm Russo and Kirk's findings and demonstrated differing levels of correlation between the position of the foramen magnum and the carotid foramen within primates and diprotodonts. The results of this study suggest that basicranial morphology, other than the location of the foramen magnum, may be used as a proxy for trunk posture in early hominins.

Nutritional change following social change in Illyria (modern Albania)

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This research examines dietary change during periods of major social transition in ancient Illyria at the site of Durres, Albania. We test the hypothesis that social change following colonization by the Greeks (c. 600 B.C) and Romans (c. 229 B.C), and subsequent cultural and biological exchange, facilitated declines in oral health at Durres. To test this, we analyzed 213 individuals from Durres, of which 114 had teeth and/or tooth sockets for observation, for evidence of dental carries, abscesses, and pre-mortem tooth loss. Differences in the prevalence of these pathologies by time period, age, and sex were examined. Dental caries prevalence remained constant through time. However, prevalence of antemortem (AM) tooth loss and abscessing decreased from the Hellenistic to Late Roman period (AM loss decreased from 47% to 26%; abscessing decreased from 53% to 36%). Mid-aged adults (97%; n=42) had higher rates of dental caries than young (52%; n=36) and older adults (46%; n=13), but slightly lower rates of antemortem tooth loss and abscessing than older adults (AM loss 40% in mid-aged and 46% in older adults; abscessing 52% in mid-aged and 62% in older adults). Interestingly males (M) had higher rates of caries (M=75%; F=51%) and antemortem tooth loss (M=48%; F=27%) than females (F), and similar rates of abscessing. Major social transitions can disrupt many cultural practices, including changes in diet and food processing. These dietary changes can either be beneficial or harmful from a nutritional standpoint. The implications of this dietary transition will be discussed.

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The diet of savanna-woodland chimpanzees (*Pan troglodytes schweinfurthii*) at Issa, western Tanzania

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Our knowledge of the present is a key element to understanding the past. Improvements in our comparative diet data of extant primates, for example, directly inform our predictions about the diet of extinct, morphologically derived hominins. However, most studies that have described chimpanzee diet stem from forest-dwelling communities, whilst fewer describe what chimpanzees living in mosaic habitats – that more closely resemble those of Plio-Pleistocene hominins – consume. We present here data on the diet of an unhabituated community of savanna-woodland chimpanzees (*Pan troglodytes schweinfurthii*) from the Issa Valley, western Tanzania. We investigated intra-annual patterns of dominant plant species consumption and the relationship with plant species distribution, availability, and density over four years. Based on macroscopic faecal analysis and direct observations, we found Issa chimpanzees to consume a minimum of 69 plant species. We found minimal evidence that Issa chimpanzees consumed vertebrate prey, in line with most other open habitat populations. Given that chimpanzee dietary diversity and seasonal variation of consumed foods is a direct result of habitat quality and heterogeneity, we conclude by contextualising these findings to those of other medium-long term studies of chimpanzees, and also by discussing what our results may suggest about fossil hominin exploitation of mosaic landscapes.

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Forensic perspectives on mass violence in prehistoric California

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Violence in prehistoric societies has been well-documented using the bioarchaeological record. In prehistoric California such practices are seen throughout the region. Violent behaviors have been argued to be due to environmental stress, culture contact, population density, the introduction of new technology, and as a means of maintaining social harmony, among others. Within central California prehistoric sites, however, there are a few instances of mass violence, which has a different taphonomic signature from other instances of violence in the region. These contexts typically include burials of multiple individuals with extensive evidence of perimortem injury (to include cutmarks around the cranial vault, craniofacial trauma, and cutmarks around major ligamentous attachments of the postcranial skeleton).

Within this study we re-evaluate these instances of mass violence within prehistoric California, with a specific focus on their relation to other forensically documented cases of mass fatalities and violence. There is a particular focus on pattern and type of injury in addition to biological profile of the affected individuals and the types of grave inclusions in both the forensic and bioarchaeological settings. Such a perspective allows us to consider motive, cause, and mechanism of injury. This type of forensic analysis on a bioarchaeological collection also provides perspective on violent behaviors in prehistory and the complexity and variation that is involved interpreting violence from skeletal remains.

Market integration and out-group valuation among three horticultural populations: The effect depends on the measure

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Research in anthropology and other social science disciplines has connected levels of acculturation, globalization, market integration, and style of life (for brevity, "MI") with human actors' willingness to cooperate, sometimes with members of different communities, different ethnic groups, and even different nations. However, the direction of effect is inconsistent: sometimes MI predicts higher cooperation between members of different groups, sometimes lower. We hypothesize that it is not MI itself that predicts cooperation, but rather a change in the benefits of interaction with out-group members that is often (but not always) a correlate of increased MI. Using interviews and economic experiments, we assessed the relationship between MI and out-group valuation, as proxied by initial cooperation with and trust for out-group members, among three populations of horticulturalists from lowland Bolivia with extensive variation in MI. We find that a material style of life measure is not predictive of initial cooperation with out-group members, but that features of this measure are; namely, we find that individuals who have abandoned traditional cooperative labor and who have more money invested in market items cooperate less, not more, with out-group members, while education, travel to large cities, media exposure, and income have no effect. We suggest that among Bolivian horticulturalists, individuals who have more to gain from out-group connections may value out-group members more highly. We conclude by discussing how these findings may reframe past work relating initial cooperation to MI.

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Chronic Non-Communicable Diseases among Urban and Rural Deorukhe Brahmin Women of Maharashtra, India: A Comparative Analysis

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This study tested the mismatch hypothesis which suggests that a mismatch between evolved adaptive behavioral human tendencies and modern day urban environments is responsible for rising non-communicable diseases. We predicted that rates of obesity, hypertension, and diabetes would be less frequent in endogamous rural Deorukhe Brahman women of Konkan and more frequent in urban ones from Mumbai, India. Women in the rural setting were expected to engage in higher levels of manual labor and eat a healthier, traditional diet marginally supplemented with processed foods. This was a cross-sectional study that used snowball sampling of 132 individuals (women, mothers and daughters post-menarche; 12-60 years). Anthropometric and blood pressure measures were taken while diabetes was self-reported. Contrary to our prediction, disease rates did not differ significantly between the two samples and relationships between diet, lifestyle, and the occurrence of non-communicable diseases were more complex than the simple, dichotomous mismatch paradigm predicted. Urban Deorukhes maintained a more traditional diet while rural Deorukhes integrated more modern foods into their diet, due to high rates of rural-urban and urban-rural flows of foods and information. Similarity in social standing of the Brahmin high caste was another factor that allowed both sample groups access to similar nutritional intakes along with lower energy expenditure. Our study demonstrates that nutrition transition and globalization are not uniform phenomena across human populations and that a nuanced approach considering population-specific economic and social parameters is necessary for

a deeper understanding of the causes of the global rise of non-communicable diseases.

Estimating human juvenile age-at-death from bone histology

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Biological anthropologists and forensic scientists routinely seek to create biological profiles from human skeletal remains. These profiles include estimating age-at-death, which is generally more accurate for juveniles compared to estimates derived for adults. However, the accuracy of current methods relies upon relatively complete skeletal remains. Often though, skeletal remains are incomplete and it is not possible to use standard methods to estimate age-at-death. Here we construct a regression equation to estimate juvenile age-at-death (0-17yrs) from bone histology. Potentially, our method can be applied to bone fragments.

Eighty-three complete juvenile skeletons, recovered from one archaeological site in England, were aged using standard methods. Following this, one 0.5 cm histological section was removed from the anterior humeral midshaft of each skeleton. Histological slides were prepared using standard methods. The population density of primary osteons and secondary osteons was recorded using a high resolution microscope.

Results show that primary osteon population density has a strong negative correlation with age (r squared = -0.672, n = 83, $p < 0.0005$). Secondary osteon population density has a strong positive correlation with age (r squared = 0.878, n = 83, $p < 0.0005$, two tailed). We constructed a regression equation from the estimated age of the skeletons, and the density of their primary and secondary osteons. The equation can be used to estimate age-at-death for juveniles from this population with 86.1% accuracy. These findings provide a basis for future studies of bone histology and juvenile age-at-death.

An assessment of great ape mandibular corpus shape with implications for understanding the hominoid fossil record

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Mandibular corpus fragments are among the most commonly found specimens in the hominoid fossil record. Since many of these specimens only retain small portions of the mandibular corpus, studies of these fossils have been limited to assessments of corpus height and breadth, which are commonly used to calculate mandibular robusticity. Although mandibular robusticity is often included in descriptions of fossil specimens, this metric has not been shown to be particularly useful to understand the functional significance and/or taxonomic placement of a specimen, possibly because measurements of height and breadth do not adequately capture corporal shape. To quantify and compare the curved contours of great ape mandibular corpora, a total of 3 landmarks and 60 semilandmarks outlining the corpus were collected at two locations on the right side of the mandible, in between M_3-M_2 and M_2-M_1, and each location was analyzed separately. 152 adult specimens of *Pan paniscus*, *Pan troglodytes*, *Gorilla gorilla* and *Pongo pygmaeus* were included in this study. Fossil specimens of Miocene apes (*Rudapithecus* and *Dryopithecus)* were also included to assess the applicability of this method to corporal fragments. Data were collected from isosurfaces created from CTscans in Amira. Semilandmarks were 'slid' via minimum bending energy using TPSrelwarp. After sliding, the landmarks were subjected to generalized Procrustes analysis and PCA was conducted on the resulting shape coordinates. Preliminary assessment of both the M_3-M_2 and M_2-M_1 analyses separation of extant taxa along PC1 and PC2, reflecting differences in corporal height and inferior buccal width.

Craniodental versus postcranial variables as estimators of body mass in extinct taxa

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Estimating body size is a critical task in paleoanthropology, as body mass plays a central role in a species' life-history and adaptations to its environment. Unfortunately, estimating body mass for most specimens is conflated by the fragmentary nature of the fossil record. While postcranial remains are usually thought to provide the most accurate estimates of body size, craniodental remains are the most common identifiable elements. Though analyses of the relationship between body mass and craniodental and postcranial remains are common, few have assessed this relationship using data derived from individuals of known body mass for a large taxonomic sample. Here we compare the relationship between body mass and postcranial and craniodental data using a large comparative data base representing 15 species (3 strepsirhine, 4 platyrrhine, 8 catarrhine) comprising 278 specimens with known, associated individual body mass data. Additional body mass data compiled from the literature were available for 96 taxa having cranial data, and 21 taxa having postcranial data, for corroborating the known-mass analyses. Standard least squares regressions of individual measures and geometric means of measures demonstrate that postcranial data do show the highest correlations, and lowest percent prediction errors. However, craniometric data provide comparably accurate estimates, with the caveat that some measures are clearly more tightly correlated than others, and that there are strong phylogenetic differences, in particular involving cercopithecoids. However, within groups craniometric and postcranial data yield comparable accuracy of estimates. We illustrate the results with data for *Australopithecus afarensis* and *A. africanus*.

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Olduvai Gorge paleoecology: a multiproxy approach using bovid ecomorphological, tooth wear, and enamel stable isotopic studies

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Bed I and lower Bed II Olduvai Gorge, Tanzania, provide one of the best records of early Pleistocene hominin biological and behavioral evolution in Africa. Here we utilize isotopic analyses of fossil herbivore tooth enamel, mesowear analysis of bovid teeth, and ecomorphic analyses of bovid postcrania to develop reconstructions of the spatial and temporal heterogeneity in paleohabitats during Bed I and Lower Bed II deposition.

The dietary preferences of the bovids *Antidorcas recki* and *Kobus sigmoidalis*, the suid *Kolpochoerus limnetes* and the proboscidean *Elephas recki* were reconstructed through stable isotopic analysis of enamel to infer diet and other environmental characteristics. These suggest significant habitat heterogeneity, as well as a drying trend through the Bed I sequence. We also developed discriminant function ecomorphology models with classification success rates of >80% that link the morphology of the bovid astragalus, calcaneus, humerus, radius and metapodials to broadly defined habitat categories (open, light cover, heavy cover and forest) using modern bovids of known ecology. These models indicate that the full spectrum of habitats was found through the Bed I and lower Bed II sequence, but the proportion of postcrania from bovids preferring open habitats increased in frequency through time. This conclusion was mirrored by mesowear analysis, which demonstrates a range of diets as

well as an increase in the frequency of individuals consuming abrasive diets through time.

These results highlight the heterogeneity of the ecosystems Olduvai hominins were exposed to over time, and the adaptability of the hominins that lived in them.

Which bone properties provide the best indicators of habitual posture?

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Comparative and experimental studies have been conducted to infer differences in habitual joint postures used by different species or treatment groups. The bone properties tested for differences in loading have varied from simple measures of apparent density to more detailed three-dimensional analyses of trabecular structure. The locations and sizes of the regions of interest being analyzed have also varied widely, from a single VOI in the center of the joint to multiple VOIs closer to the joint surface. The goal of this research is to evaluate which bone properties best reflect known differences in loading in either samples of extant species with known differences in knee posture (e.g., chimpanzees vs. humans), or in treatment groups of sheep that have experimentally induced differences in knee posture.

This study compares previously-studied functional signals to determine which provide the clearest differences between the reference species. Analyses of subchondral apparent density performed well in recovering these known postural differences. The functional signal degraded with increasing distance from the articular surface. Trabecular properties (trabecular orientation and thickness, bone volume fraction) close to the joint surface may also reflect local joint loading historie

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Relationship of proximal femoral morphology to leaping in two African colobine monkeys

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Aspects of limb morphology are known to covary with interspecific differences in locomotor behavior. For example, according to the intermembral index (IM), *Colobus polykomos* (IM = 81.6), is expected to leap more frequently than *Piliocolobus badius* (IM = 90.5); however, field data from Taï Forest, Côte d'Ivoire indicate that *P. badius* is the more frequent leaper. Paradoxically, in these similarly-sized sympatric monkeys, the species with the trait axiomatic for leaping is, in fact, less saltatory.

If the IM of *C. polykomos* reflects adaptation for leaping behaviors, we also expect to observe other "diagnostic" leaping features of a large femoral head, short, buttressed femoral neck, a long, straight femoral shaft, increased femoral diaphyseal strength, and low femoral neck angle. Four femora of each species from Taï Forest populations were scanned using NextEngine Desktop 3D Scanner and ScanStudio HD, and geometric data were analyzed in Rhinoceros 5. We find that *C. polykomos* has additional features associated with leaping, including a larger femoral head and lower femoral neck angle relative to *P. badius*. However, its more anteriorly-displaced femoral head, relatively thinner femoral neck and shaft, and greater shaft curvature are features that can be regarded as suboptimal for leaping.

The greater incidence of leaping traits in the less-frequent leaper may be explained if the bounding behavior exhibited by *C. polykomos* is recognized as a form of leaping. The relatively gracile proximal femur in *C. polykomos* may reflect species differences in leaping dynamics.

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Reconstruction of Cranial Surfaces from 3D Point Data

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Knowledge of human head shape is paramount to the design and production of protective headwear and head-mounted equipment. Current practices rely on head anthropometry, which provides only a rough head shape, or three-dimensional (3D) surface scans, in which cranial shape is often confounded by hair. Obtaining a realistic, smooth cranial contour from a live subject remains a challenge.

In previous work, we developed geometric morphometrics techniques to analyze male head shape using 3D laser scans of bald males. Here, we extend these methods to female head shape. Many women are unwilling to shave their heads to obtain high-quality scans, so a new data collection and processing method was developed. A hardware landmarking tool (a FARO arm) is used to obtain facial landmarks, a line of points marking the hairline, and a set of points on the cranial region taken by parting the subject's hair. This data is combined with a full 3D head scan (with hair) that has corresponding facial landmarks collected via a software landmarking tool. By combining the ICP algorithm and thin plate splines, we automatically remove the cranial region of the subject scan and replace it with a bald prototype cranial region that has been reshaped to exactly fit the subject's FARO data. The result is a complete head scan comprised of the subject's original facial region and an approximated cranial region.

Use of geometric data... Approved for Unlimited Distribution- NSRDEC PAO #U15-426

Reconstruction of cranial.... Approved for Unlimited Distribution- NSRDEC PAO #U15-427

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Energetics and Economics of Foraging in Humans and other Apes

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The advent and development of increasingly sophisticated, extractive foraging methods has played a critical role in the evolution and ecological expansion of the genus *Homo*. Here, we examine the energetic costs of these foraging techniques in a modern foraging population, the Hadza of northern Tanzania, and compare the costs of human foraging to those of other apes. Using respirometry, we measured the energy costs of walking (n=9 men, n=5 women), tree climbing (n=6 men), chopping (n=6 men), and digging (n=5 women) among Hadza adults. We then combined these measures with long-term data on men's and women's forays to calculate a daily cost of foraging (kcal/d) for Hadza men and women. Combining laboratory measures of primate locomotor cost with foraging data for wild populations, we calculated comparable foraging costs for adult chimpanzees, gorillas, and orangutans. Hadza foraging costs were substantially greater than those estimated for chimpanzees, gorillas, and orangutans (mean 155%, range: 43 – 288% greater). Hadza foraging efficiency, calculated as (food energy return / foraging energy expended), was marginally greater than estimates for chimpanzee, similar to those for orangutans, and considerably lower than gorillas. These comparisons suggest the development of extractive foraging techniques increased the daily costs of foraging for hominins without

substantially improving foraging efficiency. We examine the archeological record to reconstruct changes in foraging cost and efficiency in the hominin lineage.

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Ancient DNA Analysis of San Nicolas Island, California

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Human occupation of San Nicolas Island (SNI) off the coast of California extends back at least 10,000 years. At the time of European contact, the people of SNI had closest cultural and linguistic affinities with Takic speakers of the Los Angeles basin. However, there is biological and cultural evidence suggesting population movement in the region throughout the Holocene. Previous studies of craniofacial variation, osseous indicators of health and activities, and artifactual evidence show biological and cultural differences between earlier and later occupants of SNI.

Analysis of Mitochondrial DNA (mtDNA) can provide insight on possible population shifts on SNI. We obtained eleven samples of human remains from SNI sites (dated between 4520 BP and 0 BP in calibrated years) with the aim of using mtDNA variation to test the hypothesis that early and late occupants of SNI differed genetically. DNA was extracted from bone or tooth, mtDNA hypervariable region 1 (HV1) PCR amplified, and sequenced. Unambiguous sequence data were obtained from four samples. Haplogroup was assigned based on defining HV1 variants.

Two individuals belonged to haplogroup A (dating between 4520 to 3100 BP) and two were haplogroup B (dating between 730 to 0 BP). These results provide support for the hypothesis that haplogroup A was an early founding haplogroup with wide distribution along the Pacific coast in the Americas, and that specifically on SNI the founding occupants were displaced by people with a greater prevalence of haplogroup B. Our data provide insight into population dynamics in pre-contact southern California.

Patterns of variation in the hominoid appendicular skeleton: implications for fossil hominins

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A comprehensive knowledge of how limb proportions vary both within and among species is central to furthering our understanding of taxonomy, locomotor behavior, and life history. While much has been written about the polarity of shape change and 'grade transitions' in body proportions during hominin (i.e., the human clade) evolution, putative differences between fossil taxa (some represented by only one individual) are rarely considered within the context of variation within and among living hominoid species.

Here we investigate how body shape/size varies within and among taxa in a large sample of extant hominoids (N=376). We then use these results to interpret the hominin fossil record (e.g., *Australopithecus sediba*, the early *Homo* Dmanisi postcrania, *Ardipithecus ramidus, Homo floresiensis,* and the recently published *Homo naledi*) to re-evaluate evidence of locomotor and/or taxonomic 'grade shifts' during human evolution. We captured and analyzed overall body proportions using both traditional ratios (e.g., intermembral, brachial, crural indices) and multivariate methods (e.g., Mosimann shape ratios and principal components analysis). Our results show that, for most interlimb proportions, noticeable statistical differences exist among living hominoid taxa. For specific ratios, fossil hominin taxa exhibit differences that exceed those observed between closely related extant genera (e.g., *Gorilla* and *Pan*), but our fossil specimens do not segregate well by genus, so that two species of *Australopithecus* and/or *Homo* might be more different than two species of different genera. Rather than providing evidence of taxonomic 'grade shifts', our results suggest there is marked locomotor diversity within closely related hominin species.

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Big primate, small primate: possible evidence for convergent dwarfism within nocturnal galagids

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Body size is a critical trait of animal life history and many studies have shown a strong correlation between body mass and various traits, such as locomotion, climate adaptation, metabolism, social structure and behavior. Recently it has been suggested that nocturnal lemurs experienced at least four independent events of body size reduction, probably as an adaptation to environmental unpredictability. However, little is know about the body mass evolution of other nocturnal primates. Galagids are one of the most diverse primate families in terms of body size variation. Average body mass ranges from ~60g in *Galagoides rondoensis*, one of the smallest living primates, up to 1.5-2.0kg in *Otolemur crassicaudatus*, representing a variation of at least 25-fold. Recent studies indicated that the smallest galagid forms, the dwarf galagos, are polyphyletic suggesting possible body mass convergence. In this study I analyze 28 species of lorises and galagos with published body mass data. Phylogenetic reconstructions suggest that body mass evolution is strongly influenced by phylogeny (lambda=0.970, N.S.); however, there is evidence of at least two independent events of body size reduction (-40%) and one case of body size increase (+60-75%). While there is no clear trend for body mass change through time, higher rates of evolution were found in some of the branches leading to species adapted to arid environments. Finally, I discuss the possible implications of these results in relation to the known fossil record and the environmental conditions that might have affected body mass evolution within galagids.

Age Estimation from Vertebral Osteophytes in a Thai Population

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Age estimation is an important step in biological identification of skeletal remains. The purpose of this study is to evaluate the relationship between osteophyte formation and age in a Thai population. This study used vertebral columns from a Thai sample that included cervical (C2-C7), thoracic (T1-T12), and lumbar (L1-L5) vertebrae. The sample consisted of 50 Thai individuals (27 males and 23 females), aged between 22 to 94 years (mean age 58.9 years, SD 22.4) curated at the Forensic Osteology Research Center (FORC), Faculty of Medicine, Chiang Mai University. Individuals with atypical numbers of vertebrae and evidence of vertebral damage were excluded. Each vertebra was scored for degree of osteophyte formation according to criteria established by Snodgrass et al. and Watanabe et al., using a new scoring system modified for this study. The new system included length of the vertebral osteophyte. Results reveal that the scores obtained from the three methods are statistically correlated with age ($p < 0.05$). The best correlation coefficient between degree of osteophyte formation and age in each method is derived from lumbar vertebrae; $r = 0.859$, 0.835, and 0.811 for the Snodgrass method, the

Watanabe method, and the new method, respectively. These results can be applied to the development of age estimation equations using the vertebrae in forensic contexts in Thailand.

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Intergroup and Intragroup Vocalizations in the Mantled Howling Monkey (*Alouatta palliata*)

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Primates use intragroup calls in a variety of contexts including foraging, copulation, and affiliative behaviours, while intergroup calls are primarily associated with resource defense and group spacing. The purpose of this study was to evaluate whether male mantled howling monkeys (*Alouatta palliata*) at La Suerte Biological Station in Costa Rica engaged more in intergroup vocalizations or intragroup vocalizations, and whether males or females had greater rates of intragroup vocalizations. To test this, I collected 25 hours of continuous-time focal animal sampling on 25 males and 25 females. My findings demonstrated that vocalizing is not a common behaviour among mantled howling monkeys (0.61% of total focal time). Males participated in intergroup vocalizations (78.92% of total vocalization time; x^2=4.06, $p<0.05$) more than intragroup vocalizations (21.08% of total vocalization time; x^2=4.06, $p<0.05$). Males also exhibited higher rates of intragroup vocalizations per hour (2.59 calls per hour; x^2=9.88, $p<0.01$) than females (0.85 calls per hour; x^2=9.88, $p<0.01$). These findings suggest that males prioritize defending resources more than they prioritize communicating within their groups. Higher rates of intragroup vocalizations in male mantled howling monkeys are comparable to higher rates of singing by male songbirds. This characteristic may be advantageous to males in asserting their dominance within a social group and facilitating access to female mates. Future research should explore intragroup vocalization rate in males and its relationship to dominance rank, number of copulations, and paternity.

Comparative approaches to human brain evolution: New methods, resources, and discoveries

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Although the study of human brain evolution has traditionally focused on fossil endocasts, new tools and and resources have greatly enhanced our ability to compare brain organization in extant primate species, and thus identify features of brain organization distinctive of hominoids and of humans. New methods include a variety of noninvasive neuroimaging modalities—which, among other things, allow us for the first time to compare the connections of humans to those of chimpanzees and other primates—as well as new molecular approaches, including genomic and proteomic techniques. New resources include tissue banks for preserving and distributing tissue harvested postmortem and collections of neuroimaging datasets; these are vital for preserving information about chimpanzees and other great apes so essential for reconstructing change in the human lineage. Current evidence from our lab (and others), indicates that there was massive enlargement of association cortex in human evolution, as classically supposed, along with changes in connectivity between cortical areas involved in language, tool-making, tool-use, and social cognition. Also, humans evidently possess association areas that are absent in at least some other catarrhines, although it is currently unclear whether these are hominoid or human specializations. Perhaps unexpectedly, there were also modifications of sensory systems, and extensive changes in macromolecules and their networks of interaction. Comparative research thus demonstrates the human brain is not simply an enlarged ape brain—it underwent extensive changes at multiple levels of organization.

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A method for estimating age of medieval sub-adults from infancy to adulthood based on long bone length

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Objective: To develop a series of regression equations for estimating age from length of long bones for archaeological sub-adults when aging from dental development cannot be performed.

Material and Methods: 183 skeletal sub-adults from the Danish medieval period were odontologically aged from radiographic images. Linear regression formulae were produced for long bones. It was tested if the regression model could be improved by applying a quadratic model. We also estimated the age from the femur length using equations based on X-rays of the femur in a modern population, and on an archeological data set with known ages.

Results: We compiled regression equations for all long bones and the clavicle. Comparison between estimated ages revealed that the modern data result in lower estimated ages when compared to the Danish regression equations, while the estimated ages using the archaeologically-based equations were very similar to ours.

Discussion: Our results suggest that our regression equations may be applied to archaeological material more generally. Equations based on modern data sets will almost certainly tend to under-estimate age. Modern data sets not only represent sub-adults with a different growth trajectory, due to better health conditions, but also represent living sub-adults, while we wish to apply the age estimate to sub-adult skeletons, i.e. dead sub-adults.

Conclusion: We present regression equations for estimating the age of sub-adults based on the length of long bones and the clavicle. These equations will be of use for sub-adult skeletons where dental development cannot be ascertained.

An Exploration of Skeletal Evidence of Injury Recidivism in Cases of Transients from Northern California

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Studies throughout the United States have found that individuals of low socio-economic status have a high risk of injury recidivism, especially the transient and homeless population. Furthermore, the cause of death in these groups is rarely from natural causes; most frequently, the cause of death is homicide, accident, overdose, or exposure to the elements. Studies have found that injury recidivism occurs in greater frequency in particular for victims of homicide than in the rest of the population, indicating that individuals who have previously experienced physical trauma are at a greater risk for traumatic causes of death. This study examines data on the transient and homeless populations across the United States in order to develop expectations for what should be observed skeletally in cases of injury recidivism for this group. A sample of forensic skeletal cases of transient and homeless individuals from Northern California region is then examined as examples of how to apply the methodology and the complexities of identifying injury recidivism. Our results reflect no correlation between the presence of antemortem and perimortem trauma on the skeleton within this sample. However, studies have shown that soft tissue traumas including injuries such as sprains and strains of the joints are much more likely to be found among low socioeconomic status injury recidivists than injuries such as bone fractures. Thus, our results may show that while injury recidivism is prevalent within these populations, evidence on the human skeleton is often limited.

Mining and Mercury: An Examination of Entheseal Changes and Skeletal Deformities at the Santa Bárbara Encampment

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While there is extensive documentation of the organization of Spanish colonial mines in the form of chronicles, these do little to illuminate the quotidian conditions faced by the indigenous people who labored therein. Here, burials (n = 8) from the Santa Bárbara encampment, associated with the Huancavelíca mercury mine (AD 1564-1810), are analyzed to reconstruct their morbidity profile and examine skeletal evidence for congenital abnormalities related to mercury poisoning in utero. Osteoarthritis, osteochondritis dissecans, and entheseal changes are analyzed to infer the types of physical activities engaged in by this group; this will aid in determining their roles at the site through comparison with written records. Results indicate that all adolescent and adult individuals (n = 5) had high entheseal remodeling scores, presented in two distinct patterned arrays, suggestive of a division of labor. In addition, osteoarthritis is present in 60% of the adolescent/adult individuals, including extensive eburnation and spicule formation. These results indicate a high level of physical activity, even at a young age. Notably, two of the individuals exhibit hemi-lumbarization of the sacrum, inducing severe scoliosis in one individual, and two have a congenitally present 13th thoracic vertebra. Furthermore, extensive bowing of the lower legs and forearms is exhibited in another individual. Other studies have shown links between in utero heavy metal poisoning and skeletal deformities in rats; the high frequency of congenital skeletal deformities in this population supports a hypothesis that high level, multi-generational exposure to mercury may have contributed to congenital skeletal malformation.

Subadult Human Sacrifices in Midnight Terror Cave, Belize

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Children throughout Mesoamerica were preferred sacrificial victims, especially to water deities. Because caves were associated with rain, ethnohistoric sources mention the sacrifice of children in caves. The importance of children in sacrifice was documented early on by Edward Thompson's dredging of the Cenote of Sacrifice at Chichen Itza. More recently archaeological investigations of caves have recovered and identified the skeletal remains of children that have been interpreted as sacrificial victims. This poster reports on the impressive juvenile skeletal assemblage from Midnight Terror Cave with an eye toward refining our understanding of subadult human sacrifice using this large sample.

Osteocyte Morphology in the Primate Craniofacial Skeleton

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Osteocyte morphology has been linked to strain gradients and mechanosensitivity in bone. Larger, more oblate, spherical osteocytes are found in the low strain calvaria of mouse bone and more spherical, oblate osteocytes produce more nitric oxide in vitro. In this study, bone samples were extracted from high strain (anterior zygomatic root) and low strain (supraorbital) regions of five chimpanzee and five human crania. Osteocytes were stained using FITC, hard tissue was left intact, and confocal microscopy was used to produce three-dimensional images of the osteocytic network. Osteonal osteocyte cell body volume, sphericity, and ellipsicity were characterized using Imaris software. We hypothesized that low strain supraorbital regions of both species will contain smaller, more oblate, spherical, osteocytes relative to the high strain zygomatic region. Our results found that human osteocytes in the supraorbital region are significantly less oblate than those in the robust *Pan* supraorbital region ($p=0.001$). Osteocytes in the *Pan* supraorbital region were significantly more oblate ($p=0.001$) and more spherical ($p=0.001$) than in the *Pan* zygoma. Supraorbital osteocytes in both animals were larger compared to osteocytes in the zygoma. Understanding region and species specific differences in osteocyte morphology may aid in explaining the discrepancy between craniofacial strain gradients and bone adaption, and are consistent with studies that show that the low strained supraorbital region is sensitive to changes in orofacial function. These results also offer a mechanistic explanation for systemic differences observed between humans and other primates.

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The high-quality genomes of a Neandertal and a Denisovan

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The study of the genomes of our closest extinct relatives allows for insights into the recent evolutionary history of anatomically fully modern humans. Recovery of ancient samples with extraordinary preservation from a cave in the Altai mountains allowed us to sequence high coverage genomes for a Neandertal and Denisovan individual. The analysis of the genomes of these two archaic humans revealed that that they are more closely related to one another than they are to modern humans. Furthermore, at least two events of gene flow from these groups into modern humans have been found; Neandertal admixture has been detected in all out-of-Africa populations while Denisovan gene flow likely occurred to the common ancestors of Australians and New Guineans.

The high quality sequences of a Denisovan and a Neandertal individuals also allows for analyses of gene flow into the archaic lineages. We found evidence for two gene flow events into Denisovans: Gene flow from Neandertals and gene flow from am unknown hominin with a deeply divergent lineage. Taken together, these results show that gene-flow was more common among human groups in the Pleistocene than previously thought.

Apart from demographic inferences, the high-coverage Denisovan and Neandertal genomes allow us to scan for regions in the human genome that carry the signatures of recent positive selection. Using a hidden-Markov model approach, we identify such regions and discuss the resulting candidates that may underly modern human specific traits.

Phylogenetic analysis of extant hominoid postcranial characters recovers molecular clades

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Characters drawn from the postcranium are often judged *a priori* to be more homoplastic than those drawn from the cranium or dentition. This bias is evident in morphological phylogenetic analyses across primates, which focus heavily on craniodental characters, and it persists despite evidence to the contrary. Among hominoids, the assumption that postcranial characters are prone to homoplasy is particularly prevalent due to evidence suggesting that orthograde posture and suspensory locomotion are convergent among living apes. In this study, 137 postcranial characters were scored for extant hominoids, as well as several monkeys, to test the efficacy of postcranial morphology in resolving hominoid molecular clades. Characters and data were drawn from published character matrices, functional and phylogenetic studies, and novel observations of hominoid postcranial anatomy in museum collections. Where possible, traditional, binary characters were quantified or modified to include polymorphic states, and scored separately for males and females. Parsimony and Bayesian analyses of the resulting matrix recover well-supported hominoid relationships, including a *Pan-Homo* clade. Thus, in contrast to previous assumptions, the broad overall congruence between these results and those derived from the analysis of molecular data indicates that postcranial characters generally, and the postcranial character set compiled here specifically, contain a strong phylogenetic signal. While morphological analyses have rarely recovered a *Pan-Homo* clade without the addition of fossil taxa, this study demonstrates that postcranial

characters accurately track hominoid phylogeny. Thus, future phylogenetic studies of hominoids and hominins should incorporate postcranial characters in order to increase resolution and phylogenetic accuracy.

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How Linguistic Instruction Reorganizes the Neural Networks Involved in Stone Tool Knapping

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Language is considered a defining human feature, yet there is still little known about how this unique communication system evolved. Previous research has emphasized a potential co-evolutionary relationship between stone toolmaking and language; however, participants in earlier brain imaging studies on stone knapping received linguistic training, which may be a poor analogue for extinct human species. We test the validity of the language and technology co-evolution hypothesis using a cutting-edge brain imaging technology (fNIRS) to directly observe the effect of language instruction on neural activation during naturalistic stone knapping. Thirty-three right-handed, adult subjects participated in the study by attending seven knapping practice sessions, during which they received verbal (sound enabled) or nonverbal (no language input) video instruction. Participants completed three neuroimaging sessions at different stages in their learning. fNIRS data were acquired at 25 Hz with a 24-channel TechEn CW6 system. The optic signals were processed to produce functional images that were analyzed using ANOVA and subsequent Wilcoxon signed-rank tests. The nonverbal group had significantly greater centers of activation in spatial cognition areas than the verbal group, but both groups had similar levels of activation in Broca's area during knapping and language tasks. These results support a co-evolutionary relationship between language and technology but indicate that the inferior parietal and prefrontal areas that participate in spatial working memory networks may have received stronger selection, especially if Early Stone Age hominins did not possess language. This could help explain why these regions underwent major expansion in the course of human evolution.

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Understanding skeletal decomposition through physical changes caused by bone weathering

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Skeletal decomposition is an important and under-researched component of taphonomy, currently being used by forensic anthropologists and bioarchaeologists to reconstruct taphonomic processes surrounding surface deposition of human remains. Previous research on this topic has focused largely on porcine remains, but little has been done to quantify the appearance of bleaching, cortical flaking, and longitudinal cracking on human bone. This study examines the appearance of physical changes to a human skeleton as a result of environmental exposure when deposited on the surface. Understanding when skeletal decomposition characteristics occur will provide important information to forensic anthropologists and assist with Post Mortem Interval estimations.

Observation of the skeletal remains of 20 individuals from the Willed Body Donation Program at the Forensic Anthropology Center at Texas State revealed that physical changes such as bleaching can occur within 1 to 2 weeks of exposing skeletal elements to the environment. Cracking and cortical flaking can occur in remains that have been exposed to the environment for 2 years or less. Specifically, cracking occurs in the subscapular fossa and the supraspinous fossa of the scapulae and the iliac fossa in the os coxae at early stages of bone decomposition. With further observation, this study will inform estimates of the post-mortem interval in Central Texas and will refine a methodology currently being used by practitioners. Furthermore, this can be used as a baseline for researchers to develop bone decomposition timelines in different climates.

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Basal pigmentation is a poor predictor of tanning response in Mexican Americans

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The evolutionary history of skin pigmentation has been studied extensively but the role of evolutionary history in shaping tanning, a major response to UV exposure, has not. We hypothesize that tanning may be adaptive as darker acquired pigmentation could by as protective against future UV damage as the equivalent amount of constitutive melanin. Quantitative analysis of persistence of tanning response was undertaken with 82 Mexican-American volunteers in San Antonio, TX. Participants received four controlled exposures to ultraviolet radiation (UVA and UVB) in increasing doses. Erythemal and melanogenic dose-response were measured at 24 hours, 7 days, and 28 days post-exposure using a DSM-II Colorimeter (Cortex Technology). Minimal erythemal dose (MED, the amount of UV exposure necessary to induce visible reddening of the skin) and minimal melanogenic dose (MMD, the amount of UV exposure necessary to induce visible darkening of the skin) were determined at 24 hours and 7 days, respectively. Persistence of tanning response was calculated for each exposure as the melanin value at day 7 divided by melanin at day 28. Contrary to expectations, basal melanin level was only weakly predictive of either MED ($R^2 = 0.026$) or MMD ($R^2 = 0.031$), suggesting additional contributors. Persistence of tanning response was highly variable and similarly unrelated to basal pigmentation levels once the amount of initial pigmentation increase was considered. Genetic ancestry and genome-wide association analyses are ongoing to investigate the role of genes in tanning response and persistence among Mexican American individuals.

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Epigenetic analysis of intergenerational effects of maternal stress and war trauma in the Democratic Republic of Congo

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Research on the developmental origins of health and disease has stimulated interest in epigenetic alterations, which may contribute to heritable effects of psychological stressors. We examined epigenetic alterations in 125 mothers and their newborns, who were exposed to extreme daily and war stressors in the Democratic Republic of the Congo.

We use a bio-cultural approach to test for a correlation between maternal stress, epigenetic alterations, and neonatal health. We collected maternal and newborn venous blood and generated genome-wide methylation data using the Illumina 450K chip. We measured maternal stress based on semi-structured ethnographic interviews and standardized, culturally appropriate social stress interviews. We obtained newborn biological health outcomes based on medical records and anthropometric measures. We collected follow-up samples from a subset of

babies at 1 and 6 months and 1 and 2 years and measured their psychological development as well as methylation profiles.

We showed previously that maternal stress is associated with newborn birthweight in our Congolese sample. We also identified gene-specific changes in newborn methylation at the NR3C1 gene, while we identified a genome-wide shift in maternal methylation levels in a subset of 25 mother-infant dyads. Here, we present our global methylation analysis and its association with maternal stress and newborn outcomes in 125 mother-newborn dyads. Our results show that exposure to stress and violence are associated with epigenetic changes in mothers and their offspring. These alterations may modify gene expression and create changes in newborn health, which has profound global public health implications.

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Growing up with altitude: patterns of stunting and wasting in Tibetan children living in rural and urban communities in Nepal

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Generalized patterns of height and weight reduction in children living at high altitude have been well documented across numerous populations. While there appears to be some protection against wasting and stunting in children from high altitude adapted populations, such as Tibetans, both remain common in these populations, especially in rural areas. Here, we investigated weight and length z-scores (WAZ, LAZ) for age in a cross sectional sample of 200 Tibetan infants (<1 year of age) and young children (<5 years of age) from the Nubri Valley, Nepal, and a comparative sample of Tibetan children living in urban Kathmandu.

Among the youngest children in the sample, mean WAZ was not different between the two populations. However, with increasing age, the distance between the two groups increased. WAZ and LAZ decreased with infant age in the Nubri sample but not the Kathmandu sample. For young children (>2 years of age) mean WAZ was -2.84 for Nubri and -0.78 for Kathmandu; mean LAZ was -3.45 for Nubri and -0.91 for Kathmandu.

Within the Nubri Valley, altitude of residence was a significant predictor of WAZ and LAZ, after adjustment for child age. However, unlike prior reports that found an inverse association between altitude and WAZ/LAZ, WAZ was positively associated with altitude in this sample. It is likely that ecological factors such as environmental pathogen burden and differences in sanitation, but not altitude, are contributing to wasting and stunting in the Nubri sample.

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Shifting dietary and technological adaptations of the Turkana hominins under static woody cover

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Hominin enamel $\delta^{13}C$ values and lithic artifact assemblages from the Turkana Basin suggest that hominin diets and tool technologies significantly changed between ~4 and 2 Ma. In this study we contribute to the Turkana Basin paleosol carbonate $\delta^{13}C$ database during this interval with new data (nodules=50, analyses=200) from Lothagam, Kanapoi, South Turkwel, Lomekwi and Lokalalei. Reconstructed vegetation structures through $\delta^{13}C$ analysis of paleosol carbonates in proximity to hominin fossil- and lithic-bearing localities averaged between 40-50% woody cover (woodland/bushland/thicket/shrubland) and do not significantly vary from one another. The Turkana environmental contexts provide contrasting evidence to the idea that lithic technologies originated in open settings. However, these findings do not necessarily refute the savanna hypothesis and the importance of open environments to human evolution since wooded grasslands were also present. Moreover, the forest structural category is not indicated, thus hominin sites have not yet been found in strictly closed ecosystems. An unchanging woody cover over this study interval suggests that human evolution was perhaps driven by biotic competition for resources rather than by significant changes in resource availability. Small-scale environmental perturbations rather than large directional shifts may have provided selective pressures in resource change not clearly visible with paleosol carbonate isotopic records. C_4 dietary intake and technological origins precede the fossil record of genus *Homo* and occurred in predominantly wooded rather than grassy environments. Evidence for dietary and technological flexibility, considered as hallmarks of genus *Homo,* occurred circa 1 million years before grassland ascendancy at Turkana.

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Relationship between macroscopic morphology of thenar and hypothenar entheses and their microstructural design in modern humans

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Entheseal morphologies are used by biological anthropologists to reconstructs past lifestyles and activity patterns, such as stone tool behaviors in hominin populations. However, the validity of this relationship is questionable. Previous research showed no consistent patterns between muscle architectural variables (e.g., muscle mass) and the size and shape of the opponens entheses in a population of modern humans. However, using a mouse model we found the underlying bone (e.g., bone thickness) to be more informative of the associated muscle anatomy. Therefore, we tested the following two hypotheses: 1) macroscopic entheseal morphology is positively correlated with the underlying bone microstructural design, or 2) muscular anatomy is positively correlated with microscopic characteristics of the underlying bone of each enthesis.

The 1st and 5th digits of 12 female and 11 male human cadavers of known age were dissected, photographed, measured, and the bones were micro-CT scanned. A total of 6 entheses were evaluated using a statistical analysis of variance approach. Contrary to hypothesis 1, results showed a lack of dependence of cortical microarchitecture on the macroscopic entheseal morphology. Results for hypothesis 2 showed that cortical bone thickness and volume was positively correlated with potential force production of a muscle (PCSA), and negatively associated with potential muscle excursion (fiber length). Further analyses will be completed to compare cortical and trabecular microarchitecture for each site. Current results demonstrate that microstructural assessment of entheses may better contribute to an understanding of the mechanical loading occurring at the attachment site than the standard qualitative protocol.

New palaeontological discoveries from the Middle Miocene site of Napudet, west Turkana, Kenya

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Compared to the Early Miocene or Plio-Pleistocene, the Middle Miocene of Africa is relatively poorly known, although it may contain several key transitions in the evolution of catarrhine primates. Palaeoanthropological survey in the late 20th century revealed deposits from this time period in the Napudet Hills of the western Turkana Basin, from which fossils (including a primate canine) were recovered. An international team has since conducted two seasons of fieldwork in these sediments, revealing additional vertebrate and palaeobotanical remains.

The beds consist primarily of pyroclastics from a nearby, extinct volcano. Preliminary geological work suggests that the fossils lie above a columnar basalt previously dated to 12.8 Ma, and are overlain by another, as yet undated, basalt. The exposures preserve ~100 fossil trees, a substantial proportion of which are upright and *in situ*, as well as some poorly preserved leaves.

The recent fieldwork has yielded a vertebrate fauna including carnivorans, girrafoids, hippopotamids, proboscideans, suids, tragulids, rhinoceroids, rodents and primates. Associated remains of individuals for some of the larger taxa have been discovered. In addition to expanding the known geographic range of the Middle Miocene to northern Kenya, the palaeoenvironmental information and partial skeletons of Napudet offer the potential to increase our knowledge of this elusive period in primate evolution substantially.

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Ancient DNA Analysis of the Prehistoric Inhabitants of the Lower Pecos Region of Texas and Northern Mexico

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The Lower Pecos Canyonlands in central Texas and northern Mexico have a 13,000 year history of occupation and a rich and distinctive archaeological record, including lithics, clothing, and spectacular rock art preserved within caves and rockshelters throughout the region. However, the biological ancestry of people who inhabited this remote region is unknown, and it is unclear whether they were related to other Native American populations in Texas, northern Mexico, the Great Plains, or the American Southwest. We extracted DNA from 31 individuals from rockshelter sites in the Lower Pecos region and northern Mexico ranging in age from ~7,500-630 YBP. 58% of individuals tested yielded ancient mitochondrial DNA, which belonged to haplogroups A2, B2, C1, and D4h3a. We also sequenced the complete mitochondrial genomes of several lineages exhibiting novel polymorphisms to better understand genetic diversity in this region. Comparisons between the maternally-inherited mitochondrial lineages in these individuals and those previously reported from other Native American populations suggest some biological affinities between the Lower Pecos inhabitants and populations in Mexico (and perhaps also the Plains). Finally, we successfully amplified autosomal and Y-chromosome short tandem repeat (STR) markers from several individuals to test hypotheses about the biological relationships between individuals buried within the rockshelters. We discuss the implications of these results for the bioarchaeology and population history of this region.

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Detection of *Entamoeba* spp. and *Entamoeba histolytica* in seven lemur species in Ranomafana, Madagascar

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Invasive amoebiasis, caused by *Entamoeba histolytica*, affects 50 million people worldwide, resulting in 100,000 deaths annually. It is particularly prevalent in developing nations where poor sanitation contributes to food and water contamination. *E. histolytica* is a zoonotic protozoan parasite that has the potential to infect non-human primates. The lemurs, endemic to Madagascar, are the most endangered mammals worldwide due to habitat loss. As the forests are disappearing, humans and lemurs are coming into contact more frequently, and the potential for *E. histolytica* to infect lemurs is great. In this study, we screened 177 fecal samples from seven lemur species in the southeastern rainforests of Madagascar for *Entamoeba* spp. and *E. histolytica*, to determine if proximity to human villages influences the prevalence of *E. histolytica* in lemurs. Of the fecal samples, 21.1% (from five lemur species) were positive for *Entamoeba* spp., and 4% (from three lemur species) were positive for *E. histolytica*. A slight increase in *Entamoeba* spp. was found in lemurs living further from human villages, and no relationship was found between lemurs positive for *E. histolytica* and proximity to human villages. The lemurs positive for *E. histolytica* were, however, found in just two sites. While these sites vary in distance from nearby villages, they do both experience heavy foot traffic from ecotourists and researchers. Rather than solely focusing on improving sanitation and hygiene practices in Malagasy populations, our findings highlight the importance of improving these practices in ecotourists and researchers in order to protect lemurs from zoonotic parasites.

Increased dopaminergic innervation of the medial caudate nucleus in humans: implications for the evolution of speech and language

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The dopaminergic innervation of the striatum has been implicated in the development of human speech and language. The human sequence of the *FOXP2* gene is associated with decreased dopamine within the dorsomedial striatum of mice engineered to express the human variant of the gene, suggesting that evolutionary changes of this system may be associated with uniquely human cognitive and behavioral abilities. To examine this possibility, we quantified the density of tyrosine hydroxylase-immunoreactive axons as a measure of dopaminergic innervation within five basal ganglia regions of humans, great apes, and monkeys. A repeated-measures ANOVA revealed a significant interaction of brain region and species ($F_{(20,104)} = 3.12$, $p < 0.01$). Post hoc analyses revealed that humans differ from nonhuman primates in having a selectively localized, significant increase in dopaminergic innervation to the medial caudate nucleus. This region of the striatum is highly interconnected, receiving afferents from multiple cortical regions, and supports behavioral and cognitive flexibility. The medial caudate nucleus also shows hyperactivity in humans lacking a functional *FOXP2* allele and exhibits altered dopamine concentrations in humanized *Foxp2* mice. Additionally, our analyses showed that striatal dopaminergic input did not differ between chimpanzees that use socially learned attention-getting sounds compared to those that did not. This evidence indicates that the increased dopamine in humans is a species-specific characteristic that is not associated with experience-dependent plasticity. The specificity of this increase may be related to the degree of input convergence within this region of the

striatum and may also support human speech and language.

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A biohistory of Mexico from ~1250 to the present

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Mexico is well known for its rich archaeological and ethnohistorical records, which allow anthropologists to test complex, specific hypotheses about relationships between biological variation and the cultural and geographic factors shaping it. We used a large dataset of dental morphological observations from Mesoamerica, Western Europe, and West Africa (n=3563) to calculate biological distance statistics for populations in Mexico during three time periods, precontact Late Classic/Postclassic (~1250-1500), historic (~1600-1900), and contemporary (~1950-2000). We found that the distance between precontact and historic Maya (3.936) was about 40% of the distance between historic and contemporary Maya (9.207). However, the distance between precontact and historic non-Maya Mexicans was 24.38, nearly 1.8 times the distance between historic and contemporary non-Maya Mexicans (13.599). More change occurred between historic and contemporary samples in the Maya regions, while more change occurred between precontact and historic samples among non-Maya Mexicans. We also found that distance between Maya and non-Maya Mexicans increased from precontact to historic periods (6.742 to 13.26), then decreased in the contemporary period (5.831). Given the intense and diversified migration into Mesoamerica from the Old World after the contact, all of these results reflect that European and African contributions to the autochthonous genetic pool occurred earlier and at greater rates in the Mexican continental highlands in comparison to a more stable biological structure of the population in the Yucatan Peninsula through time.

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Holocene Gene Flow Patterns between New Guinea and Australia

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New Guinea and Australia have been separated by water for the majority of the Holocene. Water can be considered a gene flow barrier between populations if boating is uncommon. For Coastal New Guinean people, boating is common and is here hypothesized to facilitate gene flow with Australia. This study will compare the genetic relatedness of Highland New Guineans, Coastal New Guineans, and Australian Aboriginals to investigate a pattern of gene flow between the two islands, hypothesizing that the Coastal population will be more closely related to Australians than the Highland population, as this population would more recently need to traverse two gene flow barriers: mountains and water. We selected 64 previously sequenced mitochondrial DNA samples from GenBank: 33 Australian, 19 Highland, and 12 Coastal samples. The sequences were analyzed via Molecular Evolutionary Genetic Analysis (MEGA) using Maximum Likelihood. The initial branch in the resultant phylogenetic tree divides the majority of the Coastal sample from the majority of the Highland and Australian samples, grouping 78% of the Australian and 75% of the Highland samples, to the exclusion of 66% of the Coastal New Guinean samples. We infer this grouping pattern reflects preservation of an original gene flow signature before the formation of the Torres Strait. Once the land bridge submerged, both the Australian Aboriginal and Highland populations became more genetically isolated, preserving the interbreeding signature, whereas the Coastal population has more recently participated in frequent outbreeding with other populations due to their use of boating technology.

Sitting, squatting, and the evolution of human inactivity

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The evolution of the genus *Homo* was marked by a shift towards a highly active lifestyle that included increased physical activity. Due to this evolutionary history, many suggest our bodies require aerobic exercise to prevent chronic diseases. However, a separate set of physiological changes occurs during *inactivity* and also leads to chronic diseases in sedentary populations. During periods of inactivity, Westerners generally sit in chairs, leading to a reduction in the muscle-activity-induced production of enzymes that hydrolyze lipids for energy, increasing cardiovascular disease (CVD) risk.

Here, we examined inactivity in a hunter-forager population, the Hadza of Tanzania, to better understand patterns of inactivity in a lifestyle similar to that of our ancestors. Using thigh-worn accelerometers (activPals), we found that Hadza subjects (n=28) engaged in similar amounts of sedentary time compared with Western subjects (mean=9.02±1.10 hrs/day). However, when inactive, subjects generally sat on the ground or rested in squatting postures. Using electromyography, we found that, compared with chair-sitting, these "active" rest postures require significantly higher levels of muscle activity in soleus ($p<0.05$) and tibialis anterior ($p<0.05$). We hypothesize that the use of resting postures that require low-level muscle activity leads to increased production of enzymes that hydrolyze lipids, and an associated reduction in CVD risk. Markings on fossil limb bones suggest these "active" resting postures are an ancient part of hominin behavior, and current CVD risk may be due in part to an inactivity mismatch, where styles of rest no longer resemble the patterns of inactivity used during human evolution.

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Contextualizing body size assessments in the genus *Homo*

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Body size assessments, in terms of reconstructing stature and body mass, are ubiquitous in biological anthropology. Although similar approaches for assessing body size from skeletonized remains are used in forensic anthropology, bioarchaeology, and paleoanthropology, the context in which these assessments are interpreted is decidedly different. Forensic anthropologists primarily use stature (and much less-often, body mass) estimates of a single set of unknown skeletal remains to compare to potential missing persons whose reported size falls within the estimated range. Bioarchaeologists tend to use body size reconstructions to make biological and social inferences on past populations. Paleoanthropologists generally use body size reconstructions, typically of fragmentary fossils, to inform numerous taxonomic-level interpretations about hominin evolution and lifestyle including diet, metabolic requirements,

locomotion, brain and body size relationships, and sexual size dimorphism.

This study utilizes large (n>1000) anthropometric databases to provide robust simulations on body size reconstructions as they may be employed in the contexts of forensic anthropology, bioarchaeology, and paleoanthropology. The results drive a discussion of the practical and theoretical differences in both method choice and application as well as the interpretation of the reconstruction across the different investigative contexts. The forensic approach, often the least critically regarded, offers important insights to the bioarchaeological and paleoanthropological approaches as complicating factors such as choosing representatively large, ecogeographically and temporally relevant reference samples are reduced; the accuracy, precision, and error of a technique can be more soundly represented; and whole-to-part simulations can inform technique choice in the face of suboptimal preservation.

Assessing the application of dental cementum increment analysis for determining season of death in humans

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Dental cementum is a mineralized tissue that is continuously deposited and mineralized throughout the life of a tooth, preserving the complex developmental processes of root formation in optically distinct histologic layers. Analysis of these features has several anthropological applications, specifically in determining age and season of death in humans for establishing a more specific post-mortem interval (PMI).

The purpose of the present study is to determine whether cementum bands could accurately be assigned to fall/winter, spring/summer seasons based on their optical properties as being light or dark. A total of 143 teeth of known age and known extraction date drawn from the Boston Medical Center Oral Surgery Collection and the Antioquia Modern Skeletal Reference Collection in Medellín, Colombia were prepared and analyzed.

Cementum increment analysis was found to only be between 61.54% and 71.15% successful in accurately correlating the nature of the last cementum increment to season at death using a combination of image evaluation and through focus evaluation methods on two distinct geographic samples.

The limitations identified in this study for the reliability of using dental cementum increment analysis to determine season of death in humans include the lack of a standardized method for preparing and viewing cementum increments, and the subjectivity in identifying the last band in a given section. This indicates that cementum increment analysis is not a reliable method for estimating season at death in humans and should not be used in place of other methods for estimating postmortem interval.

A novel, probabilistically interpretable framework for localizing genomic elements underlying adaptive evolution

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Here, we introduce a novel framework for detecting hard selective sweeps, which leave behind three major genomic signatures: long-range haplotype blocks, altered site frequency spectra, and population differentiation. Composite methods generally gain substantial power by drawing on multiple sources of information, but inherent redundancies in statistics measuring similar signatures can introduce bias. Our method combines multiple statistics from across all three genomic signatures in a classification framework that returns probabilistically interpretable results, deals naturally with loci for which one or more of the component statistics are undefined, and accounts for the correlations among component statistics, using a machine-learning tool called an Averaged One-Dependence Estimator (AODE).

Our classifier infers the probability that a locus has undergone a hard sweep based on joint component statistic distributions learned from extensive demographic simulations and simulations of hard sweeps, conditional on a demographic model, of varying strengths and time periods. In simulation, we show that this classifier vastly outperforms other methods in localizing of sweep signals. Our classifier performs particularly well when identifying completed sweeps and fast sweeps. In data from the 1000 Genomes Project, we recover known sweep regions, with high scores localized near previously validated adaptive mutations, including the genes *DARC* in West Africans, *EDAR* in East Asians, and *SLC24A5* in Europeans. Our methods produce fewer false positives and negatives compared to existing approaches, thus identifying promising novel targets of selection.

Sohini Ramachandran is a Pew Scholar in the Biomedical Sciences, supported by The Pew Charitable Trusts.

Up in Arms: Early primate proximal ulnae show affinities with non-quadrupedal, non-primate mammalian taxa

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Hypotheses concerning the historical scenario for the origin of primates can be divided into two camps: selection for arboreal acrobatic locomotion or selection for predatory grasping of food items. These hypotheses are predicated on reconstructions of substrate preference, locomotor mode, and degree of manual manipulation for early fossil taxa. I sampled diversity in these variables across six mammalian orders (24 extant genera) to identify relationships between morphology and behavior. I analyzed 3D coordinate data using geometric morphometrics and used these data to calculate the angle between the radial notch and the long axis of the ulna. I tested the hypothesis that primates exhibit unique elbow morphology including a more laterally-oriented radial notch, reflecting the early evolution of increased supination and manipulative abilities in the order. Results support the relationship between radial notch orientation and supination in non-primate clades. Within primates, diversity in this trait was related to locomotor mode, but not substrate choice. Early fossil primates (*Plesiadapis*, *Cantius*, *Notharctus*, *Megaladapis*, *Paleopropithecus*, and *Archaeolemur*) are intermediate among extant primates in radial notch angle. However, a linear discriminant function analysis of the 3D data indicates that early primate proximal ulnae are more similar to those of taxa that reduced the use of the upper limb in locomotion (e.g. macropods) than to those of extant primates. This result supports previous work emphasizing the importance of non-locomotive upper limb use in primates, though it also suggests extant primates may not be the most appropriate comparisons for the interpretation of early primate functional morphology.

Are Roads a Dispersal Barrier for *Microcebus*?

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Road ecology is an underutilized line of inquiry within primate conservation biology. While roads are often assumed to be dispersal barriers in primates there is little empirical testing of this assumption. We tested the hypothesis that Route National #4, a paved highway, was a dispersal barrier for two species of mouse lemurs (*Microcebus murinus* and *M. ravelobensis*) in Ankarafantsika National Park in NW Madagascar. We conducted a capture-mark-recapture experiment from June to August 2015 in which we established three sites with pairs of parallel transects 25m apart; two sites adjacent to Route National #4 and one within intact forest without a dispersal barrier. After 2294 trap nights we caught 123 individual mouse lemurs 1054 times. We detected 18 crossings from 9 individuals on highway transects, compared with 157 crossings from 27 individuals within the intact forest. Only male *M. ravelobensis* were captured on both sides of the highway and only in the vicinity of an arboreal crossing, such as

two trees on either side of the highway with a canopy connection. No females of either species crossed the highway during our study period. One identified *M. ravelobensis* was killed by a vehicle in an apparent attempt to cross the highway. *M. ravelobensis* were inhibited in their movements across the highway, but dispersal was still possible across this potential barrier. Our study presents some of the first results on the effects of roads in Malagasy primates and showcases species-and-sex-biased effects of roads as dispersal barriers.

Department of Anthropology, University of Toronto; Natural Sciences and Engineering Research Council of Canada; Primate Conservation Inc.; Sigma Xi

Preliminary osteological analysis and stature estimates of adults in an early Medieval Prussian population at Bezławki, Poland

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Bezławki is an early Medieval (XIII c.) site in Poland that contains one of the few known remaining well-preserved Old Prussian cemeteries. Ongoing osteological analyses of excavated remains are in part focused on investigating the characteristics, activities, and pathologies of individuals from the region and period. During the 2015 field season, which ran in conjunction with the Bezławki Field School, we excavated ca. 35 individuals. Compared to previous seasons, there were a relatively high percentage juvenile burials, bringing the total MNI recovered to n=94, including 31 adults (17+ years). We estimate approximately equal numbers of adult males and females among the remains. As a whole, the skeletal remains were robust with moderately marked muscle attachments, indicating moderate levels of regular physical activity during life. Moderate to marked dental attrition is suggestive of an abrasive diet, and there is also evidence of metabolic stress events and nutritional deficiencies in the both the dentition and skeleton. Aside from a few healed antemortem fractures, the skeletons were largely atraumatic. Preliminary stature estimates range from ca. 143-173 cm for females and 157-185 cm for males. To aid in stature estimation, we used the limited number of relatively complete adult individuals to calculate a preliminary regression for the estimation of height from long bone length. Although the calculated regression is not statistically robust within this sample, it results in stature estimates comparable to published data for the nearby XI-XII c. site at Geicz.

Diploic vessels and computed tomography: segmentation and comparison in modern humans and fossil hominids

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The diploic channels mostly grow within the frontal and parietal bones. They appear to be more developed in humans than in non-human primates, suggesting a role in evolutionary biology. We provide a segmentation protocol for diploic channels in dry skulls after computed tomography, with a quantitative description of their variation in modern humans and three Neanderthals. Computed tomographic scans were used for 2D and 3D visualization of diploic channels, digital reconstruction and morphometrics. The effect of different resolution factors was evaluated. A specific protocol was designed to segment the vascular network and localize the main branches, reducing the noise of the cancellous bone. We supply a quantitative description of the frontal, parietal, and occipital diploic system in modern human skulls and in three Neanderthals. There is a correlation in the degree of vascularization of the frontal, parietal, and occipital bones, with no patent asymmetry. The diploic network communicates with the meningeal artery at the temporal fossa, with the emissary veins at the occipital bone, and with the venous sinuses at the parieto-occipital areas. The parietal bone is most vascularized than the other districts. In comparison with modern human, Neanderthals show a lower vascular complexity.

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Inhomogeneous nature of canine composition does not affect their isostress shape

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We previously reported that the tapered shapes of cercopithecoid maxillary canines may be responses to the anteroposterior loading regimes they experience. We considered the canines of six cercopithecoid species to be maximally stressed along their lengths - the so called isostress condition. However, a limitation in our work was that we considered the canines to be materially homogeneous, owing to our experimental setup (microcomputed tomography of cast teeth). Herein, we address the heterogeneous material composition of enamel covering dentin.

Regardless of the precise nature of the anteroposterior loading, a canine is subjected to maximum stresses in the enamel and dentin furthest from their mesiodistal axis. These stresses can be determined in each material using composite beam theory. If the enamel is to fail before the dentin, and thus regulate canine taper, the ratio of the maximum stress in the enamel to dentin must exceed the ratio of their strengths. These ratios use the moduli and strengths of enamel and dentin along with cross sectional dimensions in their derivation.

We surveyed the literature for enamel and dentin moduli and strengths and for enamel thickness of catarrhine canines. We substituted these values into the stress and strength ratios along with measured labiolingual dimensions and found that the stress to strength ratios in the enamel are at least an order of magnitude greater than those in the dentin. Therefore, our results support the conclusion that the isostress condition may be an outcome of canine taper irrespective of material heterogeneity.

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Evidence for intense migration influx into the Greek colony of Metaponto: A study of dental nonmetric variation

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This study examines the degree of migration influx into the Greek colony of Metaponto and into the indigenous populations in the surrounding hinterland (900-250 BC) through analysis of dental nonmetric variation of 640 human skeletons. Relethford and Blangero's R-matrix approach is extended to binary trait data in order to estimate inter-population biological distances, F_{ST}, and extra-local gene flow. The resulting biological distance pattern shows a clear separation between the populations of the Greek colony of Metaponto and the nearby indigenous Italian populations. The

overall F_{ST} estimates reveal that the among-group variation of colonial populations is much higher (F_{ST} = 0.075) than the among-group variation of indigenous populations (F_{ST} = 0.042). In the Relethford-Blangero analysis, the populations of the Greek colony of Metaponto are the only ones to exhibit positive residuals, indicating migration influx from an outside source. The indigenous populations all possess negative residuals, indicating relative isolation from extra-local immigration. Our results suggest that Greek colonies could include large numbers of people with diverse geographical origins, whereas indigenous communities exhibit high levels of cohesion. The integration of bioarchaeological data into investigations of the Greek colonization provides interesting insights into the creation of Greek colonies and their relations to indigenous populations.

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The large mammal community from Cooper's D and its significance for *Paranthropus robustus* ecology

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Paranthropus robustus is unique among the paranthropine clade in its South African geographic, temporal, and ecological contexts. Although *P. robustus* appears to share derived chewing adaptations associated with hard/tough foods with other *Paranthropus* species, it differs from its congeners in other features indicating possible diet such as isotopes and microwear. Cooper's D, Bloubank Valley, South Africa, has yielded multiple *P. robustus* specimens, and a rich associated large mammal community. Dated to 1.5-1.4 Ma, Cooper's D is the best constrained age for a *P. robustus* assemblage, providing a unique opportunity for habitat reconstruction that is clearly situated temporally and geographically.

This study includes new identification and description of mammalian fossils, specifically Bovidae, from Cooper's D, and univariate analyses of bovid size class and element distributions. Additionally, multivariate correspondence analyses were used to compare the fossil community as a whole to extant communities in modern African habitats to retrodict affinities that would have served as ecological parameters for *P. robustus* adaptations.

Analyses of taxonomic and ecological diversity indicate that Cooper's D fauna is similar to that of other, contemporaneous South African *Paranthropus* sites, but that it underwent unique taphonomic processes selectively preserving size class II bovids. Multivariate analyses suggest that the community of large mammals is ecologically most similar to those of extant African shrublands, and that the paleohabitat was one that was fairly dry. This conclusion suggests that *P. robustus* foraged in regions with lower quality food items, and therefore had a more varied diet, than its counterparts in East Africa.

Adolescent male chimpanzees do not form a linear dominance hierarchy with their peers

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Dominance relationships play an important role in the lives of many social animals. Such relationships occur between adult male chimpanzees, who form linear dominance hierarchies. Status confers benefits, as high-ranking adult males reproduce more than do low-ranking individuals. Despite the significance of rank, it is unclear when dominance relationships develop between male chimpanzees. During adolescence, when males are reproductively but not physically mature, male chimpanzees begin to integrate into the social world of adults. Adolescents are subordinate to adult males, but it is ambiguous whether adolescent males have decided dominance relationships with each other. We studied 21 adolescent and 33 adult males for one year at Ngogo, Kibale National Park, Uganda. We conducted continuous focal animal sampling on adolescent and young adult males, and recorded pant grunts, a formal signal of submission, between members of all age- and sex-classes *ad libitum*. We recorded 859 pant grunts between adolescent and adult males. Although adolescent males frequently pant grunted to adults (n = 489), they rarely pant grunted to other adolescents (n = 18). Of these 18 interactions, 14 were given by young adolescent males (mean age = 9.67 years, range: 8.89 – 10.58) to older adolescents (mean age = 15.14 years, range: 14.22 – 15.52). The four pant grunts that did occur between adolescent peers all involved late adolescents. These observations suggest that male chimpanzees begin to form a decided dominance hierarchy with their peers at the end of adolescence, or alternatively, during the start of adulthood.

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Do people with multiple injuries also have poor health?

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Clinical and bioarchaeological studies have found that injury recidivists are most likely to be young adult males. Our study sought to place these findings in a wider context by investigating: the age and sex distribution of those with single and multiple fractures, and if people with multiple injuries had poor general health. The sample of 205 males and 197 females (> 18 years old) from six populations in England, Siberia and Sudan ranged in date from the 3rd century BC to the mid-19th century AD. Health variables included cribra orbitalia, porotic hyperostosis, periostitis, Schmorl's nodes, enamel hypoplasias, dental caries and periodontitis. Ante-mortem injuries were: fractures (0/1/>2), myostosis ossificans, dental trauma, dislocation and subluxation, and sharp-force injuries. The data were analysed using chi-square (P=0.05) and hierarchical loglinear analyses.

The results failed to find a significant three-way association between age, sex and injury. There was no difference between the sexes when individuals with single versus multiple injuries were compared. There were significant differences in the age-distribution of people with 0/1/>2 fractures, but no difference between those with 1 or >2 fractures. Males and those 26-35 years old were most likely to have fractures and multiple injuries. Health variables that were significantly associated with a fracture were porotic hyperostosis, periostitis and enamel hypoplasias. However, there was no significant relationship between general poor health and multiple injuries.

The effects of environmental conditions and gender on the presence of pathological conditions on children's skeletons from the Industrial Era of Europe

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The diseases, malnutrition, and hard labor associated with the European Industrial Era (18th - 20th Centuries) negatively impacted children's growth and development. Previous research shows that individuals from this time exhibit increased evidence of stunted height and pathological conditions over their Medieval predecessors. In a previous study, I showed that Industrial Era boys and girls from varying socio-economic status (SES) responded to stress differently by exhibiting distinct patterns of stunting.

Here, I focus on the presence of pathologies in three Industrial Era subadult skeletal samples from low, middle, and high SES backgrounds to test two hypotheses. First, low SES children will exhibit more pathologies such as cribra orbitalia (CO), porotic hyperostosis (PO), linear enamel hypoplasias (LEH), and periostitis than higher SES ones. Second, boys will display more pathologies than girls,

reflecting the female buffering hypothesis that girls tend to survive and thrive better under stress.

Chi-square analysis results support both hypotheses. Lower SES children display statistically significantly higher rates of LEH and periostitis, and slightly higher rates of CO and PO, and younger boys exhibit higher frequencies of all pathologies than girls. Interestingly, higher SES adolescent girls display more CO and PO than adolescent boys, perhaps reflecting a less nutritious diet given to girls during this time. Other results show the longer children survived, the more likely they were to exhibit LEHs while younger children (0-5 years) in middle and higher SES samples display more CO and PO than older children within their samples, perhaps a reflection of maternal stress.

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Female White-handed Gibbon Great Call Linked to Resource Holding Potential Measures

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Resource holding potential (RHP) is commonly measured in mammalian males because males engage in more intra-sexual competition than females and RHP can reflect individual quality and attractiveness. In monomorphic, territorial species, however, selection for honest signals may shape male and/or female behavior. White-handed gibbons (*Hylobates lar*) live in small family-like groups on stable territories, and paired individuals produce loud, elaborate territorial duet songs. We tested the hypothesis that the most conspicuous phrase of the female vocal repertoire, the great call, would correlate with a caller's physical condition, and thus honestly indicate RHP. We used age as a proxy and predicted that if great call production is costly then older adults would produce great calls with lower quality characteristics than younger adults. We analyzed great call climaxes of 15 wild (Khao Yai NP, Thailand) and 2 captive (Leo Conservation Center, USA) lar gibbon females separated into 'young' and 'old' categories based on the sample median age of 17y7mo. Young animals (n=8) produced climaxes with a significantly higher frequency range (delta F0), maximum F0 frequency and duty cycle than old animals (n=9). During long songs maximum F0 frequency of call climaxes' decreased and the production of high notes increased. High notes are associated with rapid inhalation as an individual catches its breath, which reflected caller effort. Our findings support the hypothesis that the lar gibbon great call climax is costly and evolved as an honest signal in the context of intra-sexual territorial defense and potentially also in male mate choice.

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The impact of proximal femoral shape on midshaft cross-sectional properties: A case study involving *Pongo*

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The shape of the proximal femur has been reported to influence the shape of the femoral shaft. For example, paleoanthropologists have suggested that features of the hip joint characterizing early hominins, such as a relatively long femoral neck, resulted in larger bending moments of the femoral diaphysis related to enhanced mediolateral shaft robusticity compared to modern humans. Some aspects of the shape of the orangutan proximal femur have been reported to be similar to that of humans despite major differences in their positional repertoires. Given the similarity in proximal femoral shape, the objective of the present study is to examine if there are comparable patterns of covariation between shapes of the proximal femur and diaphysis in these two taxa. Seven measurements were collected on the proximal portion of the femur in *Pongo* and *Homo*. Using computed tomography scans, relative bending rigidity of the femoral midshaft in the mediolateral and anteroposterior axes was measured as well. Longer biomechanical neck length was correlated with greater mediolateral bending rigidity of the diaphysis. Furthermore, both humans and orangutans were characterized by a correlation between femoral neck-shaft angle and diaphyseal shape, in which individuals with lower neck-shaft angles had greater mediolateral bending rigidity at midshaft. Thus, variation in the relative length and orientation of the femoral neck was found to correspond to diaphyseal shape in both hominoid taxa despite differences in hind limb use and positional repertoire, providing additional support for the influence of the proximal femur on the development of femoral shaft shape.

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Reconstructing daily lives of individuals in ancient mass graves from Greek Sicily: Paleodietary perspectives on the Battles of Himera mortuary assemblages (480 BC, 409 BC)

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The Battles of Himera in 480 BC and 409 BC between the Carthaginian army and Greek alliance on Sicily are considered some of the ancient world's greatest battles. Mortuary assemblages from ancient battles provide unique opportunities to understand armed conflict in the past, and how political bodies mobilized armed force. Bioarchaeological perspectives afford an opportunity to examine how ancient soldiers lived, alongside knowing how they died. This study isotopically reconstructs the diets of humans interred in nine mass graves associated with two Battles of Himera (n=100). The identity of these individuals is uncertain, but burial patterns suggest they were probably Greeks: either local Himerans, or allies brought in to aid in the battles. We test the null hypothesis that carbon and nitrogen isotopic variation among the mass graves is low, reflecting similar diets and shared Sicilian origins and/or Greek cultural identity of the individuals.

Bone collagen was assayed for stable carbon and nitrogen isotope ratios ($\delta^{13}C$, $\delta^{15}N$) from human and faunal remains. Preliminary results suggest a diet with C_3 plant and animal protein, with moderate contributions from marine fish ($\delta^{13}C$ = -17.8±0.9‰, $\delta^{15}N$ = 10.3±0.6‰). Low isotopic variation suggests similar diets among individuals, which may point to shared cultural or geographic backgrounds. This research contributes to our understanding of the Himera assemblages, and allows us to look beyond the interpersonal interactions indicated by mass grave funerary contexts and customs, into the daily lives, identities, and lived experiences of individuals involved in organized violence in the past.

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Isotopic corroborates for wild capuchin (*Sapajus libidinosus*) omnivorous dietary adaptation at Fazenda Boa Vista, Brazil

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Stable carbon and nitrogen isotope analysis provides insights on diet and habitat use among nonhuman primates. Previous research has demonstrated compelling isotopic differences between nonhuman primate groups. Within-group patterned variation is also documented, but rarely exceeds 2-3‰ (carbon or nitrogen).

Capuchin monkeys are notorious omnivores, consuming fruits, animals, leaves, roots, seeds, and nuts. Capuchins also may seasonally raid crops, exploiting sugar cane and/or maize. Extractive foraging expands capuchin diets to encased foods including nuts and fruits requiring processing. Social, ecological, and psychological variables, including rank, skill, age, spatial distribution of group members and resources, and presence of infants, affect variation in foraging and diet on any given day.

We report stable carbon and nitrogen isotope ratios of bearded capuchin monkeys (*Sapajus libidinosus*) feces and dietary items (C_3, C_4, CAM plants; invertebrates; reptiles) from Fazenda Boa Vista, Brazil. We hypothesize high isotopic variation overall, but explore within-group patterning. Fazenda Boa Vista capuchins exhibit more varied isotopic signatures than previously reported nonhuman primate populations (adults $\delta^{13}C$ range=-28.4‰ to -19.7‰; $\delta^{15}N$=1.5-5.5‰). Isotopic values do not cluster by collection day or by individual, suggesting capuchins eat a wide variety of foods between and within days. Compared to an outgroup of laboratory-raised capuchins, Fazenda Boa Vista capuchins show clear signs of vertebrate protein consumption ($\delta^{15}N$: wild=3.6±1.3‰; captive=2.3±0.4‰).

High isotopic variation among capuchins points to the necessity for large sample sizes to uncover dietary patterns isotopically among omnivorous primates. Future isotopic research will explore weaning and compare isotopic data to nutritional analyses of capuchin diets.

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Telomere length: A possible mechanism linking racial discrimination and blood pressure

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Cardiovascular disease is one of a number of conditions that disproportionately affects African Americans. Shortened telomeres are a common indicator of cellular aging, and have also been linked to heart disease. Exposure to psychosocial stress has also been shown to hasten telomere shortening. Our study investigates telomere length as a potential mechanism by which exposure to racial discrimination may be associated with blood pressure in African Americans.

In collaboration with the Health Equity Alliance of Tallahassee (HEAT), we collected 165 saliva samples from African Americans, aged 25 to 65 years, from economically diverse regions of Tallahassee, FL. Ethnographic data were gathered via qualitative interviews and surveys. Discrimination was measured as unfair treatment experienced by self, other (individual close to the study participant), and all combined. Blood pressure readings and anthropometric data were also collected. Relative telomere length was measured using a qPCR-based assay.

Multiple regression analysis was performed to test for associations between telomere length and unfair treatment, socioeconomic status, and blood pressure. When controlling for age in our dataset, the best-fit model (R^2 = 0.719; AIC = 29.19) included both systolic blood pressure ($p = 0.005$) and unfair treatment experienced by others ($p = 0.039$) as significant ($p < 0.05$) predictors of relative telomere length (T/S ratio). These results add to the growing body of literature examining the complex relationship between sociocultural environment, blood pressure, and telomere length.

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Geographic and temporal variation in morphological sexing traits of the pelvis

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With the progression of multivariate statistics, the creation of population specific equations are on the rise. Multivariate analysis generally revolves around metric methods or geometric morphometrics, not on morphological features.

Eight human populations were analyzed spanning from prehistoric America (~ 4,500 BP) to Modern day South African and ranged between pygmy populations from the Andaman Islands to Medieval British populations. With a sample size of >1100 individuals, each *os coxa* was scored using eight morphological features most commonly used by physical anthropologists and osteoarcheologists.

Trait frequencies were compiled and compared between each of the eight populations. Each population was then analyzed using Principal Components Analysis (PCA) where the 1st Principal Component (PC) was variation due to sex. This helped form a specific structure of the sexual variation seen in the population. To help analyze the differences between populations, a between-group Principal Component Analysis (bgPCA) was performed on all eight populations. This approach could, theoretically, separate populations in the context of sexual variation without over manipulating the data.

When comparing trait frequencies, slight differences between populations could be seen. Minor fluctuations between component scores for each trait could be seen when comparing the PCA analyses from each population. However, results from the bgPCA showed that no overall geographic and/or temporal differences can be observed in the sexual variation of the morphological traits.

This shows that when using morphological features for sex estimation, applying multivariate techniques can be used without the knowledge of geographic or temporal origin with a high accuracy level.

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The hominoid wrist and the role of developmental perspectives on inferring homoplasy

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Developmental data can be a useful resource for resolving character homology. Both humans and orangutans have shortened pisiforms despite dramatic differences in forelimb function. Humans accomplish this through the unusual loss of a growth plate, while orangutans retain two separate ossification centers implying parallel evolution by distinct developmental mechanisms. In hominoids, pisiform reduction occurred within the context of ulnar withdrawal and superposition of the pisiform upon the triquetral. Thus, we conducted a comparative multivariate analysis to test the hypothesis that pisiform reduction is correlated with functional changes in the triquetral. Principal components analysis of 38 metrics spanning the wrist confirms greater similarity of the African ape and human carpus relative to orangutans. However, when analysis is limited to 11 metrics from the triquetral, humans and orangutans are separated from African apes. Human and orangutan triquetrals share a medial and distal placement of the pisiform articulation and a projecting pisiform pillar relative to African apes. Interestingly, *Ardipithecus* provides a combination of human/orangutan and African ape features suggesting that the African ape triquetral is also derived relative to the ancestral condition. Similarities in humans and orangutans may reflect mechanisms facilitating joint stability with the lost of constraints for quadrupedal locomotion, while African apes reflect parallel refinements for knuckle-walking from a palmigrade ancestor. As *Proconsul*

retains ulnar-pisiform contact, it is possible that ulnar withdrawal also evolved in parallel between Asian and African hominoids. We present approaches that combine functional and comparative genomics that can test these hypotheses.

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Height trends in early childhood: Easter Island and Chile from a global perspective

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Objective: to compare height trends in children 0 to 3 years of age from Easter Island and mainland Chile in association with socio-demographic variables.Methods: Retrospective data of height of 8,715 individuals from Easter Island (n=213, 99 males) and mainland Chile (8 counties, n=8,502, 4,373 males) born between 2007 and 2011 were obtained by health care providers during doctor visits. Third order polynomial models were performed to estimate the height for each child at six month intervals, and the dependent variable was z-score of height-for-age (World Health Organization, 2006). Independent variables were county of birth, household occupation, birth order, gender, gestational age, cessation of breast milk feeding, age at beginning formula-milk feeding, age at beginning solid food, and year of birth. Repeated measures ANOVA were utilised for data analysis.Results: All variables exerted a significant effect on the change of height-for-age across age intervals. When overall means were compared, only county of birth, birth order, gender, gestational age and age at cessation of breastfeeding were significant. After the effect of other variables were removed from the analysis, only age at eating solid food was not significant. Overall mean analysis showed significant effect of county of birth, birth order, and gestational age.Discussion: Differences in the change of height-for-age between Easter Island and mainland Chile were not explained by socio-demographic or food habit variables. While both patterns were within the normal limits of height-for-age change according to the WHO, differences can be better explained by enviornmental or genetic variability.

CONICYT, Becas Chile. Department of Anthropology, University of Chile. Parkes Foundation. Program U-Apoya, University of Chile. St Edmund's College.

What's the Difference? A Comparison of the Skeletal Remains of Castrated Individuals

KATHRYN REUSCH. Independent, Researcher.

Although castration has played a large role in human history, spanning the width of the Old World and the time from the earliest empires to the modern era, its effects on the male human skeleton are not fully understood. As part of a larger investigation into castration, five individuals known or believed to be castrated were examined. This included the analysis of the skeletal remains of two of the individuals and the pertinent articles and images for three of the individuals. All three major ancestry groups were represented, allowing for some assessment of possible differences between ancestry groups. At least one of the individuals examined had been castrated after puberty, while three had been castrated before puberty, giving insight into the different effects on the skeleton. Major changes to the prepubertally castrated skeletons included the elongation of the limbs, more feminine-appearing skulls, and masculine but unusual-looking pelvic girdles, likely driven by the lack of sex hormones during pubertal development. Postpubertal castration affected the skeletons less dramatically, but did leave traces, including gracile bones and osteoporosis. Understanding the changes to castrate skeletons allows archaeologists to detect the potentially thousands of castrated individuals depicted in historical narratives from across the Old World, but also opens the possibility of finding the skeletons of other, less represented intersex individuals, providing a clearer, more complete, and more complex picture of human health through time.

An ALE meta-analysis of shared and unique neural activation in the human brain during speech production and tool-use

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Language and complex tool-use are distinctive human behaviors that share cognitive processes, and possibly a common evolutionary history. Neural activation during both actions, however, has not been directly compared in a comprehensive manner. We performed a quantitative activation likelihood estimation (ALE) meta-analysis on results from published whole-brain studies to identify areas active in tool-use and speech production. The tool-use sample included 465 foci from 36 published studies, while 1959 foci were selected from 150 published studies on speech production. We executed a cluster level analysis on each group (cluster level inference: $p = 0.05$, permutation threshold = 1000, cluster-forming threshold: uncorr. $p = 0.001$) and a contrast analysis to identify shared and unique activity (uncorr. $p = 0.001$, p value permutations = 10000, min. cluster volume = 250 mm^3). Shared activation clusters were identified in left motor planning areas including the primary somatosensory and premotor cortices. Speech production alone activated left hemisphere areas involved in orofacial movements and word recognition, including Broca's area and the middle and inferior temporal gyri. Areas unique to tool-use included left hemisphere areas associated with hand motion, hand-eye coordination, and motion perception in the primary motor, premotor, and inferior parietal cortices, and middle temporal area. Tool-use and speech production thus share a network for motor planning, while separate networks are involved with specialized processing unique to each behavior. Further investigation of individual cognitive components of language and tool-use via meta-analyses can allow for a more detailed examination of the cortical networks involved in both activities.

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Genomic validation of the differential preservation of population history in modern human cranial anatomy

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In modern humans, the significant correlation between neutral genes and cranial anatomy suggests that the cranium preserves a population history signature. However, there is disagreement on whether certain parts of the cranium preserve it to a greater degree than other parts. It is also unclear how different quantitative measures of phenotype affect the association of genes and anatomy. Here, we revisit these matters by testing the correlation of genetic distances and various phenotypic distances of ten modern human populations. Geometric morphometric shape data from the cranium of N=224 individuals are used to calculate phenotypic P_{st}, Procrustes, and Mahalanobis distances. We calculate their correlation to neutral genetic distances, F_{st}, derived from single nucleotide polymorphisms (SNPs). In order to evaluate differential correlation of neutral genetics and phenotype, we subset the cranial data into landmark configurations that include the neurocranium, the face, and the temporal bone. Our results show that both P_{st} and Mahalanobis distances are appropriate measures for assessing the phenotypic association to genetic measures. They also indicate that overall cranial shape is significantly correlated with neutral genetics. Of the component parts examined, the temporal bone is the most significantly correlated, to a greater degree when considering the time in which populations

diverged. Our results reconcile some of the discrepant conclusions drawn from previous studies. They suggest that while the cranium, as a whole, can be used to reconstruct modern human population history, the temporal bone tracks it at a higher fidelity and at more profound time depth.

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Investigating possible signals of natural selection due to historic epidemics in Mesoamerica using ancient DNA

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Infectious diseases have produced some of the strongest selective pressures on humans over the course of our evolution. During the Spanish colonization of Mesoamerica in the 16th century, newly introduced pathogens are thought to have played a major role in the decline in Native American population sizes. It seems likely that disease epidemics in the early colonial period exerted selective pressures on genes involved in immune function, but few studies have explored the consequences of these epidemics on specific genomic regions. In this study, we conducted a diachronic analysis of immune-related loci spanning the time of Spanish colonization using ancient pre-Hispanic and modern samples from a site in Central Mexico.

Previous work has identified strong signals of positive selection on SNPs found in three immune genes in Mesoamerican populations: CD74_SMIM3, STAT1, and TNFRSF17. To evaluate if this selection could be a result of disease epidemics following the Spanish conquest, we used targeted pyrosequencing to genotype these loci in a sample of pre-Hispanic (N=25) and modern individuals (N=47) from Xaltocan, Mexico. We compared these results to other contemporary Mesoamerican populations and found the allele frequencies at Xaltocan to be consistent with frequencies observed elsewhere in Mesoamerica. Finally, we compared our results to forward simulations of genetic drift and natural selection to determine if the differences we saw between pre-Hispanic and modern samples could be explained by selection in early historic times.

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Play behavior in captive black crested mangabeys (*Lophocebus aterrimus*)

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The study of animal play provides valuable information about behavioral and cognitive development, and informs the full behavioral repertoire of a species at all stages of its life-history. We conducted a study of play in black crested mangabeys (*Lophocebus aterrimus*) at the San Antonio Zoo and Aquarium. Currently, little is known about play in this species. We observed two socially-housed groups of seven individuals in total. We recorded various play categories: solitary locomotor-rotational play, object play, and social play. Additionally, we recorded rates of social play between individuals, and analyzed overall play frequency according to age-sex categories.

Overall, play accounted for 15.4% of observed behavior. Consistent with previous studies, juveniles played more frequently than did adults. However, preliminary analyses show that adults played more frequently than predicted by the literature (24.3% of total play observed). Adult-juvenile play dyads accounted for most (89.5%) of play in adults. Compared with the adult females, the adult male of the group spent significantly more time engaged in social play with his juvenile offspring. Adult females on average engaged in 5.37% fewer instances of social play with juveniles compared with the adult male regardless of sex, or relatedness to the juvenile play partner. This is surprising since adult-juvenile social play interactions in other primates reportedly occur most frequently between mothers and their offspring. These findings may be explained by group composition and age- and sex-preferences in play partners.

To investigate differences in social play between individuals, signals and directionality of initiation gestures are also discussed.

Life in a new world: The Silver River rhesus macaques' feeding ecology and encounters with humans

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The study of primates living in novel environments represents an interesting context in which to examine patterns of behavioral and ecological flexibility. Our research focused on an understudied, human-introduced primate population living in Florida, U.S.: the Silver River rhesus macaques (*Macaca mulatta*). We collected data on their feeding ecology and encounters with boaters along the Silver River from January – May 2013 to better understand how this population has ecologically adjusted to life in Florida's riparian woodlands. Using scan sampling and all-occurrences sampling, we collected 166 hours of diet data and 105 hours of human-macaque encounter data. The Silver River macaques consumed a total of 31 plant species, representing 30% of the plant species in the floodplain swamp. Leaves and other vegetative plant parts (87.5%) were predominantly consumed, with ash trees (*Fraxinus* spp.) serving as a staple food (66.5% of feeding records). Although human-macaque encounters were frequent (80% of 611 boats observed), only a small proportion of boats (11.5%) provisioned the macaques. Motorized boats (e.g., pontoon and motor boats) were more likely to provision, while kayaks and canoes were more likely to move in close proximity of the macaques. Our results indicate that the Silver River macaques have adjusted to life in Florida by adopting a temperate-dwelling feeding strategy and incorporating locally available foods (e.g., sedges) into their diet. They have also learned that the river's edge provides opportunities to receive provisions from boaters. However, because the rate of provisioning is low, these foods likely play a filler fallback role.

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Evolution of human language circuits revealed with comparative diffusion tensor imaging

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Humans are the only species that communicates by combining thousands of symbols according to a defined set of rules to generate phrases with a nearly infinite variety of meanings. How were human brains modified during evolution to endow us with this capacity? Comparing human brains with the brains of our closest living primate relative, the chimpanzee, can shed light on this question. Using modern non-invasive neuroimaging techniques, we can compare human language pathways with their homologues in non-human primates. We acquired diffusion-weighted images from humans, chimpanzees and rhesus macaques and used diffusion tractography to reconstruct language pathways in all three species. Our results show that in contrast to results for macaques and chimpanzees, the human arcuate fasciculus has a massive projection beyond classic Wernicke's area into the ventral lateral temporal cortex that is known to be involved in processing word meaning. We propose this as a neurological specialization that evolved to support human language

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An evaluation of integration in the hybrid baboon cranium

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Studies in many mammal groups have shown that hybrid populations are highly variable and possess a range of phenotypic traits, including those resembling either parent population, intermediate traits, and traits outside the range of either parent population. Hybrid baboon crania have also been shown to be highly variable, both in size and shape, and transgressive. Underlying causes for this variation – particularly for shape variation – are currently not fully understood. This study tests the hypothesis that hybridization changes the magnitude and/or pattern of morphological integration, with the prediction that the hybrids will exhibit lower levels of integration than (and different patterns from) parents. This hypothesis was tested using a dataset of 32 three-dimensional landmarks from *Papio cynocephalus* (*n*=45, *P. anubis* (*n*=195), and their F1 hybrids (*n*=75). These landmarks were converted into 25 linear distances, which were subsequently analyzed; geometric morphometric analyses were also performed. To quantify levels integration, variance-covariance matrices were compared. Patterns of integration were assessed by examining axes of shape from Procrustes superimposed principal components analyses. Results indicate that, as predicted, the hybrids have significantly lower levels of integration than their parents ($p<0.001$); clear differences in patterns of integration are also evident, and this 'dis-integration' may explain the increased morphological variance observed in these hybrids. These results suggest that hybridization disrupts previously evolved patterns of integration, resulting in distinctive patterns of covariation in the cranium, and thereby providing novel variation upon which selection can subsequently act.

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Secular belongingness in religious congregation leads to lower stress

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Evolutionary signaling theory suggests that humans communicate the quality of their intentions through displays of commitment and gain benefits of well-being and social integration or "belongingness". Belongingness has been associated with the construct of "spirituality" in humans, applicable to religious and secular groups. We use these cognitive science and behavioral models to examine the influences of signaling, social integration, proclivity, and perceived stress in a religious community. We hypothesize religious groups which embrace diversity and appeal to belongingness in secular and religious ways are more successful and social integration in the church should correlate positively with integration outside the church and negatively with perceived stress. For the past two years, we have collected data from congregants at a Wesleyan church in the U.S. Southeast using observational and survey methods. The church expressly states that different churches are needed to appeal to different people and provides diversity within its congregation. It has over 10 secular interest groups within the church to attract people of different socioeconomic backgrounds. Preliminary data collected from 18 church members suggests commitment is signaled via interest group membership, and the church requires training of members to facilitate this integration. High degree centrality through membership in multiple church groups appears to correlate with increased status outside the church. Questions remain whether outside success and proclivity motivate church integration or vice versa. This study is important toward better understanding the dynamics of within and between group cooperation in humans.

Variation in human lower limb morphology and the relative influence of neutral and selective evolutionary processes

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Previous studies of human cranial and pelvic shape have detected a strong signature of neutral microevolutionary processes (*e.g.*, shared ancestry and gene flow) influencing recent phenotypic variability. Conversely, limb proportions appear to reflect a weaker influence of neutral genetic differentiation in comparison to the stronger effects of climatic selection and phenotypic plasticity. Using geographic distances as proxies for neutral genetic affinity, we aimed to quantify the relative effects of neutral and selective evolutionary forces on femoral and tibial shape variation in males and females.

Thirty-six morphometric measurements were taken from femoral and tibial samples representing 23 human populations within 6 continents (n = 924), with a minimum of 8 individuals per sample. All measurements were size-adjusted using the geometric mean of all measurements, then used to generate matrices of femoral and tibial phenotypic distance. Similar matrices were created using geographic distances (representative of neutral genetic distances) and temperature data. Differences in the relationships between lower limb morphology, geography and climate were tested using full and partial Mantel tests. Results suggest that temperature differences correspond with overall tibial morphology and the diaphyseal morphology of the femur, but not overall femoral shape or the epiphyses of either bone. The results also provide preliminary evidence for sexual differences in neutral demographic and climatic influences on limb morphology. While this study confirms a strong environmental influence on lower limb morphology among humans, it is also suggestive of morphological and sex-based variation in the relative effects of neutral evolution, climatic adaptation, and phenotypic plasticity.

St. Catharine's College, Cambridge (MBCR), SSHRC (JTS), NERC (JTS), ERC (JTS)

***Homo erectus* paleoecology and behavior based on 1.5 million year old footprints from northwestern Kenya**

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Hominin paleoecological models often lack fine-scale temporal and spatial resolution due to the scarcity of hominin fossils and the necessarily time-averaged nature of faunal assemblages. Large numbers of fossil footprints from the Koobi Fora Formation in northwestern Kenya provide a unique opportunity to examine animal communities and hominin habitat associations in a well-defined geographic area over very short time intervals.

Here we present data from 481 fossil tracks, including 97 footprints attributed to *Homo erectus*. The tracks are preserved in multiple sedimentary layers, which are tightly time bracketed within the Ileret Tuff Complex (1.51–1.53Ma) and represent the recurring presence of hominins and other animals over a period of approximately 20kyr. Modern taphonomic experiments and trackway sediment analyses confirm that each print surface records a period of time ranging from minutes to no more than a few days as individuals crossed this

landscape. The sedimentology and associated vertebrate fauna place these tracks in a deltaic setting, near a lakeshore bordered by open grasslands. To further assess the prevalence of hominin use of this lakeshore habitat, we conducted 20 randomly placed excavations within the same sedimentary sequence, sampling over a 2.5km^2 area. We found that hominin footprints are disproportionately abundant in this lake margin environment, relative to frequencies of their skeletal fossils in coeval deposits. Clusters of large *H. erectus* prints, in the same preservational state and moving in the same direction, suggest they traversed this paleolakeshore in multi-male groups, potentially searching for aquatic foods or prey animals drawn to water.

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Patterns sex-based shape in the human hipbone among non-metric traits categorized on a 5-point scale

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Non-metric traits in the human hipbone are important for sex identification, however, few studies have related non-metric sex traits to overall hipbone sex-based shape. This study compares whole hipbone shape, examining morphological variation of the greater sciatic notch (GSN) as categorized by Walker as well as the ventral arc (VA), subpubic concavity (SPC), and ischiopubic ramus ridge (IPRR) as defined by Phenice and expanded by Klales and colleagues. Sex was assessed in 59 adult left hipbones and 30 landmarks represented whole hipbone shape for geometric morphometric analysis. The VA and SPC differed binomially in parametric and non-parametric tests between Klales et al.'s morphological scores 2-3. The IPRR showed a more complicated pattern that could be related to landmark placement. The results of the parametric ANOVA and post-hoc tests on GSN shape support Walker's findings that the most extreme female GSN shape (score 1) is distinct from all other GSN shapes (F (df=4)=26.59, p=<0.001) with a significantly lower PC1 median (-0.07), while the non-parametric k-sample comparison and post-hoc tests contradicts Walker's results: extreme male GSN shape (score 5) is distinct from all other GSN shapes (x^2(df=4)=33.02, p=<0.001) with a significantly higher PC1 median (0.03). This research supports Klales et al.'s results and highlights the importance of using whole hipbone shape when developing improvements to sex estimation and the sex trait scoring techniques, particularly those involving non-metric sex traits.

Combining data from multiple sources: A cautionary tale

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With the increasing numbers of instruments available for collecting linear and three-dimensional (3D) data, and with more published and on-line morphometric datasets, many studies now include data pooled from multiple observers and methods. Although several researchers have examined inter-observer and inter-method error, they have focused on limited numbers of methods and specimens.

We compare sources of error across a range of levels. Two observers collected data on 15 cranial specimens from 12 species ranging in size from *Callicebus* to *Gorilla* using four methods: calipers were employed to collect 15 linear measurements, and 3D coordinate data were collected using a Microscribe and NextEngine and microCT scans of the same specimens. For the 3D data we calculated Procrustes distances among the trials of the same specimen, among observers, among methods, and all combinations therein. We compared these distances to distances between specimens in the same species, the same genus, and among genera and superfamilies. Results indicate that levels of intra-observer and inter-method error are similar to intra-specific distances and only slightly less than intra-generic distances. A nested ANOVA examining the caliper data and linear distances extracted from the coordinate data identified the greatest variance among species, with observer being the second most variable factor (i.e., more variable than specimens within species). Our results suggest researchers should be cautious when compiling data from multiple methods and/or observers, especially if their analysis focuses on intraspecific variation or examines closely related species, since these patterns may be obscured by inter-observer and inter-method error.

Allele Sharing between Archaic and Modern Humans

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Rates of archaic admixture can be estimated from patterns of allele sharing between modern and archaic hominins. These estimates may be strongly biased when there is more than one archaic source population. In addition, current methods use only a fraction of the information in such data. We describe a new method, which makes full use of the available data and deals gracefully with complex patterns of phylogeny and admixture.

Genetic Variation between the Population of the Ancient Xiongnu and Modern Populations in Central Mongolia

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The first hypervariable region from ancient mitochondrial DNA (mtDNA) from 48 individuals from Xiongnu (3rd century BCE – 2nd century CE) burials in central Mongolia has been sequenced showing a significant proportion of "western" mtDNA haplotypes. This suggests that the Xiongnu, the polity based in Mongolia which was the primary adversaries of Han Dynasty China, were predominantly "Europoid" in appearance. The mtDNA gene pool from this site is not consistent with the Xiongnu from the Egiin Gol site, the only population of the Xiongnu that has been sequenced, supporting a hypothesis that the Xiongnu may have been a confederation of unrelated smaller local political units. Also, the large proportion of "western" haplotypes found in this population suggest closer genetic and cultural affinity with western populations, which include the Pazyryk Scythian culture and the Deer-Stone-Khirigsuur (DSK) culture complex, as opposed to northeastern Asians, such as the populations of the Mongolic, Tungusic or other Paleo-Siberian peoples. The significant amount of western mtDNA in this region supports an East-West genetic border much father to the east than a generally accepted Altai Mountains hypothesis. The data from this study also suggest that a significant gene pool displacement occurred between the periods of the Xiongnu and Mongol Empires, which implies that after the last glacial maximum Eurasia east to Mongolia was initially settled from southwestern Eurasia and not East Asia.

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Investigating variation in age at menarche: relationships between gene methylation and reproductive traits in rural Polish women

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Age at menarche, a woman's first menstrual period, marks the transition from

investment in growth to reproduction. In multiple populations, age at menarche correlates with measures of reproductive success. Two models offer different but nonexclusive perspectives on why pubertal timing varies: one focuses on energy intake and expenditure, while another focuses on psychosocial stress and social support. Because epigenetic modifications are sensitive to both early energetic and psychosocial environments, this study explores gene methylation, an epigenetic modification, as a potential link for these models.

We investigated gene methylation of the CYP19A1 promoter; CYP19A1 codes for aromatase, an essential enzyme for estradiol production, and has been shown to correspond to menarcheal age in a U.S. population. This study included 90 rural Polish women recruited at the Mogielica Human Ecology Study Site in 2014 and 2015. Participants provided buccal swabs for gene methylation analysis and completed surveys detailing reproductive trait timing, early childhood exposures, and current physical activity. The most significant covariates of age at menarche in a linear regression model were gene methylation ($p=0.011$), body fat percentage ($p=0.004$), and time to regular cycles ($p=0.007$), while the Adverse Childhood Experiences scale ($p=0.094$) and waist-to-hip ratio ($p=0.085$) approached significance ($n = 30$-54, depending on variable). Our results suggest both childhood psychosocial and energetic stressors associate with age of menarche in this sample. Future analyses will include causal modeling of age at menarche to differentiate direct effects of early environmental traits from their indirect effects via gene methylation.

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Bioarchaeology at the site of Canímar Abajo: The issue of identity

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Canímar Abajo, Matanzas, Cuba is a two-component cemetery with an interpolated midden layers. The older component (Older Cemetery or OC) is dated to cal BC 1380-800 (2σ) and the younger component (Younger Cemetery or YC) is dated to cal AD 360-950 (2σ) by AMS 14C dating. A possible burial hiatus of more than 1000 years, poses question of continuity of ritual space, identity of buried population, and the persistence of social memory. We examine several possible scenarios: 1) the same biological population reclaimed the burial space after a 1000 years hiatus in the occupation of the area; 2) the same population occupied the area but ceased to bury their dead in the cemetery over a period of 1000 years; 3) the population buries their dead continuously over the 1000 years but we fail to recognize it because of the sampling error and 4) the population of the YC is a different biological population that claimed the abandoned earlier cemetery in order to legitimize its territorial claim. Different bioanthropological aspects and cultural practices of these two temporally distinct populations are contrasted in order to examine these questions. While the resolution of the excavation and dating strategy do not allow us to distinguish between the first three scenarios, current data indicate that the two groups of individuals share similar biological background, subsistence strategies and cultural practices that are not encountered among groups in the western Cuba dated to the time of the younger cemetery at Canimar Abajo.

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Genetic evidence for the prehistoric expansion of *Enterobius vermicularis* parasites and their human hosts in the greater American Southwest

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The human-specific pinworm, *Enterobius vermicularis,* provides an excellent proxy for elucidating the prehistoric migration patterns of its host. This intestinal helminth is transmitted through close personal contact and has been found in prehistoric coprolites throughout the greater American Southwest and northern Mexico. Here, we reconstruct genetic haplogroups from partial sequences of the *E. vermicularis cox1* gene obtained from coprolites of Ancestral Pueblo and contemporaneous Mesoamerican origins. These include Ancestral Pueblo samples (circa 1200 CE) from Antelope House in the Canyon de Chelly, AZ and from Salmon Ruin of the San Juan region, NM; from the oldest Ancestral Pueblo coprolites (circa 400 CE) from Turkey Pen Ruin in Grand Gulch, UT; and from La Cueva de los Muertos Chiquitos in Rio Zape Valley, Durango, Mexico (600-1400 CE). These genetic haplogroups were used to infer the spread of the parasitic *E. vermicularis* infection, which was then compared to migration patterns extrapolated from published mitochondrial DNA sequences of human skeletal and mummified remains in the greater American Southwest. Establishing the relationships of Ancestral Pueblo individuals within and between all of these culturally identifiable ethnic groups, as well as comparing them to outlier sites, provides a comprehensive means of assessing the geographic origins of the original migrants and subsequent migration patterns during the Ancestral Pueblo occupation of the American Southwest.

Craniofacial and dental effects shown in rats following *in utero/*lactational exposure to 2,2',3,4,4',5,5'-heptachlorobiphenyl (PCB-180)

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Polychlorinated biphenyls (PCBs) – a large class of persistent organic pollutants – are potentially harmful to human and wildlife health at current exposure levels. We conducted a dose-response study of the craniodental effects of *in utero/*lactational exposure to PCB-180, a non-dioxin-like (NDL) PCB congener that is abundantly present in the environment and foods, including mother's milk. In a sample of 81 offspring from pregnant rats exposed to 6 different doses of PCB-180 (range 0-1000 mg/kg bw/day), we measured 27 landmarks on the craniofacial skeleton with a Microscribe G2X system, as well as the width of each of the maxillary molars with digital sliding calipers. The landmark coordinates were analyzed for variation in size, shape, and bilateral asymmetry using MorphoJ software. Our results showed no effects on cranial size in male and female offspring at 84 days of age, but minor effects on shape (e.g., decreased facial length). Females showed 1.4-2.0 mm decreases in dose groups of 300-1000 mg/kg bw/day in the second and third molars, whereas males showed 1.6-2.1 mm increases in dose groups of 10-300 mg/kg bw/day in all molars. In all high dose groups (100-1000 mg/kg bw/day) the interfrontal bone was absent, but present in 10-29 percent of rats in the control and low dose groups (10-30 mg/kg bw/day). This study provides new information about how the mammalian skull responds to environmental stress during early life, and expands our understanding of how NDL PCBs in our environment may perturb the growth and development of bones and teeth.

Chimpanzees show human-like shifts in cognition during adolescence

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The human adolescent period is characterized by a suite of changes in cognition, including decision-making, self-regulation, and social motivation. In particular, human adolescence is marked by increased risk-taking and impulsivity, reduced emotional regulation, and increased interest in novel social partners. Although some work has examined patterns of early cognitive development in humans and other primates (for example, in infants), it is

currently unclear whether these hallmarks of "adolescent psychology" are unique to our species. Indeed, human life history shows several divergences in comparison to other primates, in terms of behavioral and physiological changes across the juvenile period and maturation. This study examined whether chimpanzees (*Pan troglodytes*), our closest living relative, share human-like patterns of cognitive change as they transition from juvenility to adulthood. Forty chimpanzees, ranging from late childhood to early adulthood, completed an experimental task battery measuring cognitive processes that shift in human adolescence. This included a risky choice task where individuals made decisions about variation in reward payoffs; a temporal choice task involving tradeoffs between immediate gratification and future rewards; and a temperament task probing the chimpanzees' motivation to approach novel stimuli of both a social and non-social nature. In comparisons of adolescent and adult individuals, younger chimpanzees exhibited greater risk-taking, increased emotional reactivity, and increased interest in the novel social stimuli. These results indicate that several core cognitive features of human adolescence are shared with chimpanzees, which has implications for understanding evolutionary changes in human life-history and patterns of cognitive development.

The teeth of Tell el-Amarna, Egypt: A reconstruction of past lifeways from the perspective of a century of Nile Valley research and 30 years advancement in dental anthropology

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Dental researchers began reconstructing ancient Egyptian diets and lifeways when Mummery compared dental decay observed on Egyptian teeth with other ancient groups to estimate dietary carbohydrates. Unfortunately, his suggestion that sand in the diet caused extensive dental wear inhibited more nuanced dietary reconstructions for more than a century and sand became the standard explanation for dental disease and tooth loss among ancient Egyptians. We utilize the long history of anthropological research in the Nile Valley and apply the past 30 years of advances in dental anthropology to interpret the teeth of recently excavated skeletons at Tell el-Amarna, Egypt (1353-1336 BCE).

Microwear patterns and surface textures of Amarna incisors and molars were compared to those of other samples with known diets to establish that dietary sand was not an issue related to dental decay and tooth loss. Our analysis shows dental decay to be frequent with, for example, 5.8% of the right maxillary molars and 15.1% of the right mandibular molars in our youngest (12-25 years) age group having one or more lesions. Contemporaneous Egyptian reliefs show an abundance of fruiting trees; Amarna funerary offerings include fibrous, sugary fruits such as dates, and doum-palm fruit; and previous studies have shown that honey and dates were used as additives to bread. Application of the full range of dental anthropology interpretive tools permits us to reconstruct the Amarna diet to have been grains prepared on stone grinders, various vegetables, and large amounts of sticky sweet fruits.

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Dads *and* cads? Male reproductive success, androgen profiles, and male-infant social bonds in wild mountain gorillas (*Gorilla beringei beringei*)

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Male reproductive strategies are often reduced to a 'dad versus cad' dichotomy. When paternity certainty is high and mating opportunities scarce, theory predicts high levels of paternal investment; if paternity certainty is low and/or access to mating opportunities plentiful, male parenting is expected to be scarce. However, conflict between mating and parenting behavior is not equally strong across ecologies and social structures. Wild mountain gorillas (*Gorilla beringei*) have variable paternity certainty and a morphology suggestive of intense male contest competition. Despite this, relationships between males and infants are an important component of group structure, likely because males protect infants from infanticide and predation. Using data from gorilla groups monitored by the Dian Fossey Gorilla Fund's Karisoke Research Center, we evaluated 1) the relationship between male-infant social bond strength and males' reproductive success, and 2) the relationship between male-infant social bonds and males' fecal androgen metabolite levels. Higher testosterone levels are generally correlated with increased aggression and mating activity, which are typically considered incompatible with parenting behavior. After controlling for male age and rank, males who had the strongest social bonds with infants were also the males with the highest reproductive success. There was no relationship between strength of male-infant social bonds and fecal androgen metabolite levels. Results demonstrate that reductive descriptions of male reproductive strategies may obscure important connections between mating and parenting effort, and highlight the need for additional data on the relationship between androgen activity, mating, and parenting in multimale/multifemale social systems.

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Evidence that male face shape in rhesus macaques (*Macaca mulatta*) is subject to inter-sexual selection

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Sexual selection acts on traits underlying within-sex variation in mating success. Under inter-sexual selection, traits that are attractive to females can grant a mating advantage to males. Morphological traits may be attractive because they are associated with physiological, morphological, or behavioral characteristics indicating male quality. In this study, we tested the hypothesis that the evolution of sexually dimorphic male face shape in rhesus macaques is subject to inter-sexual selection. We analyzed facial photographs of rhesus macaques (N=71 male, 28 female) and found significant sex differences in 6 of 8 facial measures. We used these to calculate an index of facial masculinity (FM) and selected 20 male photos–ten each with low and high FM scores. Paired low-high FM images were shown to free-ranging female rhesus macaques during the mating season in a differential looking-time experiment.

Females looked significantly longer at high FM stimuli when the difference in masculinity scores within the stimulus pair was high, and this attentional bias toward high FM stimuli correlated positively with the absolute difference in FM. Furthermore, contrary to what one would expect if the attentional bias were due to threat, we found no difference in latency to disengage depending on FM. This supports the view that females' attentional bias was explained by attraction rather than fear. Further research should elucidate the information content of high FM, in regards to its function as a potential indicator of genetic and/or phenotypic quality, as well as its possible relation with male mating and reproductive success.

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The role of obesity on water intake and hydration status in U.S. adults: 2009-2012

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Water is an essential nutrient that is critical to physiological and cognitive functioning. While water needs increase with larger bodies, it remains unclear how variation in weight status affects hydration (i.e., meeting water needs). Osmoregulation and thermoregulation may be competing homeostatic processes that lead to dehydration vulnerability among individuals with obesity due to higher water needs. This study examines the association between obesity and 24 hour water intake from all foods and liquids and hydration status using data from 6,850 non-pregnant adults aged 20 years and older without diabetes or kidney failure who provided a urine sample in the National Health and Nutrition Examination Survey (2009-2012). We conducted analyses using sample weights and survey commands in Stata 13.1. Overall, mean water intake was 3,141 ± 36 ml (standard error) and mean urine osmolality (a biomarker of hydration) was 645.1 ± 6.1 mOsm/kg with 33.6% of adults dehydrated (osmolality≥800 mOsm/kg). Obese adults (BMI≥30), comprising 33% of the sample, had significantly higher water intake, urine osmolality, and prevalence of dehydration than non-obese adults ($p<0.01$). Regression analyses suggest that obese adults had higher urine osmolality ($\beta=48.2$ mOsm/kg; $p=0.000$) and 31% higher odds of dehydration than non-obese adults (Odds ratio 1.31, 95% CI 1.13-1.52, $p=0.001$) controlling for water intake, sex, reported physical activity, age, ethnicity, alcohol intake, caffeine intake, and time of day. An interaction between obesity and water intake was not significant. Human hydration is a dynamic process and obesity may add stress on the system, making it harder to maintain proper hydration.

The Cuban Infectious disease experience: 2000 ybp Ciboneys treponemal virgins and SAPHO

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Criteria developed for macroscopic recognition of disease were applied to macroscopic examination of 151 Ciboneys (Cueva del Perico, Guayabo Blanco, Cueva del Esqueletos I, Cueva de la Santa, Pinar del Rio and Cueva del Infierno), dated 2000 ybp, compared to 90 individuals from a 19th century Chinese Cuban cemetery and 365 individuals from 700 to 1200 ypb Dominican Republic Taino cemeteries. Filigree bone reaction and draining sinuses characteristic of osteomyelitis were present in four individuals. One individual had isolated phalangeal expansion (dactylitis), suggestive of histoplasmosis or tuberculosis. Periosteal reaction characteristic of syphilis was absent in Cuban Ciboneys. This virgin state contrasts with 5 syphilis-affected individuals among 19th century Chinese (Fisher exact test, $p = 0.03$) and 21 afflicted individuals in 600-1200 ybp Dominican Republic cemeteries (Chi Square $= 10.346$, $p < 0.001$).

The most remarkable pathology among the Ciboneys was isolated ulna enlargement, noted in seven of 56 infants. These mega-ulnae (three times normal diameter, but with normal length and normal proximal articular surface) otherwise retained their shape. Although possibly a homeobox/congenital disorder, the only currently documented cause of this unique pathology is a disorder referred to as SAPHO (Synovitis, Acne, Pustulosis, Hyperostosis, Osteitis), although the ulna is only rarely affected in modern patients. SAPHO is considered an unusual form of chronic osteomyelitis, as bacteria (*Propionibacterium acnes*) have occasionally been isolated from such bones in modern patients. Is this ulna ballooning a manifestation of SAPHO or is this a congenital disorder specific to this 2000 ybp Cuban population?

None

Intentional Cranial Vault Modification and the Biomechanics of Head Balance

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Over the course of human evolution, the need to walk bipedally has influenced the shape of the skeleton, including the skull. Because it must balance atop a vertically oriented vertebral column, human skull dimensions have been modified to minimize forces placed on neck musculature. Intentional cranial vault modification is a cultural practice and marker of identity that alters the shape of the human skull, and thus, how the skull balances. Three morphologically distinct samples of South American crania were analyzed in order to quantify changes to the cranial vault and face induced by intentional vault modification and to assess how these changes may affect the way in which the skull balances. A MicroScribe 2Dx digitizer was utilized to collect 41 craniometric points and linear skull dimensions were extracted from 3D coordinate data. These data were then used to compare dimensional changes in the skull and model head balance. While both anteroposterior and circumferential types of cranial vault modification are detrimental to head balance, anteroposterior deformation has the greatest influence on how the head balances, producing more strain on the neck musculature than circumferential deformation. The differential patterns between these two groups suggest broader implications for making transitive inferences about the day-to-day lives of these individuals.

Implications and applications of non-penetrating cortical bone modifications by carnivorous scavengers

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Archaeologically recognized bone modification categories currently fail to define modifications that specifically do not penetrate cortical bone. The current study shows that modifications that do not penetrate cortical bone and are only macroscopically visible as color changes, coined here as *periosteal abrasions (PA)*, may be linked to stages of flesh consumption during the scavenging process.

Soft tissue is assumed to protect cortical bone from the damaging effects of consumption techniques used by scavengers, therefore I propose that PA will be associated with those elements that are less intensively scavenged by carnivorous scavengers. This study, which used 24-hour video surveillance to monitor the flesh consumption sequences of carcasses by carnivorous avian and mammalian scavengers, suggests a correlation between soft tissue consumption and the amount and type of modifications that were left behind. The results show that modifications left on bones that were consumed less intensively, therefore retaining soft tissue, were limited to PA. Alternatively, heavily consumed elements, void of soft tissue, had PA as well as cortical penetrating modifications.

The results also suggest the persistence of PA in the fossil record may be facilitated by weakening the integrity of the cortical surface making it prone to exploitation by opportunistic organisms that can cause bioerosion. Comparing the definition of PA to definitions regarding microbial bioerosion, a similarity in the beginning stages of both processes is seen. Consequently, I may be able to show how tooth-mark modifications at Olduvai Gorge are misinterpreted as bioerosion marks, leading to erroneous conclusions regarding hominid carcass acquisition.

In the Thick of Things: Menstrual Bleeding Reflects Placental Development in Non-Human Primates

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Humans shed a large amount of fluid during menstruation compared to other mammals. This trait has generated several

adaptive hypotheses. One possible evolutionary explanation for menstruation is that it reflects uterine features related to depth of embryonic implantation during early pregnancy. Mammal species vary with regard to the depth of embryonic implantation, and deeper implantation requires a thicker uterine lining, which may in turn be shed externally during menstruation. Although several non-human primate species have also been observed to menstruate, no quantitative studies of menstrual bleeding in non-human primates have previously been performed. I investigated whether the depth of implantation was related to menstrual bleeding in 55 non-human primate species. Zoo keepers at 29 zoos in the United States provided data on externally visible menstrual bleeding from 640 individual primates. These individuals were sexually mature, non-contracepting, and not pregnant. I used a Chi-square test to compare these data to species-specific data on depth of implantation from an online comparative placentation database. I found that primate species that have the deepest form of implantation were also more likely to have external menstrual bleeding ($P < 0.001$). My results support the argument that menstruation is related to features of the uterus important to implantation in early pregnancy and may help explain why our own species exhibits relatively heavy menstrual bleeding. Further, my results indicate that externally visible menstrual bleeding may be a trait specific to certain primate groups and reflect important taxonomic variation in the physiology of early pregnancy.

Environmental and Dietary Factors Shaping African Gut Microbiomes

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Africans harbor the greatest levels of human genetic variation, and their diverse diets and environments have produced distinct selection pressures resulting in adaptations. This study investigates dietary adaptations in Africans by interrogating their gut microbiomes (GMs), or the multifunctional microorganisms of the gut that have roles in health and diet. We analyzed the GMs from sixty ethnically diverse rural Tanzanians practicing different subsistence strategies (Hadza hunter-gatherers, Burunge agriculturalists, Maasai pastoralists, recently-settled Sandawe hunter-gatherers) with urban European and African-Americans in Philadelphia, USA using ribosomal marker classification (16s RNA V1/V2) from fecal samples. Data on climate, genetic ancestry, and traditional diet are tested as potential covariates shaping microbiome composition. This data was paired with nutritional and ethnographic surveys as well as genetic data from an Illumina 5M Omni SNP Array. Bacterial compositional analysis between Africans and US samples confirm previous research showing marked population differences in GMs, with fine-scale analyses showing that Hadza have lower within-group diversity than other populations. Principal coordinate analysis of bacterial families showed that Tanzanians have two predominant bacterial gradients associated with broad global enterotypes: A strong Prevotellaceae-Ruminococcaceae gradient and a weak Bacteroidales-Ruminococcaceae gradient. Bacteroidales is associated with diets high in protein and fats, whereas Prevotellaceae and Ruminococcaceae are associated with diets rich in plants and fiber, and this result affirms expectations for populations eating rural, nonwestern foods. This represents one of the largest GM studies to date of ethnically diverse Africans, including the first data from pastoralists, and provides novel microbiome data from sparsely characterized African groups.

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Biology trumps mechanics: bone adaptation to exercise correlates more closely to bone marrow stem cell responsivity than peak forces

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Force magnitudes are considered a primary determinant of bone's adaptive response to exercise. Yet, to a degree, the ability of a bone to respond to functional challenges may be regulated by regional variations in the capacity of marrow progenitors to differentiate into bone-forming cells. Here, we examine the relationship between bone adaptation and mesenchymal stem cell (MSC) responsivity in growing mice subject to exercise. First, using a force plate, we show that peak external forces generated by forelimbs during running are approximately 20% ($P<0.001$) higher than hindlimb forces. Second, using micro-CT to quantify humeral and femoral morphology in mice subject to 4 weeks of treadmill running as compared to sedentary controls, the skeletal response to increases in loading is shown to be site-specific but not predicted by peak forces. While exercise failed to augment either cortical or trabecular structure in the humerus, the femoral mid-diaphyses of running mice had 11% ($P<0.001$) larger cortical areas, 17% ($P<0.01$) larger maximum second moments of area, and 16% ($P<0.01$) larger minimum second moments of area. Trabecular bone quantity in the distal femur increased 24% ($P<0.05$) in runners. Finally, fluorescence-activated cell sorting (FACS) was used to show that marrow-derived MSCs from the femur are more responsive to exercise-induced loads than those from the humerus, such that running lowered MSC populations only in the femur (by 34%, $P<0.05$). Together, these data suggest that changes in skeletal morphology induced by exercise must consider both the mechanical challenge, as well as the biologically defined ability to respond.

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Asymmetry of Broca's cap using GIS

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Endocasts are the best-preserved materials for estimating gross changes in brain structure through hominid evolution. Although various methods have been used to assess endocasts, geographic information systems (GIS) are an underutilized suite of tools that can be used on endocasts. This study is an assessment of asymmetry in Broca's cap in *Homo sapiens* using ArcGIS. Broca's area has a well-established trend for leftward asymmetry in living humans, so human endocasts should show leftward asymmetry in Broca's cap. We scanned 34 human inferior prefrontal endocast molds using a Next Engine 3D Laser Scanner, and examined the topography of Broca's cap in ArcMap 10.1. A ratio of left-to-right hemisphere surface area was calculated to allow intersample comparisons of asymmetry. Twenty-two samples (65%) displayed left lateralization, and 12 samples (35%) displayed right lateralization. Overall, the left Broca's cap was found to be an average of 15% larger. The geometric mean for the left-lateralized subset was 1.32, while that for the right subset was 0.91. A two-sample t-test comparing the mean of the left-lateralized subset with the reciprocal of the mean of the right-lateralized subset found that the left-lateralized subset was in fact more lateralized in an absolute sense, with a p-value of 0.0094. A Shapiro-Wilk test on the sample determined that it was not normally distributed, with a p-value of 0.0005. These figures are consistent with expectations and provide an impetus to carry out interspecific and temporal comparison of Broca's cap asymmetry in hominid endocasts using GIS spatial analysis.

A Test of the Meindl and Lovejoy Method for Age Estimation from Cranial Suture Closure in a Thai Population

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One of the challenges of developing a biological profile of unknown skeletal remains is age estimation. Cranial suture closure has been widely used and studied as an age indicator for nearly a century, but its reliability is still debated. Because of these concerns, anthropologists have attempted to improve and develop this method, perhaps because the skull is very often found in forensic circumstances. Many researchers have suggested that the degree of cranial suture closure varies between populations. In addition, there is no standard method for utilizing cranial suture closure in Thai populations and traditional methods of applying suture closure have not been tested on them. Therefore, this study aims to examine Thai cranial suture closure by testing the reliability of the Meindl and Lovejoy method. Closure of vault and lateral-anterior sutures was investigated using 50 Thai crania. Results reveal underestimation of age using this method. There was also strong evidence for inter-population variation in the efficacy of the standard approach. However, composite scores for the degree of closure of the three lateral-anterior sutures; midcoronal, sphenofrontal, and pterion, did express a moderately good relationship with age ($r = 0.557$) compared with the other sutures. The results suggest that cranial suture closure can be applied as an age indicator in Thailand. However, further study is needed to establish a standard aging method using cranial suture closure for this population.

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Phylogenetic and environmental effects on limb bone structure in *Gorilla*

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The degree to which developmental plasticity versus phylogenetic constraint influences different long bone morphological features has major implications for interpreting the hominin fossil record. Here we investigate this issue using adult and ontogenetic comparisons among different taxa of *Gorilla* that are characterized by varying degrees of genetic and environmental similarity. The study included 37 *G. g. gorilla* (western lowland), 22 low elevation *G. b. graueri*, 25 high elevation *G. b. graueri*, and 48 *G. b. beringei* (mountain) adult specimens, and pre-adult ontogenetic series of 64 *G. g. gorilla* and 50 *G. b. beringei*. Diaphyseal strength parameters of the femur, tibia, humerus, radius, and ulna were obtained using pQCT scanning, and lengths and articular breadths measured with calipers.

Variation among adults in hindlimb to forelimb bone strength closely parallels environmental and locomotor (arboreal/terrestrial) behavioral differences between groups, and not phylogeny: *G. g. gorilla* and low elevation *G. b. graueri* have similarly low values, high elevation *G. b. graueri* is intermediate, and *G. b. beringei* has very high values. In contrast, inter-limb bone length and articular breadth proportions show very little variation between groups. In ontogenetic comparisons, infant *G. g. gorilla* and *G. b. beringei* are indistinguishable in inter-limb bone strength proportions, but diverge after 2 years of age when locomotor behavior also diverges. There are no differences between the species in bone length or articular proportions at any age. These results clearly demonstrate the developmental plasticity of diaphyseal structure and greater phylogenetic constraint on length and articular dimensions of long bones.

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Differences in DNA yield among buccal swab types: Medical-grade vs. standard cotton swabs

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Accurate and efficient collection of biomaterial is necessary for a wide variety of studies in biological anthropology, including human population genetic analyses and forensic investigations. Buccal swabs are one of the most efficient methods of collecting biological samples, but medical-grade swabs are often associated with high costs. We therefore tested three types of medical-grade buccal swabs against standard cotton swabs (i.e Q-tips) for differences in DNA yield using a QiaCube extraction robot and a Qubit 3.0 fluorometer. Our data suggest that standard cotton swabs, when using one end for each cheek, produce no significant difference in mean DNA yield relative to the tested medical swabs. Furthermore, these swabs produced a much smaller standard deviation than the medical-grade brands which suggests a greater consistency in yield values. Factors such as duration and temperature of storage may have an effect on yield and will require further investigation. However, for buccal cell samples to be extracted soon after collection, we recommend the use of standard cotton swabs, specifically Q-tips. Therefore, they represent the optimal choice for the important balance of cost-efficacy and yield in genetic analyses.

Size-related and Demographic Effects on the Morphology of the Lateral Meniscal Notch of the Proximal Tibia

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The lateral meniscal notch of the proximal tibia is often utilized to interpret locomotor behavior and determine the taxonomic assignment of fossil hominin postcrania. However, not all humans possess a meniscal notch, and this study addresses how the size and presence of this feature is influenced by body size, sex, age, and ancestry. Though Dugan and Holliday discuss variability in this feature, previous work has failed to address the ways in which the posterior attachment of the lateral meniscus is influenced by body size and demography. In this study, I introduce quantitative methods for assessing the size and dimensions of the lateral meniscal notch relative to the tibial plateau in a large sample of modern humans (350 individuals) spanning the range of human body size. Individuals who lack or have a small meniscal notch area (<3 mm^2) are significantly smaller in body size than those with larger notches. Those who lack or have a small notch are also significantly more likely to be female, and this difference is not explainable by body size alone. This quantitative method for analyzing the lateral meniscal notch will decrease ambiguity in the interpretation of the morphology of the proximal tibia. My results also have implications for the interpretation of the knee morphology of Plio-Pleistocene hominins, and caution should be taken in interpreting the locomotor behavior of small-

bodied, female hominins on the basis of absence of the meniscal notch.

Elucidating the evolutionary pathways of hominoid and hominin basicranial morphology using a formal phylogenetic comparative primate approach

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The morphology of the basicranium distinguishes modern humans from our closest living relatives and has therefore served as a key anatomical region in paleoanthropological studies seeking to elucidate the evolutionary pathways that led from the panin-hominin last common ancestor (LCA) to *Homo sapiens*. The central goal of this project is to improve our understanding of how patterns of basicranial morphological change observed for living great apes relate to those that occurred in deep-time haplorhine evolution. We collected 3D geometric morphometric data from the basicrania of over 670 individuals from 101 haplorhine species with available phylogenetic data. A Simpsonian landscape model was used to describe the structure of the multivariate basicranial macroevolutionary space. Preliminary results indicate that, considering foramen magnum position and basicranial length, all great apes constitute a synapomorphic regime (anteriorly-positioned foramina magna and anteroposteriorly-shortened basicrania), but that both modern humans and panins are further derived in distinctive directions (moderns humans toward further decreased basicranial length and panins toward more posteriorly-positioned foramina magna). The statistical fit of this inferred evolutionary scenario is superior to that obtained with a standard Brownian motion model (AIC_{Δ}=128.87, AIC_{w}=1.00). This preliminary finding highlights the challenge of using a generalized African great ape model (or one solely based on panins) for understanding basicranial morphological evolution in hominoids and hominins. Results for additional basicranial features and the estimated basicranial morphological condition of the panin-hominin LCA will be discussed.

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Metabolic hormone dynamics across marmoset monkey pregnancy: sources of variation and implications for birth outcomes

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Maternal metabolic hormones interact in dynamic ways across pregnancy, as a result of maternal energetics and placental function, as well as the development of fetuses themselves. In particular, leptin, insulin, cortisol, and cortisone reflect glucose metabolism, a crucial substrate for maintaining fetoplacental integrity. The common marmoset (*Callithrix jacchus*) is an important model of intrauterine variation. We report serum leptin and insulin and urinary cortisol and cortisone levels from 11 pregnant marmoset females across 19 pregnancies, with litters ranging from two to four offspring of varying viability at birth. Gestational age for leptin and insulin values ranged from 57 to 128 days (out of a 143 day gestation), with cortisol and cortisone values extending to day 138. Hormone values increased dramatically across gestation. Leptin levels ranged from 0.5 to 2.4 ng/mL; insulin ranged from 1.5 to 62.7 µU/mL suggesting enhanced mobilization of glucose. Both cortisol and its metabolite cortisone increased across gestation (cortisol: 2.8-171.6 ug/mg creatinine; cortisone: 0.7-64.3 ug/mg creatinine), but not proportionally, such that relative cortisone levels increased, indicating increased cortisol activity. Embedded in these overall patterns is considerable variation between females, as well as within females between pregnancies. Maternal characteristics such as pre-pregnancy weight, parity, and her own litter size and weight at birth will be explored as predictors of variation in gestational hormone dynamics, as will consequences such as litter size, sex, birth weight, and viability of offspring. Understanding the maternal causes and fetal consequences of these dynamics can improve birth outcomes and sequelae relevant to developmental programming.

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Radial Maximum Intensity Projection (rMIP): A new method for mapping 3D subchondral bone apparent density on curved joint surfaces

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Analyses of variation in subchondral bone apparent density and three-dimensional (3D) trabecular bone structure can provide important insights into joint function in living and extinct primates. The goals of this study were to map subchondral bone apparent density patterns on curved joint surfaces using a radial maximum intensity projection and to evaluate the correspondence between subchondral bone density and underlying 3D trabecular bone structure. The proximal humerus from five individuals each of *Homo sapiens*, *Pan troglodytes*, *Pongo pygmaeus,* and *Papio sp.* were microCT scanned with resolutions between 0.05 and 0.06 mm. The articular surface cortical bone of each element was isolated and used to generate 3D reconstructions of the joint articular surface. Radial maximum intensity projections were used to map grayscale variation in the subchondral bone using virtual rays emanating from the centroid of the articular region to each point on the articular surface. The maximum intensity values were mapped onto the 3D isosurface and compared to quantified trabecular structure in each joint. Results indicate differences in subchondral bone density distributions between the taxa with *Pongo* displaying the most uniform density distribution across the humeral head, *Pan* having high density posteromedially, *Papio* posteriorly, and *Homo* on the superiorly. Trabecular bone underlying dense subchondral bone regions is thicker and has higher bone volume fraction than that underlying lower density areas. These results suggest that the combined characterization of subchondral bone density and 3D trabecular bone structure in large, complex joints can provide valuable insights into joint structure and function.

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Shape variation of the human orbital cavity

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Shape analysis of the human orbital cavity is challenging due to several reasons. First, it is a smooth surface where only few anatomical landmarks can be identified. Second, data acquisition via CT-scanning is limited due to poor representation of the orbital walls caused by the so-called partial volume effect. The structure of the orbital walls can also lead to gray values differing from the rest of the bony tissue. Hence, automatic segmentations based on gray value thresholds will not include them in the segmentation and produce pseudoforamina in the segmented orbital walls.

In this study, a symmetric template mesh representing the orbital region was created. Forty-six landmarks were placed manually onto skull surfaces which were automatically segmented from CT-scans of 656 individuals of European (♀:n=164, ♂:n=164) and Chinese (♀:n=164, ♂:n=164) origin. A statistical model was computed on basis of the template mesh and semi-automatically matched onto the skull surfaces. This way, the defects in the representation of the orbital wall were interpolated. Next, 600 bilateral semi-landmarks,

evenly distributed on the surface of the orbital cavity, were placed automatically on each individual. Procrustes analysis and principal component analysis were performed on these configurations. Shape variation depending on the factors sex and population affinity was analysed using the principal component (PC) scores of the PCs accounting for 98% of the total variance. The results indicate significant influence of population affinity and sex on orbital cavity shape with weak interaction between the two.

Anthropologic-radiologic analyses of newly found ancient Egyptian Human Mummies from tomb KV 40, Valley of the Kings (Upper Egypt)

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The Valley of the Kings (KV) near Luxor was the main site for royal (and some) elite burials during the New Kingdom (c. 1500 - 1100 BCE). In this study an anthropologic-radiological overview of the newly discovered human remains in KV 40 will be presented. Archaeological findings from KV 40 showed an initial burial period dating to the 18th dynasty (c. 1479 – 1350 BCE), followed by reuse of the tomb in the Third Intermediate Period (c. 1077 – 800 BCE). Tomb robberies in ancient times and a fire occurring in the late 19th century CE, led to severely damaged and burnt human remains in every stage of fragmentation. Sixty human individuals have been determined so far and besides basic anthropological assessments (sex, age, body height), the remains were conventionally X-rayed by a portable x-ray unit (EXAMION® PX60HF*) in-situ*. These radiological image data serve as an additional basis for sex and age determination - especially when not applicable due to mummification artifacts - and are of diagnostic importance for paleopathology. The adult sample shows a tendency towards more females. Interestingly, unlike in other tombs many younger individuals were buried in KV 40. Skeletal developmental abnormalities (such as a possible case of achondroplasia) as well as a case of skullcap deformation and long-bone fractures are of paleopathological interest. In addition, general stress markers (e.g. Harris lines, cribra orbitalia) point towards poor health in some individuals. The hereby-presented unique human mummified remains reveal more insight into life conditions in ancient Western Thebes.

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Examining Mitochondrial Haplotype Diversity in Ancient and Modern Indigenous Caribbean Populations

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During the colonial era in the Caribbean, Africans, Europeans, and Asians each left their mark upon the region's diverse biocultural milieu. However, indigenous heritages of the Caribbean islands are also important legacies that should be emphasized. This study compares published data of Native American haplotype diversity in the mitochondrial HV-I region from ancient and modern Caribbean individuals in order to examine the relationship between past and current indigenous populations.

Regions represented in the ancient sample include Cuba, the Dominican Republic, and the Guadeloupe Islands. The modern sample was comprised of individuals from Cuba, Puerto Rico, Dominica, Trinidad, St. Vincent, the Dominican Republic, and Jamaica. We calculated summary statistics and produced a distance matrix via multi-dimensional scaling in order to explore the affinities between the study populations. An analysis of population differentiation revealed significant differences between the pooled ancient and pooled modern Caribbean samples. However, there was not a significant difference between the modern and ancient Lesser Antillean populations. Our results also indicate an overall increase in haplotype diversity between ancient times and the present. Migration from circum-Caribbean regions may account for this difference in diversity, or possibly that the ancient samples lack the regional representation captured in the modern samples. Our results highlight regional differences in variation between the Greater and Lesser Antilles. These findings support the idea that the genetic diversity present in pre-Columbian Caribbean was disrupted with European colonization and is a testament to the significant biological and social change that occurred in indigenous Caribbean populations.

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Trabecular bone structural variation throughout the lower limb in three human populations

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Trabecular bone may contribute to behavioural interpretations from hominin fossil morphology, but we require a better understanding of the developmental and mechanical influences on trabecular morphology. Our ability to meaningfully interpret variation in trabecular morphology depends on the extent to which trabecular bone properties are integrated throughout the postcranium, or locally variable in response to joint specific loading.

We address both of these factors by comparing trabecular bone across the lower limb between a group of highly mobile foragers and two groups of sedentary agriculturalists. Trabecular structure is quantified in four volumes of interest placed within the proximal and distal joints of the femur and tibia. We determine how trabecular structures correspond to inferred behavioural differences between populations and whether the patterns are consistent throughout the limb.

Relative to the agriculturalists, the more mobile foragers are significantly more robust in all volumes of interest, displaying thicker and more plate-like trabeculae throughout the lower limb. Group differences are highest in the proximal femur and distal tibia and lowest at the knee, suggesting that the proximal femur and distal tibia are most responsive to mechanical loading.

Trabecular structures decrease in bone volume fraction but increase in anisotropy proximodistally. This observation mirrors reductions in cortical bone mass resulting from proximodistal limb tapering. The reduction in strength associated with reduced bone volume fraction may be compensated by the increased anisotropy. Further work is required to determine whether this pattern should be attributed to local differences in loading or developmental constraints on morphology.

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Effects of adaptive Neandertal introgression at the OAS locus on the modern human innate immune response

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It is now clear the ancestry of all individuals living outside of sub-Saharan Africa is composed of roughly two percent Neandertal ancestry. Yet, it remains largely unclear to what extent this contribution from Neandertals impacts modern human biology, and further, to what extent it may have provided adaptive genetic variation to modern human populations.

The immune system is one physiological system that harbors higher than typical amounts of genetic variation in order to provide a flexible set of responses to infection. Here we use coalescent simulation and population genetic approaches to demonstrate a signal of adaptive introgression in the 2'-5' oligoadenylate synthetase (OAS) gene cluster region of chromosome 12. The adaptive region encodes for three active OAS enzymes (OAS1-3) that are involved in the innate immune response to viral infection. In order to evaluate the functional consequences of the adaptive haplotype we infected primary macrophages and peripheral blood mononuclear cells from people with and without the Neandertal haplotype with a panel of viruses and viral-syntetic ligands. Our results show that people with the Neandertal-like haplotype show marked functional differences in the transcriptional regulation of OAS1 and OAS3 in response to virtually all viral agents tested, which illuminate the phenotypic effects of Neandertal haplotypes into the regulation of innate immune responses in modern human populations.

Sleep duration, quality and timing in a non-electric population in Madagascar

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Sleep comprises 36% of the average human lifespan in developed countries, yet little is known about sleep in "traditional" small-scale societies that lack access to electricity. It is widely thought that access to electricity shortens and consolidates sleep durations, with individuals sacrificing sleep for work, entertainment and socializing that can continue past dark via effective lighting. We aimed to characterize sleep in a community without electricity in Madagascar and to examine associations between measures of sleep and age, sex, household size, and occupation. Twenty-three Madagascar residents (10 females, 13males) volunteered to generate actigraphy for up to 21 days per individual (*n* total nights = 329). Sleep onset occurred on average at 19:21 hours, with a high standard deviation (SD=3.38). Awake times were also early compared to developed countries (5:44), and showed less variation (SD=0.53), with individuals spending an average of 9.4 hours in bed. Of these hours, however, only 6.5 involved sleep. Sleep efficiency (70.7%, SD=12.2%), was estimated to be lower and sleep fragmentation (41.6, SD=14.6) higher when compared to Western populations. Wake after sleep onset (2.1 hours, SD=0.9) was more than double typical values in developed countries. Our linear mixed effects model revealed that older individuals slept longer ($\beta = 0.31$, $z = 2.82$, $p = 0.004$), and farmers slept less than non-farmers ($\beta = -0.41$, $z = 3.22$, $p = 0.001$) and had more fragmented sleep. This study supports emerging findings that traditional populations exhibit shorter duration and greater flexibility of sleep expression than those in developed countries.

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Social bonds in adolescent and young adult male chimpanzees at Ngogo, Kibale National Park, Uganda

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Primates form strong social bonds with conspecifics in many species across the Order. These "friendships" are particularly important for adult male chimpanzees, whose bonds with other males influence the acquisition and maintenance of dominance rank and ultimately have significant fitness effects. Despite this, it is unclear when strong social bonds arise. Are friendships forged in adolescence when males begin to interact independently with group mates for the first time? If so, are bonds formed preferentially with maternal kin and age-mates, as is the case in adult males? To answer these questions, I studied 18 male chimpanzees ranging from 12 to 20 years of age at Ngogo, Kibale National Park, Uganda. During hour-long observation sessions of individual males, I recorded social behavior continuously and all males in proximity (within 5 m) of the focal male every 10 minutes. I computed the frequency that each subject was in proximity of another adolescent or adult male. Dyads that spent a disproportionate time in proximity were considered strongly bonded. All but three males, including six of the eight adolescents, formed at least one strong social bond. There was no relationship between age and the number of strong bonds individuals maintained. Three adolescents formed bonds with adults, one with a younger adolescent, and two with both adolescent age-mates and adults. Of those with maternal adolescent or adult brothers, 36% formed bonds with their kin. Although adolescent male chimpanzees are less engaged in the competitive world of adults, these results suggest that they still form friendships.

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Population Dynamics of Ancient Egypt and the Neighboring World: A Craniometric Analysis

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The Ancient Egyptians are often viewed as one distinct historical group; in reality, the population history of Ancient Egypt is very dynamic, with population movement both within Egypt and between Egypt and the Mediterranean world. Morphological features of skeletal remains can be used to examine biological relationships and/or gene flow that may not be discussed in the historical record.

In order to understand the dynamics of the populations of Predynastic and Dynastic Egypt as well as their relationship to populations from Nubia, the Levant, and Greece, a multivariate craniometric analysis was performed using samples from these regions. Archival data of cranial measurements were gathered from several sources. Cluster analysis from Mahalanobis D^2 matrices obtained from Canonical Variates Analysis and Principal Components Analysis were used to explore group affinities. Population continuity was found between the Predynastic and Dynastic Periods, as well as throughout the Dynastic Period, though there were statistically significant differences between Egyptian sub-groups. The relationships between the Egyptian populations reflected distinct patterns based on region, time period, and socio-economic status. Strong relationships were also found between populations from Egypt and populations from Nubia, Palestine, and Greece, suggesting there was migration and gene flow between the four regions.

Development in adolescent girls: physiological, social, and life history factors

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The extended juvenile period in primates is evolutionarily advantageous, as important social development must take place before initiating adult fecundity. Due to a secular trend of age at menarche in humans, transitional stages of social and reproductive development are starting to overlap, creating life history trade-offs between survival and fitness. This puts energetic and social variables somewhat in conflict during human adolescence. We hypothesize that energetic and social factors produce variation in the closeness of adolescent friend social networks. We test these predictions in a sample of adolescent girls participating in an American summer science camp (n=56, 13-17 years old). We conduct one-way ANOVAs to compare the effects of closeness of friend social networks by: Social Model) Epidemiological Studies Depression scale (CES-D), and Parent Adolescent Communication Scale (PACS), and Ethnic Identity Scale (EIS); Physiological Model) gynecological age, age at menarche, and body mass index. Preliminary analysis of the Social Model found that closeness of friend social networks is negatively correlated with

CES-D (r=-.34, p=.009) and non-significantly with EIS(r=-.14, p=.28.) There were no significant associations between any of the Physiological Model variables and the closeness of friend social networks. Social network quality as measured by closeness of friend social networks appears to be more susceptible to social context in this sample. This has life history implications with how social variables influence the typical developmental shift in adolescent social networks from family to friends. Future work will include a more fine-grained analysis of social network variables with physiological and social factors.

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A discriminative model for inferring genome-wide maps of Neandertal and Denisovan ancestry

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Understanding the impact of these ancient admixture events on evolution and phenotypes is a central goal in human population genomics. A major step to this end is to infer the archaic local ancestry of modern human populations. I will present a discriminative statistical model called a Conditional Random Field that can combine multiple lines of evidence to infer archaic local ancestry. We have applied the CRF to infer both Neanderthal and Denisovan ancestries in the diverse set of human populations sequenced to high-coverage in the Simons Genome Diversity Project (SGDP) that diverse set of modern human populations.

Our statistical method identifies around 38,000 Neanderthal-derived alleles and around 25,000 Denisovan-derived alleles. Using the confidently inferred Denisovan ancestries across multiple Melanesian individuals, we can reconstruct about 150 Mb of the genome of the introgressing Denisovan. We observe that the proportion of both Denisovan and Neanderthal local ancestry in Melanesian populations is reduced in regions of the genome with strong background selection. This observation is consistent with a model in which Neanderthal and Denisovan alleles are subject to strong purifying selection in the admixed Melanesian populations analogous to the previous observation of strong purifying selection against Neanderthal alleles in non-Africans. In addition, we document a number of regions with elevated proportions of archaic ancestry which represent putative candidates for adaptive introgression.

Dietary Patterns in Northern Chile during the Transition to Agriculture (Tarapaca Region, 1000 BC–AD 900)

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The Formative Period (1000 BC- AD 900) is characterized by important cultural changes, such as the transition to agriculture and animal domestication, which impacted on ancient South Central Andes societies. It is argued that the transition in northern Chile followed a similar trend to the European Neolithic Revolution, yet dietary habits of Formative Period populations have been mainly studied using indirect methods like archaeobotanical and bioanthropological analysis. This study aims to evaluate the impact of the transition to agriculture on the dietary patterns of the Tarapacá 40 cemetery's population in northern Chile, through stable isotope analysis. Inferential statistical analyses were performed in order to compare Tarapacá 40's carbon and nitrogen isotopic values with other Formative and Late Intermediate Period groups. Results indicate a mixed diet, including terrestrial and marine fauna as well as C_3 and C_4 plants. Furthermore, the results show a relatively modest consumption of maize during the Formative Period contrasting with observations for greater reliance on maize during later periods. We suggest a gradual transition to crop consumption, especially maize, which complemented the earlier hunter-gatherer tradition of marine resources and wild fruit consumption. The results differ to the classical perspective of a "Neolithic Revolution" in northern Chile which states that the transition to agriculture occurred more abruptly and linearly.

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Rethinking chimpanzee tool use: Niche construction and developmental bias in maintaining technological traditions among African apes

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Understanding the differences in technological skills among hominids has proven a formidable challenge for biological anthropologists. Examining the environment as a background condition for the vast degree of behavioral diversity observed within the clade of African apes has proven insufficient in explaining some of the most interesting and salient differences among our closest living relatives. In this study, we employed the extended evolutionary framework to examine the relationship between great apes and their environments and also the potential role of developmental bias. Using ten years of field observations of ape ranging and feeding behavior, we compared resource selection and habitat use among sympatric chimpanzees (*Pan troglodytes troglodytes*) and western lowland gorillas (*Gorilla gorilla gorilla*) in the Goualougo Triangle of northern Republic of Congo. Combined with botanical surveys of their home ranges, our results showed that apes modify their environments in ways that systematically influence selection pressures acting on current populations and their descendants. This comparative approach provides a means of identifying the "ecological legacies" that each ape species bequests future generations and which may facilitate scaffolding of technological skill acquisition. We also compared potential developmental biases among these apes to determine if some kinds of variation were more common than others and possibly play a role in driving evolutionary change. Reconsidering the influence of environment and forces generating behavioral variation provides a fresh perspective on a long-standing debate about factors influencing the emergence and maintenance of material culture among apes.

Early Life Social Influences on Men's Testosterone & Parenting Behavior

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When viewed across species, high rates of extrinsic mortality appear to select for faster life histories. There is interest in applying this principle to within-species variation in life history pace and reproductive strategy, based on the notion that developing organisms should be adaptively attuned to environmental cues that correlate with high extrinsic mortality. Meanwhile, a growing number of animal models suggest that early life conditions help shape later behavior via developmental effects on neuroendocrine pathways. Among humans, allomaternal investments may have such effects on developing children. Accordingly, early life experiences of paternal care and cues of extrinsic mortality are possible factors influencing social-reproductive behavior and physiology in adulthood. Drawing on a large, ongoing study in Metro Cebu, Philippines, we test whether early life social experiences (sibling death and paternal instability) predict later life testosterone changes during life history transitions (n=159) and parenting behavior (n=408). Compared to males whose siblings did not die, men who experienced the death of a sibling showed a trend towards greater morning testosterone

declines when they became newly partnered new fathers (p=0.06) and were more likely to be involved fathers (p=0.04). Fathers' testosterone changes and parenting did not otherwise differ based on early life social experiences. Thus, we find modest evidence supporting the notion that the early life social stressor of sibling death predicts paternal behavior and testosterone in adulthood; however, these preliminary findings run counter to theoretical predictions that extrinsic mortality cues should be linked to "faster" life histories.

Chimpanzee memory for complex events

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Some workers suggest that the key to human cognitive uniqueness lies in episodic memory, often defined as conscious, self-aware memory involving a subjective sense of time. Whatever the merits of this definition, little work to date has examined nonhuman primate memory with the type of difficult, trial-unique problems generally presented to humans. We investigated memory for complex events with three chimpanzees (*Pan troglodytes*), two of them lexigram (symbol) proficient, at the Language Research Center. While the apes observed, various foods were hidden in unique locations in a wooded test area. On any given trial, the hidden items varied by type, distance from chimpanzee, quantity, and/or perishability over time. In certain variations, some items decreased in value over time, or increased in value over time; in another, a subset of the foods increased in value while another subset simultaneously decreased in value. The chimpanzees were allowed to recover the items after delays ranging from 5 minutes to greater than 24 hours, with lexigram readings, where applicable, being recorded before each individual recovery. It was found that the chimpanzees could weigh multiple variables concurrently, including, in some cases, information about time elapsed since cue-giving, to approximate an optimal recovery sequence. In addition, lexigrams touched matched, with high accuracy, the individual items subsequently recovered. Chimpanzee performance is compared and contrasted with humans and other nonhuman animals.

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Group coordination and the distribution of leadership in tufted capuchin monkeys: implications from a natural removal experiment

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Although consensus decision-making regarding collective movements requires that group members conform to the decision, individuals do not necessarily contribute equally to the decision-making process. Here we examine the process underlying post-departure coordination of group movements among Argentine tufted capuchin monkeys (*Sapajus nigritus*) by comparing changes in the patterns of group movement associated with male immigration and mortality. We conducted all-day follows of two social groups, recording the spatial location of the group's center of mass at 15-minute intervals and conducting instantaneous focal animal sampling to identify individual differences in within-group spatial position. Although dominant males generally occupied a central spatial position and did not lead group progressions, following the death of the dominant male, group movements became more erratic as directed forward movement decreased, and backtracking increased. In contrast, despite multiple changes in the identity and number of adult and subadult males within the second social group, similar interannual differences in the directness of travel were not apparent. Nevertheless, in spite of the increased frequency of short-term changes in the direction of group movement, the absence of the dominant male had no apparent effect on the number of long-distance, goal-directed travel segments per day. These differences in the impact of a stable male dominance hierarchy on group movements depending on the scale of analysis suggest: 1) selective mimitism of travel decisions by dominant males has a pronounced effect on the coordination of short-term group movements and 2) group coordination in landscape-scale space is governed by a separate mechanism.

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Have You Seen a Pet Lemur? Using Online Surveys for Data Collection

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It is difficult to assess the magnitude of pet lemur ownership in Madagascar. The current study used an online survey to collect data on pet lemur sightings from the public to determine the extent of pet lemur ownership. Based on prior research in northern Madagascar, we predicted that pet lemur ownership would be reported throughout Madagascar and that *Lemur catta* would be the most commonly reported pet. As of September 15, 2015, our website received 317 responses reporting over 685 sightings of pet lemurs. Our results accord with those of the previous study. The most common lemurs seen as pets were *Lemur catta*, *Varecia variagata*, and *Eulemur fulvus*. Pet lemurs were geographically widespread reported in 19 of Madagascar's 22 regions. Prior research in northern Madagascar estimated that over 28,000 lemurs were kept as pets between 2010 and 2013. Results of the current study found that the region with the highest number of pet lemurs (Atsimo-Andrefana) was in southern Madagascar suggesting the estimate of 28,000 pet lemurs should be revisited. Online surveys have several advantages over direct sampling through face-to-face interviews: 1) research costs are significantly lower; 2) anonymity may yield better responses to questions about illegal activities like owning a lemur; and 3) broader geographic areas can be surveyed. Additionally, this result identifies the region of Madagascar where further on-the-ground research into pet lemurs is most needed. The results of this study identify the potential of online surveys in collecting data on pet ownership.

Life History Variation in Strepsirrhine Primates from the Duke Lemur Center

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Much of the variation within mammalian life histories can be explained by body size and phylogeny. Allometric scaling of life history traits with life history related variables (LHRVs) is a fundamental technique for distinguishing traits that arise as a consequence of body mass (first-order trait) from traits that may vary between populations and environments (second-order traits). In this study, 6 life history traits from 26 captive strepsirrhine taxa at the Duke Lemur Center were analyzed to summarize the data and current understandings of life history variation in strepsirrhine primates through means of principal components analysis (PCA). This technique allows for the examination of uncorrelated variables (minor components) after eliminating body size as the confounding factor. Results show that 90.78% of the variation in 6 life history traits and 2 indices for maternal reproductive investment are accounted for in the first 3 principal components. PC1 is shown to represent a general size variable; high scores in this component are characteristic of large species with high neonatal weights. PC2 is primarily a developmental variable; high scores on this component are shown in genera with slow developmental rates such long gestation lengths and small litter sizes. PC3 is primarily a maternal investment variable; high scores on this component are shown in genera with lower amounts of maternal investment. Overall, this

analysis shows the interspecific variation of life history traits within strepsirrhine primates and as well as a technique to distinguish first and second order life history traits.

Additional IGG haplotype data supporting two founding populations of Native Americans

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Immunoglobulin heavy chain (IGG) haplotypes are ancestry informative markers. In 1980 only two human populations could not be differentiated: Central Australian Aborigines and South American Indians.[1.] Using IGG haplotypes it was postulated in 1992 that there had to have been two founding Native American populations.[2.] Recently Scoglund et al, using a large battery of SNPs produced evidence to support this observation.[3.] We present additional IGG haplotype data on untested South American Indians from Brazil, Chile and Argentina supporting the two founding population model.

IGG haplotype data was generated on 502 samples from 4 populations in Brazil, 6 in Argentina and 1 from Chile. The previous pattern of two distinct founders differentiated by the presence of the Northeast Asian *IGH*AT* haplotype was confirmed.

Copying error, artifactual mutation, and phylogenetic signal in cultural evolution: Experimental approaches to "model artifacts"

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Biological models are increasingly being used to study cultural evolution in a Darwinian framework. Model organisms have played a crucial role within experimental biology to understand the role of fundamental processes, such as mutation and the inheritance of variation. There has been little equivalent work to understand such crucial factors in cultural evolution. Here, we adopt a "model artifact" approach to experimentally study the issues of copy error (mutation) and phylogenetic signal in cultural evolution. We used morphometric procedures to examine shape copying error rates in our "model artifacts." We first established experimentally that statistically different rates of copying error (mutation) could be induced when participants used two different types of shaping tool to produce copies of foam "handaxes." Using this as a baseline, we then tested whether these differing mutation rates lead to differing phylogenetic signal in two separate experimental transmission chains (lineages), involving participants copying the previous participant's artifact. We predicted that higher mutation rates would lead to lower phylogenetic signal compared to situations where artifactual copying error rates are statistically lower. Maximum parsimony (cladistic) analysis demonstrated that phylogenetic reconstruction is significantly more accurate in artifactual lineages where copying error is demonstrably lower. Such results demonstrate how fidelity of transmission will impact on the "evolvability" of technological traditions. These results thus have important implications for cumulative technological evolution within the hominin lineage, and demonstrate the importance of a "model artifact" approach in discussions of cultural evolution, equivalent in importance to the use of model organisms in evolutionary biology.

Model-Based Facial Soft Tissue Estimation From Dry Skull

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Facial reconstruction from dry bone is an important task in Forensic Anthropology. It is, in most cases, still accomplished by expert practitioners who are applying a variety of 2D and 3D reconstruction methods. Within the last decade, attempts have been made to deploy statistical models for incorporating prior knowledge in a semi-automated process. In most cases, the set-up consists of a model containing a combination of both soft- and hard-tissue data. Unfortunately, these are data which are hard to obtain (irradiation during CT-scanning) and/or flawed by the position during data-acquisition (soft-tissue deformation caused by horizontal positioning).

We propose a semi-automatic approach for the estimation of facial soft tissue by constraining and conditioning a statistical shape model (SSM) of the human face to soft tissue thickness values obtained from published sources, nasal shape prediction (from a region specific SSM containing hard- and soft tissue) and factors such as gender, age and BMI. The result is not simply a surface but, again, a shape model representing a space of valid faces. In contrast to existing methods, we combine knowledge from different sources, increasing the incorporated prior information: 181 3D-surface scans, shape information on hard- and soft-tissue data from clinical CT-scans and tissue depths from a published database.

Our approach provides an easy-to-use workflow for creating statistically valid faces from the underlying bone tissue. It can be assumed that the reconstruction of the human face can be further improved by larger databases and by implementing more SSMs of facial subregions.

Dietary Nuances of Late Prehistoric Agriculturists Determined Via Dental Microwear Texture Analysis

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Dental microwear texture analysis (DMTA) is a means for elucidating ancient diets; it uses a white light confocal profiler to examine, most often, phase II wear facets on molar occlusal surfaces. It is employed here to address the diet of the Ray site, a roughly 600-year-old Mississippian mortuary from southern Indiana known for its stone box graves (MNI = 57). Archaeological evidence and dental pathology point to a diet based on maize. Ten adults had teeth suitable for DMTA. They were compared to Middle Mississippian (n = 12), Middle Woodland (n = 19), and Middle/Late Archaic (n = 32) people from Indiana and Kentucky. Molars were molded and replicated following standard techniques. Magnification was 100X; the area studied was 242x181µm. Resulting data clouds were leveled (least squares algorithm) and manually cleaned. Three variables, complexity (Asfc), anisotropy (epLsar), and textural fill volume were calculated using scale-sensitive fractal analysis software (Sfrax® and Toothfrax®). Results indicate the Ray site had significantly higher complexity (1.88) than the other Mississippian site (1.05). In fact, the Ray complexity exceeded that of the Middle Woodland, which is known for its hard food consumption. This dietary nuance has been confirmed via DMTA in other late prehistoric groups from Ohio and Illinois. It is clear that in addition to maize, certain late prehistoric populations of the eastern woodlands consumed hard foods like nuts and seeds. Since high complexity values are common among the Ray Site people, it is plausible hard foods were more than a seasonal indulgence.

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Comparative growth and static allometry in the genus *Chlorocebus*

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Characterizing variation in growth across populations is critical to understanding multiple aspects of development in primates, including within-taxon developmental plasticity and the evolution of life history patterns. Growth in wild primates has often been reported and directly compared across larger taxonomic groups and within social groups, but comparisons are rarely investigated across widely dispersed populations of a single taxon. With the Vervet Phenome-Genome Project and the International Vervet Research Consortium, we trapped 936 vervet monkeys of all ages representing three populations (Kenyan *pygerythrus*, South African *pygerythrus*, and *sabaeus* from St. Kitts & Nevis). We gathered 10 different body measurements from each including mass, body breadth and length, segmental limb lengths, and chest circumference. To gain a better understanding of how ontogenetic patterns vary in these populations, we calculated bivariate allometry coefficients, derived using PCA on log-transformed and z-standardized trait values, and compared them to isometric vector coefficients. Within all population samples, around weaning age most traits showed a negative allometric relationship to body length. As each population ages, however, distinct patterns emerge, showing population differences in onset and intensity of growth among traits. In concordance with other analyses on growth in these populations, our results suggest that there exist relative differences in patterns of growth between *Chlorocebus* populations, further suggesting selection for unique developmental pathways in each.

Gorilla limb kinematics and hominoid locomotor diversity: Implications for hominin locomotor evolution

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Hominin postcranial remains often share morphological affinities with Gorilla, yet very little is known about Gorilla locomotor biomechanics. Kinematic data from *Pan* and *Homo* remain the foundation for form-function relationships that are often extended to Gorilla, with the assumption that Pan and Gorilla are mechanically similar. Here we test the hypothesis that forelimb and hind limb kinematics are the same in Pan and Gorilla. Data were collected at the North Carolina Zoological Park. Animals moved freely in large enclosures. Coordinate data were digitized from high-speed video of 4 adult gorillas and 4 adult chimpanzees. Forelimb and hind limb angles were calculated for steady-state quadrupedal walking sequences perpendicular to the camera. Gorilla and *Pan* showed large forelimb protraction angles like most primates but very limited elbow yield (average<5^o) compared to other primates. In *Gorilla* high levels of forelimb medial rotation were also observed. In the hind limb, Gorilla showed slightly less hip protraction, but greater knee extension (average=164^o; max=177^o) and dorsiflexion at touchdown than Pan. Hip and knee extension values (average=114^o and 151^o) were greater at lift-off in Gorilla than Pan. Forelimb kinematics of *Pan* and *Gorilla* differ from other primates, perhaps in association with knuckle-walking, and *Gorilla* shows forelimb rotation not seen elsewhere. Gorilla hind limb kinematics are more similar to modern humans than Pan. These results suggest that biomechanical interpretations of fossil hominin morphology would benefit from the inclusion of mechanical data on *Gorilla* (and not just *Pan*), particularly with regard to the evolution of bipedal locomotion.

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Cease and De-Cyst: Female geladas are more likely than males to fight off cyst-inducing tapeworms

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Life history trade-offs may shape host susceptibility to parasites. However, previous work has struggled to distinguish between individuals that develop *established infections* from those that develop infections and recover; in most natural systems, it is impossible to differentiate a single infection from reinfections. Gelada monkeys (*Theropithecus gelada*) infected with the intramuscular parasite *Taenia serialis* are a particularly good study system because we can track the trajectory of single infections and determine which individuals develop established infections and which recover. Combined with the marked sexual dimorphism of gelada reproductive strategies, this parasite-host dynamic permits the investigation of how life history traits shape immunocompetence. With a urinary antigen ELISA, we described the prevalence of *T. serialis* infections in geladas in the Simien Mountains National Park, Ethiopia, and tested the hypothesis that the high energetic and physiological demands of male reproductive success reduce their ability to resolve *T. serialis* infections. From 2013-2015, we processed 644 urine samples from 144 geladas. Of the 62 individuals that tested positive, 37% developed established infections and 63% eliminated their infections. Eighteen percent had established infections; 56.5% of these exhibited the protuberant cysts associated with *T. serialis* infection, while the 43.5% harbored internal cysts. Importantly, males are significantly more likely to have established infections than resolved infections, as compared to females (z-score= -2.48; p=0.013). Thus, females are better at eliminating initial *T. serialis* infections, while males are more likely to develop established infections. These results support our hypothesis that male reproductive investment is accompanied by a fitness trade-off.

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Lipid metabolism and nutritive factors of the gut microbiota in human foragers

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Lipid metabolism in bacteria is considered an important process both for energy production and cellular growth and maintenance. Lipids are rich in carbon and therefore are a rich sources of energy, which is especially critical to human forager nutrition. Significant focus on microbial metabolism of carbohydrates has earned us much insight to microbe-host mutualism. However, the role of lipid manufacture and processing in microbiota as it relates to host diet and health is by comparison less well understood. Here we contribute a focused analysis of the lipid metabolic profiles from gut microbiome communities in different human foragers, as well as other animals from different dietary niches. Shot-gun metagenomic sequences of the gut microbiome from two forager groups, the Hadza of Tanzania and the Matses from the Peruvian Amazon, were downloaded from public archives and compared to Western individuals from Europe and the US. A manually assembled database of protein families associated with lipid metabolism was used to target correspondent sequences among assembled microbial sequences. This conservative profiling of the lipid metabolic pathways illustrates interesting differences in gene abundance, especially for degradation pathways. This is suggestive of a dietary vector of influence, and we use other animal dietary specialists to make comparative models. Lipid pathways in human forager microbiota cluster more closely with that of herbivores, potentially due to a similar ability of the microbiota to harvest and convert phospholipids from fibrous plants that are

passing into the colon. Importantly, this could supply nutritive fatty acids to the human host.

Brain function and Broca's Cap: A meta-analysis of fMRI studies

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The possibility of tracking the evolution of language using hominin fossil endocasts has long been of great interest. Because important aspects of language production are localized to the left hemisphere - in particular Broca's region - in most modern human brains, and because anatomical asymmetries favoring the left side have been documented for modern humans but not apes, there has been a keen interest in endocranial morphology overlying this region. Qualitative assessment of hominin fossil endocasts by Holloway et al. (2004) suggests a more pronounced Broca's Cap on the left side compared to the right in most specimens. However, Broca's Cap on an endocast overlays a brain region that is somewhat inferior to Broca's Region. This raises the question of whether asymmetry of Broca's Cap on endocasts is actually relevant to language.

The present study assesses the function of the cortex specifically underlying Broca's Cap on the endocranial surface (distinct from Broca's Region) using a meta-analysis of fMRI studies from neurosynth.org (11406 studies in total). A brain activation map summarizing the areas activated in studies for which the word "language" occurs in high frequency clearly includes cortical areas directly underlying Broca's Cap. In addition, 9 of the 13 (69%) of the top function words reported in studies with activation in the left Broca's Cap cortical region specifically refer to aspects of language, compared to only 1 of 6 (33%) for the right. These findings strongly suggest that Broca's Cap asymmetries are likely to be relevant to the evolution of language.

Variation in the $\delta^{18}O$ record of Allia Bay, Kenya hippopotamidae

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The ecological niche exploited by early hominins is assumed to have played an essential role in the origins of our lineage and of bipedalism, a distinguishing characteristic. We focus on one aspect of the paleoenvironment at the early hominin site of Allia Bay, Kenya (3.97±0.03 Ma). This poster highlights variation in the oxygen isotope ratios of fossil faunal tooth enamel ($\delta^{18}O_{en}$) within one single family, the hippopotamidae. We reconstruct seasonal rainfall patterns using a secondary ion mass spectrometer (SIMS) to generate high-resolution $\delta^{18}O_{en}$ values.

The hippopotamidae, whose closest living relatives are the cetaceans, is composed of fossil and extant water-dependent species, such as today's common and pygmy hippopotamus. Similar to extant water-dependent species, we expect the $\delta^{18}O_{en}$ values in the Allia Bay hippopotamidae to track variation in precipitation patterns. The fossil enamel analyzed in this study dates to a fluvial phase of the Omo River within the Turkana Basin of northern Kenya. The river, which originates in the Ethiopian Highlands, provided the most important water source for the fossil fauna at Allia Bay. Intra-tooth variation is only 1.4‰, which indicates relatively little seasonal variation in rainfall amounts during the time of enamel deposition. There is, however, a 7.5‰ difference between individual animals. This large difference might be due to 1) two species of hippopotamidae with different adaptations (e.g., body water from food vs surface water) or 2) a change in the amount and/or pattern of rainfall during the time represented at the site (3.97±0.03 Ma).

Wenner Gren Foundation

Socializing Violence: Interpersonal Violence Recidivism at Abu Fatima (Sudan)

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Recent excavations at Abu Fatima, Sudan, have uncovered a Kerma Period cemetery that was in use from ~2,500-1,500 BCE. During this period the Kushite State, centered at the capital city of Kerma (5km from Abu Fatima), emerged as a major player in Near Eastern politics. A total of nine individuals were excavated during a pilot study (February-March, 2015). Of the seven adults in this sample, six display indicators of interpersonal violence (sharp force trauma, blunt force trauma, broken nasals, broken hands, stab wound to the sternum). Furthermore, four of these individuals have multiple injuries that appear to be at various stages of healing; we can infer that these individuals likely experienced several episodes of interpersonal conflict throughout their lifetimes.

This poster examines the diachronic trends of interpersonal recidivistic violence in this pilot sample. The prevalence of interpersonal violent injury in this small sample is marked and speaks to the possibility of a socially sanctioned form of interpersonal violence. Due to the low sample size, definitive conclusions cannot be made at this time. However, continued excavations (January-March 2016) will elucidate the interesting context of Abu Fatima.

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A preliminary examination of genetic diversity in mantled howler monkeys (*Alouatta palliata)* in a fragmented forest in Costa Rica

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Dispersal from one's natal group reduces inbreeding. Habitat fragmentation may limit primates' dispersal opportunities, however, which has implications for species survival. We examined the influence of fragmentation on genetic diversity in wild mantled howler monkeys (*Alouatta palliata*) at La Suerte, Costa Rica. The La Suerte region has seen increased fragmentation over the past decade as forest has been cleared for fruit plantations. We hypothesized that genetic diversity would be lowest in the forest edges compared to the interior because fragment boundaries restrict dispersal opportunities for edge groups. In summer 2014 we collected 41 fecal samples from the howler population. To examine polymorphism, we isolated DNA from these samples and used primersets to perform PCR amplifications of selected microsatellite loci. We overlaid these data with the locations of sample collections. Our initial results show that genetic diversity is highest at the edges of the forest and lowest in the interior. We also calculated inbreeding coefficients via fixation indices which suggest that this population may be outbred. This suggests that howler monkeys may be dispersing across open areas into neighboring fragments. These results may, however, be an artifact of our limited sample size. We therefore collected additional samples in summer 2015 allowing us to establish a firm baseline to monitor the relationship between changes in the landscape and population structure over time. The results we present here are the initial stage of what we anticipate will become a long-term project examining the influence of habitat fragmentation on dispersal and genetic diversity.

The origin of *Mycobacterium leprae*: A comprehensive meta-analysis of the paleopathological literature

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Leprosy, *Mycobacterium leprae*, is a chronic, controllable infectious disease causing disfiguring skin lesions and nerve damage. Even though leprosy has been nearly eliminated in many parts of the world today, it remains endemic in India, Myanmar, Nepal, Brazil, and a few African countries. In the past, however, leprosy spread globally and was a pervasive, horrifying disease. There is possible skeletal evidence of leprosy in Rajasthan, India from

2000 BCE, suggesting it originated there and spread on a larger scale, but leprosy's dissemination remains uncertain.

Presently, numerous scientific articles exist on the paleopathology of leprosy, but no meta-analysis of leprosy has ever been done. In this paper, I present a meta-analysis of the transmission and prevalence of leprosy, which is important for tracing the pathways of the disease and for understanding why the formerly ubiquitous disease died out in most of the Western world over 200 years ago. First, I performed a comprehensive search on previously published literature to identify archaeological sites where leprosy was reported. These were geographically and temporally grouped together to trace the disease's effect in the varying populations over time. Second, I tested the null hypothesis that the frequency of bone lesions due to leprosy did not change through time. Preliminary results suggest that the frequency of bone lesions did change over change, contrary to the null hypothesis.

This project is the first meta-analysis examining leprosy's global transmission in the archaeological record and provides evidence for how bone lesion frequency changed across time and space.

Subadult Age-at-Death and Mortuary Practice during the Neolithic Transition at Niah Cave, Sarawak, Malaysia

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Childhood mortality is not random. It is patterned and connected to underlying biocultural factors. This study examines age-at-death, health status, and mortuary treatment of subadult skeletal remains (n=43) from the Neolithic cemetery of Niah Cave, Sarawak, Malaysia. Niah Cave is the largest known Southeast Asian Neolithic cemetery, providing valuable information about subadult health during the Neolithic Transition. Very few cases of porotic hyperostosis (4.7%) and cribera orbitalia (11.6%) were found. There was a high number of subadults with periosteal reactions (65.1%) indicating that infection was the biggest risk factor in subadult death. Of these, 50% of subadults with periosteal reactions were between the ages of 1.5 and 6, with 64.3% of these between the ages of 1.5-3 years old. This follows weaning stress and infection patterns associated with the Neolithic transition to sedentary agriculture and pastoralism. A pot sherd found at the site contained a rice grain, suggesting that there may have been trade for agricultural goods in this area. Domesticated pig remains were also found at the site indicating that they were experimenting with pastoralism. While Niah Cave may not have been practicing agriculture, they were transitioning into a sedentary lifestyle with pig pastoralism and trading for rice and this may have placed the children between the ages of 1.5-6 at risk for infection and early death.

Sociodemographic and lifestyle factors associated with lung function in five countries

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Peak expiratory flow (PEF), a measure of lung function, has emerged as a strong predictor of mortality among older adults. However, few studies have examined factors associated with PEF in economically developing countries. In the present study, we use binomial logistic regression models to investigate associations between various sociodemographic and health variables and low PEF (lowest quartile) in a sample of older adults (50+) in five low-to-middle income countries drawn from Wave 1 of the Study on AGEing and adult health (SAGE) (n=20,954). Being in the highest versus lowest wealth quintile [Odds ratio (OR)=0.89, P=0.049], as well as having high school or greater versus no formal education (OR=0.73, P<0.001), were associated with lower odds of low PEF. However, these associations were attenuated after adjusting for demographic and lifestyle variables. In the main effects model, never having smoked versus being a current smoker (OR=0.86, P=0.002), as well as being female (OR=0.84, P<0.001), were associated with lower odds of low PEF. In addition, the odds of low PEF increased with age (OR=1.01, P<0.001). A groupwise test revealed a significant overall effect of country residence on lung function (ChiSq=1093.8, df=4, P<0.001). The proportion of those with low PEF was greatest in South Africa (49.4%), followed by India (24.0%), Mexico (23.1%), Russia (13.8%), and Ghana (12.0%). These results highlight the need for further research to identify the specific factors driving poor lung function in each nation. Furthermore, they offer insight into factors that may drive differential mortality rates in economically developing countries.

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Skull diversity within the *Homo* lineage and the relative position of *Homo naledi*

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The discovery of *Homo naledi* has expanded the range of morphological variation observed within our genus, and has led to new questions surrounding the mosaic nature of morphological evolution. Though the geological dates of this species are currently unknown, its unique morphological pattern (small brain, derived skull features) and possible phylogenetic connections with other hominin taxa suggest a potentially complex evolutionary scenario. Here, we perform a series of multivariate and 3D geometric morphometric analyses on cranial and mandibular remains of *Homo naledi* to investigate the morphological patterning/relationships between *Homo naledi* and several species of *Homo* and *Australopithecus*. We also explore the potential evolutionary processes acting to differentiate this species, applying statistical tests developed from quantitative genetics theory to evaluate whether genetic drift versus selection is responsible for the observed pattern of variation. Morphometric results indicate that, for the cranium, *Homo naledi* is most similar to other members of the genus *Homo,* with closest affiliations to *Homo erectus* specimens. In contrast, results for the mandible are less clear; *Homo naledi* closely associates with a number of taxa, including some australopiths, depending on the analysis. The quantitative genetic tests reveal that for all cases the cranial/mandibular phenotypic diversity seen among *Homo naledi* and other hominin groups is consistent with drift. Taken together, these results support the notion that it is the combination of features (*erectus*-like cranium; less derived mandible) that makes *Homo naledi* unique, and suggests that drift, and possibly small population sizes, were important factors influencing the evolution of this species.

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Genetic History of the Major Tribes of Pakistan

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In this collaborative project, we conducted a detailed genetic and ethnographic study of tribal populations from the Buner and Swabi areas of Khyber Pakhtunkhwa Province (KPP) of Pakistan. We worked with five KPP tribes (Yousafzai, Gujars, Syeds, Jadoon and Tanoli) to elucidate their origins and affinities with other tribes of the Indian subcontinent, as well as populations from Europe, the Near East and Central Asia. All individuals from these groups were analyzed for mtDNA and Y-chromosome diversity through sequencing and genotyping methods. An understanding of their maternal and paternal lineages, viewed through a phylogeographic perspective, allowed us to reconstruct the movements of human groups into and out of this region for the past 60,000-70,000 years, as well as begin to elucidate the histories of the ethnic groups themselves. The results of this work also allowed us to explore the relationship between genetic and ethnolinguistic diversity in contemporary villages from this region.

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Socio-ecological determinants of differential childhood morbidity in post-medieval London

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Bioarchaeological studies frequently report on childhood disease frequencies to assess population health in general. Equally frequently, however, such studies exclude biological sex of the sub-adult individuals, despite confirmation of suitable methods for the assessment of sub-adult sex from skeletal indicators. This renders the interpretation of sub-adult morbidity incomplete and foregoes the detection of important differentials in disease load and eventual survival, known to be linked to both genetic (X-chromosome related female buffering) and environmental (prevailing socio-ecological conditions) factors.

A total of 480 sub-adult individuals from four cemetery populations of ascribed higher and lower socio-economic status (SES) in London, dating to the 18th-19th century, were examined to ascertain patterns of sex-differential morbidity across the early life course. Conditions assessed included non-specific stress indicators and metabolic diseases. Boys displayed higher frequencies and more severe lesions of cribra orbitalia, but more active lesions were seen in girls. Similarly, linear enamel hypoplasia had higher rates in boys overall; however, girls affected presented more and more severe defects. Conversely, girls generally showed higher frequencies of endocranial lesions and periosteal reactions than boys. Evidence of rickets was slightly higher in girls, who also had more active lesions than boys. Scurvy, again, was more frequent in girls overall. No general difference in gender-related morbidity was seen for SES.

This overall pattern of girls being more affected by childhood diseases mirrors mortality trends at those ages, where these conditions prevail. This suggests non-random resource allocation and parental investment, irrespective of living conditions, during the heydays of industrialisation.

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Sex, age, and reproduction: tooth loss among the Tsimané in lowland Bolivia

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There is well-documented disparity in rates of tooth loss among the sexes, with women having a higher rate of tooth loss than males.

These studies have focused on modern populations that engage in behaviors that mitigate tooth loss through the active maintenance of oral hygiene, regular access to modern dentistry, and low fertility, likely masking sex-based disparities in oral health. Specifically, we hypothesize that sex differences in tooth loss will exacerbated by high fertility in populations that do not engage in tooth-loss mitigating behaviors.

To test this hypothesis we surveyed the oral health and parity of Tsimané (N=848, 486 females, 362 males, ages 15-49) in the Amazon river Basin of Bolivia. The Tsimané have a high fertility (total average fertility = 9) and no access to modern dentistry.

Multiple regression analysis of missing teeth on age, sex, and their interaction showed that females lose significantly more teeth per year than males ($p<.0001$) at a rate of about .24 more teeth per year than males ($b = -.24$, $p<.0001$). The results are striking, at the ages of 15-19 the mean difference in tooth loss between males and females is .24, by the ages of 40-44, females have lost 9.4 more teeth than their male counterparts. A second regression, restricted to women, of tooth loss on parity, controlling for age, revealed women lose about 0.3 teeth for each additional birth ($p<.03$), possibly implying that parity accounts for the sex difference. These results suggest that high fertility increases sex differences in oral health.

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rASUDAS: A New Method for Estimating Ancestry from Tooth Crown and Root Morphology

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Based on crown and root trait frequencies reported in *The Anthropology of Modern Human Teeth*, an application was developed that assigns individuals to a geographic subdivision of humankind. All that is required is to take an individual dentition and score traits as present (at or above a given breakpoint), absent, or unobservable. The analysis generates the probability of an individual being assigned to one or more groups. The method was developed in two stages. First, Nei's distance matrix was computed using each crown and root trait, from which a hierarchical clustering tree was created using UPGMA algorithm with *complete* linkage. Based on a visual inspection of the clustering tree, two to seven biogeographic population clusters were defined. Second, probabilistic biogeographic ancestry prediction models were fitted using *naive Bayes* classifier algorithm, a simple yet powerful technique that uses Bayes' theorem as a prediction engine. This algorithm outputs the ancestral group and its associated posterior probability. It is called *naive* because the algorithm assumes total conditional independence between traits, which significantly simplifies the full multivariate predictive density computation. Mathematical conditional independence is a strong assumption, but this conforms to the working assumption that crown and root traits are expressed independently of one another. To simplify and expand the usage of this method, a simple program and web application named rASUDAS was developed. Test runs on 150 data sheets from world populations arrived at correct classifications ranging from 57 to 92 percent, depending on the number of biogeographic groups included in the analysis.

Craniofacial size influences the strength of the molar inhibitory cascade in anthropoid primates

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The inhibitory-cascade model proposes that much of the variation in molar size proportions

among species is a result of modifications to low-level developmental processes governing the relative intensities of mesenchymally derived activator signals and distally directed intertooth inhibitory signals. A very strong inhibitory cascade results in greater inhibition and thus a decrease in size from M1 to M3, whereas a weaker cascade results in less inhibition and relatively larger distal molars. The predictive power of this model has been demonstrated in several mammalian clades, including primates, but the underlying causes of variation in cascade strength are unclear. This study tests the hypothesis that the size of the face is related to the strength of the cascade. Specifically, I predict that cascade strength decreases when facial size increases, especially if such increases are associated with a decrease in M1 size relative to facial size. Morphometric data describing palate length and molar areas (product of mesiodistal and buccolingual dimensions) for 90 anthropoid species were analyzed using phylogenetic generalized least squares. Results are consistent with predictions: molar ratios (M_2/M_1, M_3/M_1) are (1) moderately positively correlated with absolute and body-mass-adjusted palate length, and (2) moderately negatively correlated with palate-length-adjusted M_1 area. In other words, species with large faces and relatively small M_1s tend to have relatively large M_2s and M_3s. These relationships support the idea that modifications to the inhibitory cascade are partially related to changes in facial size, highlighting the importance of tooth-face interactions for understanding phenotypic diversity in the primate masticatory apparatus.

Spatial determinants of mandibular symphyseal morphology in Pleistocene *Homo*

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The mentum osseum has long been considered a marker of anatomical modernity, and its presence has been causally linked to several adaptive explanations including articulate speech production, masticatory biomechanical force dissipation, and sexual selection. Some craniofacial features previously thought to have arisen via adaptive selection have more recently been shown to be related to an overall decrease in facial size and prognathism (*e.g.*, supraorbital torus size). Additionally, recent studies examining *Homo sapiens* have demonstrated an inverse relationship between chin size and facial prognathism, indicating that the size of the chin likely results from differential growth of the maxilla and mandible. The present study extends these analyses to the fossil record, testing whether alveolar prognathism can account for variation in prominence of the mandibular symphyseal region across a sample of adult recent *Homo sapiens* and Middle-Late Pleistocene *Homo*. The prediction that symphyseal prominence is associated with the relative anterior-posterior placement of the maxilla and dentoalveolar complex was tested with 3-D coordinate landmark data. The coordinate data were subjected to principal components analysis of Procrustes shape variables. As predicted, symphyseal prominence was positively associated with the anterior-posterior position of the dentoalveolar complex and maxilla. These findings suggest that the degree of projection of the mandibular symphyseal region in both *Homo sapiens* and Pleistocene *Homo* is related, at least in part, to lower anterior maxillary growth reduction, indicating that the presence of the chin, like the supraorbital torus, is part of the suite of characters related to facial size reduction throughout the Pleistocene.

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Practical reality of taking semi-landmark data on archaeological human remains

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Recent advancements in three-dimensional technology have impacted the field of biological anthropology and the use of geometric morphometrics. Three-dimensional digitizers such as Microscribe serve as excellent tools for collecting landmark and semi-landmark data. However, Microscribe requires direct access to skeletal materials, which is a problem on several levels. For instance, recording semi-landmark data over curved areas of bone can compromise poorly preserved specimens. Additionally, access to archaeological skeletal collections can often be impeded by restrictions mandated by the curation authority. This project explores a best-practices data acquisition method for recording semi-landmark data on fragile archaeological human remains, with a case study centered on Japan.

For this purpose, we chose the curvature of the maxillary alveolar process as well as traditional craniofacial landmarks. Curve data were taken from 3D virtual cranial models from three collections spanning historical and modern population samples from Japan using Stratovan Checkpoint software. For comparison, we collected 3D coordinate data on modern Japanese skulls using a Microscribe digitizer.

Our study incorporates an assessment of the validity of landmark data acquired by Microscribe versus Checkpoint software. However, considering the difficulties of direct collection of curve data, using the Microscribe on actual skulls can present challenges.

We demonstrate the process of acquiring curve data on virtual cranial models by using Checkpoint software, which improves data quality and benefits research by: 1) improving accuracy when identifying landmarks corresponding to maximum width and length; and 2) visualizing curve data allows for the determination of data quality and necessary adjustments.

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Open access to Fayum primate fossils through the digital data archive MorphoSource

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Over the course of the last four decades, regular expeditions to the Fayum Depression of northern Egypt led by Elwyn Simons resulted in the recovery of a large and important sample of early fossil primates that are now held in the collections of the Egyptian Geological Museum and the Duke Lemur Center Division of Fossil Primates. Many of these fossils are iconic and provide critical evidence for understanding the origin and early evolution of the primate clades Anthropoidea and Strepsirrhini, as well as other mammalian clades such as Hyracoidea, Hystricognathi, and Proboscidea. We seek to make the Duke Lemur Center's collection of early fossil primates and other fossil mammals the most accessible in the world, by employing micro-CT scanning to generate high-resolution digital models of all described specimens, each of which will be freely downloadable via the publicly accessible data archive MorphoSource (www.morphosource.com). Any person with internet access will be able to access this virtual museum and download three-dimensional PLY surface files and original micro-CT scan data, and/or manipulate digital models online through MorphoSource's specimen viewer. The initial focus of this project is on the release of digital models of previously published fossils, but newly described Fayum material will also become immediately accessible upon formal publication. The benefits of this project to the scientific community are numerous, including stimulation of research on, and increased interest

in, the Fayum primates — and will ultimately lead to improved public understanding of this phase of our shared evolutionary history with other primates.

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Olecranon and trochlear notch orientation is related to extended limb postures during locomotion

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Most anthropoids have anteriorly facing trochlear notches and proximally directed olecranons, as they utilize crouched postures during arboreal locomotion. African apes have posteriorly oriented olecranons and proximally angled trochlear notches, which have been argued to be suspensory and quadrupedal adaptations, respectively. However, baboons converge on this phenotype, which suggests a possible association with either body size or reliance on extended forelimb locomotor behaviors rather than forelimb suspension. To test the association with size and locomotor mode, we measured olecranon and trochlear notch angles and compared them to olecranon and distal ulna lengths, controlling for body size by use of both a geometric mean of limb joint skeletal dimensions and species body masses, in a broad sample of anthropoids. We found strong correlations between olecranon orientation and trochlear notch angle. Both had relatively strong negative correlations with olecranon size and weaker correlations with ulna length. This relationship appears to be largely driven by larger-bodied hominoids having more posteriorly oriented olecranons and proximally positioned trochlear notches than smaller-bodied monkeys. However, both gibbons and baboons have a more posterior olecranon and proximal trochlear notch relative to monkeys of similar size. The strongest correlations of olecranon and trochlear notch orientations, however, were to body size (both for the geometric mean and body mass). These results suggest that increasingly posterior olecranon orientation and proximal trochlear notch orientation may be associated with increased reliance upon extended forelimb postures, either during suspension or terrestrial quadrupedal locomotion.

A multi-species approach to elucidating the ecological function of primate geophagy

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Soil consumption, or geophagy, has been observed across primate taxa, yet the ecological function of geophagy remains unknown. Geophagy has been largely associated with folivory, though frugivores have been observed consuming soils. Five functional hypotheses have been proposed: 1) antacid relief, 2) plant secondary metabolite (PSM) adsorption, 3) parasite mitigation, 4) diarrhea alleviation, and 5) nutrient supplementation. Sympatric diademed sifakas (*Propithecus diadema*), frugivorous-folivores, and common brown lemurs (*Eulemur fulvus*), frugivores, were studied across the early (EDS; June-August) and late (LDS; October-November) dry seasons near Tsinjoarivo, Madagascar. Both species consumed soils, but *E. fulvus* spent a reduced percentage of feeding time consuming soil during the EDS (0.01%) compared to the LDS (0.13%); consumption remained constant for *P. diadema* (0.12% and 0.15%). Sampled soils (n=4) were comprised largely of sand (43.5-73.7%) while clay fractions were 11.4-42.9%. Sample pH was low (2.8-3.3) and organic matter was high (2.18-3.66% C). *E. fulvus* spent significantly more time consuming leaves during the LDS (P<0.001); consumption by *P. diadema* was stable (69.5-68.0%). Soils were more frequently consumed after high PSM intake. *Propithecus diadema* had significantly lower fecal parasite diversity and egg density than *E. fulvus* (P<0.001). Diarrhea was never observed. Iron was the only mineral found in significantly higher amounts in soil than in plants. We conclude that the consumption of chemically defended plant parts likely drives these two primate species to consume soil. Other factors, such as parasites that were not sampled or mineral supplementation, may also contribute, but to a lesser degree.

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On the correlation between latitude and orbital volume in humans

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This study examines the relationship between orbital dimensions and latitude, a subject that has recently been the topic of several studies related to recent and modern human orbital morphology and brain organization. Specifically, it has been suggested that larger orbital volume is an adaptation to lower light levels associated with a presumed reduction in both the daily amount of and intensity of light in populations located farther away from the equator.

In the current study, we evaluate this hypothesis using orbital volume measurements from a large sample of individuals (N=228) from populations representing seven different latitudes in the northern and southern hemispheres. In addition to orbital volume, we also examine how orbital breadth, height and depth (the three main components of orbital volume) relate to latitude, and specifically if the proposed hypothesis of a linear relationship between latitude and orbital size is supported.

Results demonstrate that a quadratic regression represents the best fit to these data, indicating that internal orbital size, as well as size of the orbital margins, do not increase linearly in associate with increased latitude. Additionally, these results show that, in contrast to previous studies with smaller samples, orbital volume actually decreases in high latitude populations, and that a more anterior position of ectochonchion is associated with deeper, but smaller orbits at high latitude.

Detecting malaria parasites postmortem: experiments, results, and implications

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Identifying malaria in bioarchaeological contexts remains a challenge to researchers studying the coevolution of pathogen and host. In this study, we conducted a controlled experiment to determine if malaria parasites can be detected with microscopy in a postmortem context. Murine models (donated by the Johns Hopkins Malaria Research Institute) infected with *Plasmodium sp.* were dissected ten days after death. Parasites were observed. The methods used to prepare hepatic and osseous tissues, which were embedded in paraffin and examined, using 1000x light microscopy, are presented. The effectiveness of Wright-Giemsa and QBC Fast malaria stains, which are standard stains used in histology to identify malaria parasites, are also compared. Implications for biological anthropologists, in particular bioarchaeologists and forensic anthropologist, are presented, as well as caveats concerning preservation, data collection protocols in the field, and the interpretation of results.

What is a patch? Quantifying resource dispersion in primate studies

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Few concepts are more central to models of primate socioecology than the food patch. Many aspects of primate behavior are thought to be

strongly influenced or even constrained by the distribution and quality of food patches, including group size and cohesiveness, daily path length and home range size, activity patterns, social structure, and patterns of agonistic behavior. Yet defining what constitutes a food patch has proven notoriously difficult in studies of wild primates. The increased availability of powerful and relatively easy to use spatial statistics software in the last decade gives the primatologist an extremely versatile tool kit for measuring patchiness in primate studies. Here I demonstrate several methods for quantifying what constitutes a food patch with an explicitly GIS based approach. Using data from a long term study of bearded saki (*Chiropotes sagulatus*) ranging behavior in Guyana, I identify useful spatial statistics for defining food patches, show how these methods can produce differing results, and suggest which method is most appropriate for which socioecological questions. Measures of bearded saki resource dispersion were generally correlated but did show considerable variation. While DBH alone was significantly correlated with subgroup size and patch occupancy, composite patch definitions that included both a measure of dispersion and a measure of patch size (Moran's I, Getis-Ord Gi*, Patch Quality Index) were better predictors of behavioral variables. The results of this study provide quantitative food patch definitions that allow primatologists to compare how aspects of primate socioecology relate to patch quality and distribution across studies.

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Reconstructing the Population Genetics of Hakkari Mountains: A mtDNA Study of Assyrian Highlanders

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The demographic changes driven by acts of genocide and forced displacement are massive and often irreversible. Subsequently, the indigenous population structure may be lost, making it impossible to study the population genetics of the impacted region. In the mountainous region of Hakkari in southeastern Anatolia, the atrocities of the early 20th century altered the ancient population structure consisted of roughly equal numbers of Assyrian and Kurdish settlements. By 1924 the Hakkari Mountains were completely depopulated of Assyrians. That is while pre-genocide Assyrian population of the Hakkari is believed to have exceeded 150,000 individuals who settled 280 historical villages. This study aimed to reconstruct the population genetics of the Hakkari settlements through sampling the descendants of the Hakkari Assyrians in diaspora. 70 individuals included in this study could trace back their maternal ancestries to 21 major Assyrian settlements prior to the genocide. The patterns of mtDNA lineages found among major Hakkari Assyrian tribes are similar to other populations of the region, yet these patterns are distinct; in accordance with previous findings for Assyrian populations of Iran and Iraq, the mtDNA lineages of Hakkari Assyrians are all of West Eurasian origins with a strikingly high frequency of haplogroup K lineages. In comparison with other Assyrians, highlanders of Hakkari are distinctive due to significantly higher frequencies of J1b and R0a2, and a decreased frequency of U lineages. While our results provide first insight into Hakkari's population genetics, better understanding of this region's population structure is due to study of Kurdish tribes of Hakkari.

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Characterizing the trabecular bone of the primate ischium and its relationship to locomotion in *Rudapithecus hungaricus*

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Trabecular bone responds to mechanical loading by remodeling to better resist stress, allowing for the reconstruction of the loading history of a skeletal element. Studies have suggested a relationship exists between loading regime and specific trabecular variables (bone volume fraction and degree of anisotropy) related to bone's mechanical properties, however studies of pelvic trabecular bone are rare, despite the pelvis' role in locomotion.

We analyzed the ischial trabecular bone of five primates (*Papio, Symphalangus, Pan, Pongo, Macaca*) with different locomotor regimes to determine whether the ischium contains a distinctive locomotor signature. Following that, we compared the trabecular architecture of *Rudapithecus hungaricus* (a late Miocene hominine from Hungary) with living primates to reconstruct its locomotor habits. The ischium was chosen because it is suspected of being differentially subjected to bending and/or torsion by the hamstrings, depending on locomotor mode.

HRXCT scans were analyzed using ImageJ and Quant3D, with scaled, spherical VOIs placed in the anterior, central, and posterior portions of the ischia from approximately the inferior-most point on the acetabular rim to the end of the ischial tuberosity. We found wide variation in BV/TV and DA in both antero-posterior and supero-inferior directions. *Papio* had the greatest range in BV/TV (0.12971-0.557578), while *Macaca* had the greatest range in DA (2.10746-13.2764). All taxa (including *Rudapithecus*) tended toward having their lowest BV/TV and DA in the anterior VOIs, and their highest in the posterior ones. This suggests that primate ischia are reinforced against bending, via increased bone volume and anisotropy in the posterior ischium.

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Tail kinematics during asymmetrical gaits in mouse lemurs (*Microcebus murinus*)

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Mouse lemurs, like other small mammals, often rely on asymmetrical gaits such as galloping or bounding during arboreal quadrupedalism. Asymmetrical gaits are associated with relatively fast speeds, and may disrupt stability - especially on narrow or non-horizontal substrates. Our previous lab-based research demonstrated that mouse lemurs adjust asymmetrical gait limb kinematics to ensure stability across changes in substrate size and orientation. In this study, we predicted that mouse lemurs would also use their long tails (128% of head+trunk length) to promote dynamic stability during asymmetrical gaits, as has been recently shown for primates using symmetrical gaits. 3D angular kinematics (amplitude, velocity and acceleration of pitch, roll and yaw angles) of the tail were quantified for five mouse lemurs (n=97 strides) moving across horizontal, 30° inclining and declining poles of 2.5, 1.0 and 0.5cm diameter, and on a 10cm wide flat board. As predicted, angular rotations of the tail increased as substrate diameter decreased, primarily via significant modulations in pitch and yaw angles. The effects of substrate orientation on tail kinematics were mainly non-significant, with the exception of significantly higher roll angle amplitude on inclines compared to declines. These results suggest that the dynamic stability provided by tail movements allows primates to take advantage of small diameter substrates even at fast speed, and that long tails would have provided an adaptive advantage to small-bodied ancestral primates. The functional contribution of the tail to arboreal locomotion highlights the need for increased attention to tails in future biomechanical studies of primate locomotion.

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Scapula morphology variation at Point Hope, Alaska

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Excavations at Point Hope, Alaska revealed burials of two recognized cultures, the Ipiutak (2100-500 BP) and Tigara (800-300 BP). Based on material culture, the Ipiutak had more varied subsistence in hunting terrestrial and marine mammals over large areas, while the Tigara were more sedentary and relied on large marine mammals with a heavy emphasis on small boats powered with paddles, and harpoon hunting. This specialized behavior may be reflected skeletally, and particularly in the shoulder girdle.

This project investigates shoulder morphology and infers function using 29 homologous 3D landmarks on the scapula. The scapula is a particularly plastic bone that responds to behavior. The sample consists of Ipiutak, Tigara, and two distinct out groups: archaeological agriculturalist Native Americans from Canyon del Muerto, Arizona (400-1300 CE) and modern New Yorkers. Data were subjected to Generalized Procrustes Analysis and analyzed using multivariate techniques.

Results indicate clear separation between modern New Yorkers and the entire Native American sample, and between the Ipiutak, Tigara, and Canyon del Muerto samples. While the Native American scapulae are generally more robust, we hypothesize that differing demands from activity patterns shape scapula morphology epigenetically. Compared to the Ipiutak, the Tigara have a relatively larger attachment area for the infraspinatus muscle, which is significant in shoulder extension and lateral rotation, as well as a number of other functionally relevant shape differences. These results are discussed within the broader context of different activity patterns such as paddling, spear throwing, and harpooning in the Tigara and Ipiutak.

New insights into *Alouatta* vocal tract anatomy and functional morphology via CT and MRI

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The howler monkey (Primates: *Alouatta*) has one of the most highly derived hyolaryngeal morphologies of any living taxon, which includes a bulbous, pneumatized hyoid bone hypothesized to act as a resonating chamber for its distinctive vocalizations and highly modified laryngeal cartilages. With this unique anatomy, howlers can produce one of the loudest calls of any land animal: a low pitched but high volume howl that can reach 140 decibels and be heard from five kilometers away. However, the anatomical mechanisms of this phonation are not well understood. Previous research has left many questions unanswered regarding the functional morphology of the hyolaryngeal complex and the derived extra laryngeal structures found in this taxon. Here we present an ongoing anatomical study of *Alouatta* in which we use computed tomography (CT) and magnetic resonance imaging (MRI) to investigate the functional morphology of howler monkey vocal tract in comparison to other anthropoid taxa. In our three-dimensional reassessment of the hyolaryngeal complex in four adult howlers and four specimens of outgroup taxa, we identify soft-and hard-tissue autapomorphies in howlers, provide additional clarity to locations and functions of extra-laryngeal structures, and corroborate some early hypotheses on function. We additionally propose a mechanism for the path of airflow through the vocal tract and extra-laryngeal air sacs that we suggest may potentially facilitate re-breathing, thereby allowing *Alouatta* to regulate the volume of its calls while maintaining a consistent frequency over an extended duration.

"What beautiful days we lived in the past": Untangling the conundrum of increased perception of mortality and morbidity risk in rural Bangladesh

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In rural Bangladesh a large majority of local people believe that mortality (and sometimes morbidity) rates are rising in their communities despite well-documented evidence that mortality rates have decreased by over 70% in the last few decades. In this paper we draw on detailed data from 944 surveys and 52 semi-structured qualitative interviews to explore (a) the potential causes of this contrast between perception and reality, focusing on individual, family-level, and community-level predictors of risk perception, and (b) the consequences of such perceptions for family health, child education, and the family's use of healthcare.

Some authors have argued that such perceptions are a result of increased longevity and the epidemiological transition in which infectious disease mortality is replaced by long-term morbidity and mortality due to chronic diseases, while other scholars have argued that the phenomenon is instead related to a shifting worldview brought about by market integration. We examine and compare the evidence for these hypotheses, additionally examining the utility of the concepts of intrinsic vs. extrinsic risk by exploring whether individual, family, or community-level factors that render particular types of risk more controllable reduce risk perception and/or improve health, parental investment, or the use of healthcare.

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Simplified access to human genomic evidence for clinical variants with new NCBI services

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NCBI provides resources for evaluating and declaring evidence of pathogenicity for an increasing number of human sequence variants. Primary details about a genetic test's analytical validity and clinical utility are reported in the Genetic Test Repository, and evidence for inferences of variant pathogenicity are summarized in ClinVar. NCBI database services link these these phenotypic and clinical records with nucleotide variant assay and population-level frequency data in dbSNP and dbVar, with individual research participant-level observations: called genotypes (the NCBI Genotype Server), phenotypes (dbGaP), whole genome/exome sequences (SRA), and finally with positions on the reference genome (GRC human reference assemblies).

Traversing the connections between variant-level records, e.g. GTR, ClinVar and dbSNP, and individual-level data (e.g. genotypes, sequnces, samples, and phenotypes) is a computationally intensive activity, and NCBI has developed several new services to pre-compute these relationships and permit users to quickly move from summary records to individual level data. This presentation will introduce several of these services including *Variation Reporter*, *Variation Viewer*, *Beacon Search*, and the *Genome Browser* with particular emphasis on how users can access and review individual level data for clinical variants or *ad hoc* genomic positions of particular interest.

Examples of use include the review of ClinVar records by expert panels, research into the existence of specific sequence alleles, automatic notification when new data for specific potential alleles of interest are submitted to NCBI, confirmation of variant properties during manuscript review, and research in general questions of human genetic architecture.

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The heritability and plasticity of chimpanzee and human brain asymmetry

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Human brains show a strong degree of micro and macrostructural asymmetry that is related to marked functional lateralization. Previous studies have revealed that chimpanzees also show similar patterns of asymmetry, although to a lesser degree. We use classic and geometric morphometrics, as well as quantitative genetics, to explore the genetic bases of chimpanzee and human cortical asymmetry, differentiating between directional asymmetry (consistent asymmetric variations across all individuals in a population) and fluctuating asymmetry (non-directional departures from the average directional asymmetry), which may be indicative of neural plasticity. We found that general lobar asymmetries and consistent patterns of directional asymmetry have significant heritability in both species, which points to their genetic origin. However, sulcal asymmetries in humans and, more generally, non-directional asymmetric variation in both species, appear to be more influenced by environmental factors, as demonstrated by low genetic correlations between left and right sulci in humans and by non-significant heritabilities for non-directional patterns of asymmetric variation. Our results, however, reveal a genetic basis for the degree of fluctuating asymmetry or, in other words, for the tendency to have a brain that is more heavily influenced by environmental factors. These results show that fluctuating asymmetry —and also plasticity if the latter is indeed indicative of the former— is heritable and, therefore, evolvable, thus underscoring the importance of gene-environment interactions in human brain evolution.

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The Jiri Dental Study: Uncovering Genetic Influences on Orofacial Morphology

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Genetic influence on traits of the craniofacial complex is central to interpretations of living populations and fossilized ancestral forms. The Jiri Dental Study, established in 2009 in eastern Nepal, investigates fundamental aspects of orofacial morphology and its genetic architecture through the most powerful documented human pedigree currently available for study anywhere in the world.

The Jirel population and inherent family structure has revealed new areas of the human genome to be associated with variation in orofacial traits including palatal dimensions. Because disorders of the craniofacial complex are among the most common congenital defects, traditional studies of these disorders are necessarily confounded by a high level of genetic heterogeneity with single gene defects producing a variety of dysmorphisms or, conversely, by a variety of gene defects independently producing a similar phenotype. The identification of the underlying *normal* phenotypic variation, and its genetic basis, is critical to understanding the epidemiology of craniofacial anomalies.

Multiple measures of the upper and lower dental arcades were examined in 993 healthy participants in the Jiri Dental Study. Estimates of heritability and multipoint LOD scores were obtained through variance components-based linkage analysis method (SOLAR). All traits were significantly heritable (h^2: 0.30 to 0.56). An unambiguous significant linkage to chromosome 19p13.12 (LOD = 3.15) was found for palate length, an area previously been implicated in cases of branchial arch defects and cleft palate. Additional linkage signals above a LOD of 2 were found for nine other traits.

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Evolution of the Human Dentition: 5,000 years in the San Francisco Bay Area

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The archaeological record of the San Francisco Bay Area provides one of the best opportunities to study the biology of the early colonists of the Americas and the microevolutionary forces they faced. Over the last 5,000 years, this region has experienced dramatic rises in sea levels and tremendous fluctuations in temperature and precipitation. In traditional schemes, different patterns of material culture (Berkeley, Windmiller, and Augustine) have been identified across a tripartite chronology (Early= 5000-2500 BP, Middle= 2500-1000 BP, and Late= 1000-150 BP) of coastal and inland occupation (SF Bay and Central Valley) at numerous archaeological sites. Human skeletal remains from these sites are part of the largest collection of hunter-gatherer remains in the world, housed at the Phoebe A. Hearst Museum of Anthropology (PAHMA). As part of a large-scale project to understand the evolution of human dentition, we conducted a study to explore 5,000 years of oral health in the PAHMA collection. In a preliminary sample of 215 individuals (SF Bay: Early=23, Middle=54, Late=60; Central Valley: Early=35, Middle=43), we scored 22 crown traits using the ASUDAS system and compared these data to a sample of 201 individuals spanning the Early Holocene to the 19th century in Brazil, Peru, Venezuela, and Chile. Our initial biodistance analyses indicate population discontinuity in the SF Bay between the Early and Late periods and with the Central Valley. Combining these new phenotypic datasets with published literature suggests that these populations are ideal for testing hypotheses of how environmental and cultural factors correlate with oral health.

Positional and Postural Behavior of *Ateles geoffroyi* at Osa Peninsula, Costa Rica

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A quantitative study on the positional and postural behavior of *Ateles geoffroyi* is completed and compared to similar studies completed on *Ateles paniscus* and members of the Hominoidea. The primary goal of this study was to gain greater insight of *Ateles geoffroyi* positional and postural behavior. Specifically, the generality of Hunt's 1992 terminal branch feeding hypothesis was tested. Statistical comparison with data from *Ateles paniscus* and the Hominoidea was attempted in an effort to examine convergence. The general profile of *Ateles geoffroyi* was attained, and comparison of internal variables revealed patterns of weight-bearing structure use as well as positional activity budgets. The generality of the terminal-branch feeding hypothesis was confirmed. However, the limited sample size of this study inhibited proper comparison with outside data sets. Issues of positional behavior study are

consequently addressed. Further study is required to reach reliable conclusions on convergence, and should be completed for greater understanding of the relationship amongst adaptation, behavior, and evolution.

Craniometric analysis of unaffiliated native american remains from texas

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Texas prehistory is defined mainly based on stylistic material culture, specifically projectile points and ceramics. The biological population history of Texas is less understood, as the availability of well-documented osteological analysis is lacking for the region. The purpose of this research is to explore the levels of cranial variation within archaic and prehistoric peoples of Texas, in an effort to provide a comparative sample for individuals of unknown archaeological context. Cranial morphology is highly heritable and therefore can be used as a proxy for understanding genetic distance and group relatedness. This research provides a framework for understanding inter-regional migration and cultural interactions across Texas before European contact.

Archaeological sites in Texas with multiple intact crania were included in craniometric analyses and date from the Archaic to the late Prehistoric. Population groups from Howell's (1973) and other prehistoric and historic sites from the Plains and Great Basin served as comparative groups. In order to assess the biological relationships among the samples included, a discriminate function analysis was run, and a Mahalanobis D^2 matrix generated. The D^2 distance matrix was double centered and the eigenvectors and eigenvalues generated using the EIGEN function in NTSYS 2.2r, making analysis less subject to errors caused by small sample size. Results show Texas archaic and prehistoric groups are differentiated from other comparative groups. Craniometric data can be used to assign individuals of unknown chronological context and provide a potential framework to understand inter-regional migration patterns in Texas.

Consideration of allometry improves skeletal stature reconstructions from long bones

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Traditionally, stature is reconstructed from the length of bones using linear regressions. These methods tend to overestimate shorter individuals, underestimate taller individuals and produce standard errors between 3cm and 5cm. Attempts at improvements, e.g. reduced major axis, do not change the situation substantially. Actual relationships between sizes of body parts are allometric. Growth studies show that body proportions differ in various environments. In this study a method of stature estimation, which takes into account differences in body proportions between individuals, has been developed using long bone lengths of 120 individuals of known stature, sex, ancestry and age, held in the Terry Collection. We subtracted the length of the lower limb (tibia + femur) from body height, and then regressed the result on the ratio of tibia to femur length and on the length of the lower limb. We have found that the ratio T/F correlates with stature stronger than the sum of the length of the two bones (T+F). An age corrected stature can be reconstructed from the equation: 131.726-(73.879(T/F))+0.204(T+F)+(T+F) ± 3.96cm. This does not overestimate shorter individuals or underestimate taller individuals. Average differences between estimated and age-corrected actual statures (AVGDIF) of males and of females do not differ significantly from zero. AVGDIF for people of African and of European ancestry differ by less than 2cm from zero. Therefore this equation can be universally applied irrespective of sex and ancestry. Similar equations including proportions and sums of different long bones can also be used.

A new approach for comparison of cranial ontogenetic trajectories, using cercopithecine monkeys as an example

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Comparisons of ontogenetic shape trajectories are a standard approach in geometric morphometrics, however, analyzing many trajectories simultaneously can be difficult. This investigation explores a new method for comparing ontogenetic shape trajectories simultaneously in the cercopithecine cranium by performing a principal components analysis on the trajectories themselves.

Forty three 3D landmarks were digitized with a Microscribe 3DX from an ontogenetic series of 605 specimens representing 19 cercopithecine species from 8 genera, and superimposed using generalized Procrustes analysis. Specimens were partitioned into six developmental stages based on dental eruption. Ontogenetic trajectories of cranial shape change were computed through multivariate regression of Procrustes coordinates on developmental stage. These regression coefficients were then entered into a PCA, producing an ontogeneticPCA (oPCA). The trajectories were also compared by calculating the pair-wise angles between them.

The first two oPCA axes (67% total variance) grouped taxa with similar ontogenetic cranial shape trajectories (i.e., those with smaller pair-wise angles) together, indicating that this is a reliable way to visualize ontogenetic trajectories among many taxa simultaneously, while being less difficult than a comparison of many angles. OPC1 reflects relative (as compared with the rest of the cranium) rates of inferior movement of inion, widening of the cranial base, and anterior rostral growth. This widely separates *Theropithecus* from other taxa, which shows slower relative rates. OPC2 largely reflects relative rates of nasal bone growth, for which *Mandrillus* and *Theropithecus* are separated from the main grouping, with the former having relatively faster nasal bone growth, and the latter having relatively slower.

Disease-associated genetic variation drives differential expression of *MHC-DQA1 in vitro*: A role for *cis*-regulatory variation in disease susceptibility in wild primates

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Human health is shaped by both ecological and genetic factors. To better understand patterns of infectious disease in our own species, it is important to investigate how evolutionary forces have shaped disease in primates. Our previous work identified genetic variation in the promoter region of a Major Histocompatibility Complex Class II gene (*MHC-DQA1*) in Ugandan red colobus. We tested genotypes of each SNP for associations with shedding of whipworm (*Trichuris* sp) eggs in feces using a GLM and identified two *cis*-regulatory variants associated with increased shedding for the heterozygote genotype (SNP -96, $p = 0.007$, and SNP -172, $p = 0.012$). To test the functional role of these SNPs we synthesized promoter sequences containing all possible combinations of the two SNPs (four total promoter haplotypes) and used luciferase reporter assays to test expression differences among these alleles in mammalian cell lines. Of the two disease-associated SNPs, one (SNP -96) was found to significantly influence gene expression *in vitro* ($p = 0.006$). This SNP is located in a putative T box and the derived allele was associated with significantly higher expression than the ancestral allele. Consistent with our *in vitro* findings, *in silico* analyses revealed that 95% of transcription factors in the UniPROBE database are predicted to bind more strongly to this derived allele than the ancestral allele. We are currently using RNA-seq to test if this SNP influences expression of *MHC-DQA1 in vivo*. This

contributes to our understanding of how *cis*-regulatory variation shapes disease susceptibility in wild primates.

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GriffinVC: Video Coding Software for Microanalysis of Complex Behavior

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GriffinVC is a free and open-source video program designed for continuous or frame-by-frame analysis of dyadic interactions in play, communicative gestures, and teaching/learning. Such recording and analyses of reiterated sequences identify rule-like structures constraining the cooperative, imitative, and/or reciprocal dynamics found in games, courting, fighting, and parenting. Research examples include the emergent structure in Bonobo play, differentiation of dolphin foraging vocalizations, and the social development of 7, 10, and 13 month old human twins. We present snapshots of such research projects to illustrate the program's simplicity, flexibility, and potential contributions to observational research. GriffinVC can be run on Windows, Mac, and Linux operating systems. The software was developed using Python and the wxPython GUI library in conjunction with the VLC media player. The basic elements consist of an integrated video player, a custom list of behaviors (pick list), and a spread sheet for time-stamped observations that can be exported to Excel for statistical analysis. It is available online at https://svirs.github.io/griffinvc.

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Zygomaxillary shape variation in *Lophocebus* and *Papio*: a comparative allometric analysis

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African papionin monkeys (subtribe Papionina) are distinguished from other cercopithecines by the presence of facial fossae, and a deeply excavated suborbital fossa (SOF) is thought to be primitive for the clade comprising arboreal mangabeys (*Lophocebus*/*Rungwecebus*), baboons (*Papio*), and geladas (*Theropithecus*). Because this trait is most pronounced in smaller papionins, it has been hypothesized that it varies with size. However, SOF variation and development are poorly understood, and the allometric hypothesis has not been formally tested. This study applies geometric morphometric analysis to characterize ontogenetic and static allometry of zygomaxillary shape in *Lophocebus* and *Papio* and to test the hypothesis that SOF variation is related to size. Semi-landmarks (p=225) were used to capture zygomaxillary surface shape in cross-sectional ontogenetic series of *L. albigena sspp.* and *Papio hamadryas anubis.* Following Procrustes analysis with semi-landmark sliding, ontogenetic and adult allometry were explored using MANCOVA, angular comparisons of allometric vectors, and form-space PCA.

Adult and ontogenetic allometric trajectories differ significantly between *Lophocebus* and *Papio* (MANCOVA, $p<0.0001$; FPC1 angle, $p<0.0001$), and the taxa exhibit different patterns of SOF shape ontogeny relative to size. The common ontogenetic trajectory, accounting for ~70% of shape variance, is associated with variation in malar orientation, fossa depth, and rostral shape. Residual shape variance (FPC2) is related to significant differences between taxa in malar orientation and excavation (MANOVA, $p<0.0001$). These results suggest allometry contributes substantially to zygomaxillary variation but is not sufficient to explain SOF shape differences between *Papio* and *Lophocebus*. Implications for papioninan facial evolution will be discussed.

A test of seven variables of the adult acetabulum for age estimation in a Thai population

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Age estimation from human remains is one of the more challenging tasks when developing a biological profile in a forensic context. Seven characteristics of the acetabulum have been shown to be a reliable age indicator in a previous study of Portuguese skeletons. This region of the os coxa is potentially useful because it often preserves better than the pubis. Using Rissech *et al*.'s original scoring method. This study aims to investigate the degree of correlation between seven variables and age in human skeletons from a Thai population. A sample of 50 skeletons (28 males and 22 females) from the Forensic Osteology Research Center, Faculty of Medicine, Chiang Mai University were the subjects of the study. Ages of these skeletons ranged from 22 to 94 years with an average age of 60 years for both sexes. The variables considered were acetabular groove, acetabular rim shape, acetabular rim porosity, apex activity, activity on the outer edge of the acetabular fossa, activity of the acetabular fossa, and porosities of the acetabular fossa. All variables were found to be correlated with age using Spearman's correlation coefficient. Acetabular rim porosity on the left side ($r = 0.69$) and porosities of the acetabular fossa on the right side ($r = 0.65$) indicated the highest correlations with age. Importantly, the results showed no significant differences between the sexes or sides ($p \leq 0.05$). Therefore, these variables show promise for application to age estimation in Thailand.

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Morphological and genetic analysis of Nubian populations from the Early to Late Holocene

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The biological history of the occupants of Nubia throughout the Holocene remains a topic of debate; specifically, there is some tendency to assume a discontinuous history of occupation and cultural development based on traditional anthropological and archaeological evidence. Population movements, a shift in subsistence strategies and in-situ evolution have all been used to explain the biological variation observed in Nubian remains, particularly in the cranium. Here we investigate craniofacial and mandibular shape patterns, as well as ancient DNA variation, among populations from Upper and Lower Nubia spanning 12,000 years and reflecting a transition from hunting-gathering to intensive farming.

Our sample includes 150 adult specimens from six archaeological sites along the Nile River in Egypt and Sudan that belong to eight chrono-cultural groups spanning from the Late Mesolithic through the Christian periods. All individuals were digitized with a surface scanner, then 397 and 120 three-dimensional landmarks and semilandmarks respectively were extracted on skulls and mandibles of each specimen. Landmark configurations were subjected to generalized Procrustes analysis, tangent space projection, principal component analysis, discriminant analysis, and MANOVA. Endogenous DNA was extracted and sequenced from a subsample in order to explore variation in Nubian population genetics throughout time and space using informative SNPs and haplogroup determination.

Our results highlight a strong distinction between Mesolithic and the Neolithic samples.

Craniofacial patterns underline the importance of gene flow and give some support to the hypothesis of regional continuity among more recent groups, while patterns of mandibular morphology show high correlation with subsistence strategy.

Patterns of collagen fiber orientation in the human fibula middle-to-proximal diaphysis suggest a history of anterior-posterior bending and torsion consistent with "intermediate complexity" loading

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Patterns of predominant collagen fiber orientation (CFO) strongly correlate with habitual unidirectional bending, making this characteristic important for distinguishing bending from more complex loading (e.g., prevalent torsion). When in vivo strain data are not obtainable, a large data set must be assembled in bones with known and unknown strain histories in order to establish the relative reliability of CFO vs. other histomorphological characteristics for determining load history. The lack of in vivo strain data from the human fibula prompted our investigation of regional CFO data as an indirect way to determine whether or not the proximal-to-middle diaphysis receives relatively simple anterior-to-posterior bending vs. more complex loading (i.e., "low" vs. "intermediate-A" vs. "intermediate-B" vs. "high" complexity). Modern human fibulae (n=11; mean age 47y; range 25-65y; 8 males, 3 females) were sectioned transversely at the proximal-to-middle diaphysis. Sections were milled to 100 microns and circularly polarized light images were taken in the anterior, posterior, medial, and lateral cortices, and predominant CFO and secondary osteon population density (OPD) were analyzed. Results showed: (1) a trend ($p = 0.08$) in anterior vs. posterior CFO differences (posterior = more oblique-to-transverse ("compression adapted") collagen) and compression-adapted CFO medially ($p = 0.05$), and (2) no trends or statistical significance in OPD data. These results likely reflect significant torsion in some bones, which reduces regional CFO differences, especially when data from many individuals are averaged. Consequently, the proximal portion of the human fibula diaphysis should be placed in the "intermediate-B" complexity load category.

Enamel-dentine junction morphology and enamel thickness of the Dinaledi dental collection

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The dental remains of the *H. naledi* hypodigm constitute one of the largest samples of teeth and jaws of any fossil hominin species. Estimated to derive from at least 15 individuals, they offer an opportunity to characterize dental morphology in a temporally and geographically restricted population belonging to the genus *Homo*. We apply microtomography to examine the morphology of the enamel-dentine junction (EDJ) of the mandibular molar sample. Previous research has demonstrated that EDJ morphology carries a strong taxonomic signal, facilitates the examination of discrete dental traits, and provides insights into the developmental processes underlying tooth crown morphology. Using geometric morphometrics (GM), we compare molar EDJ morphology of the *H. naledi* remains to a comparative sample that includes numerous Plio-Pleistocene hominin species from *Australopithecus*, *Paranthropus* and *Homo*. We also measure 2D average and relative enamel thickness and conduct a qualitative analysis of the EDJ expression of dental traits. Results of the GM analysis indicate that the molars of *H. naledi* are distinct from both *Australopithecus*/*Paranthropus* and early/later *Homo*; presenting a unique combination of dentine horn size and spacing and cervix shape. 2D enamel thickness of *H. naledi* is relatively thick, overlapping with *P. robustus* and some specimens of early *Homo*. Discrete traits, such as cusp 6 and the protostylid, are both rare and only mildly expressed and the molar occlusal basin lacks complexity in terms of crest development. The molar EDJ morphology of *H. naledi* is discussed within the context of both early and later species of the genus *Homo*.

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Analyzing the biological relatedness of individuals from a late 1800s Missouri cemetery

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Biodistance studies are valuable tools in biological anthropology because they help address questions about population structure and demographics. In this study, metric and nonmetric data are used to examine the biological relatedness of 11 American Black individuals whose graves in the abandoned 19th century Shiloh Methodist Cemetery were exposed during flooding of the Missouri River in 1993. The purpose of the study is to provide more information about the life of Black Americans in this community and in 19th century central Missouri.

Analyses of the metric and nonmetric data indicate the Shiloh individuals align most closely with American Blacks from the era than African populations. Mahalanobis distances between each pair of crania ($D=2.79$) are less than expected ($D=3.61$) for an American Black population, and indicate that the Shiloh individuals examined were members of the same biological and cultural community. The results of this study do not support that the Shiloh individuals were recent migrants from Africa or members of a single family unit. The contrast between the funerary adornment of Shiloh Feature 13 and the other 10 individuals combined with their morphological similarities imply there were likely multiple social levels in the Black community. Future research will include DNA analyses of the Shiloh sample to define their biological relationships, which will be compared with the current results to evaluate the relationship between metric and nonmetric data and their level(s) of genetic influence.

Visualization and Materialization for High-dimensional Morphometric Data

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Data dimensionality is an increasingly important problem in morphometric analysis. Even basic generalized Procrustes analysis produces data matrices with singular covariances due to constraints imposed by the superimposition process. This precludes subjecting the data directly to familiar multivariate analyses that require a full-rank covariance matrix. Projection onto partial or relative warps or principle component axes can be used to address this issue, but fails as analysis moves to surfaces that might yield hundreds of thousands, even millions of variables (dimensions X vertices). Here we present a way to address this issue using Gower's method of principle co-ordinates combined with regression.

Principle coordinates analysis involves the extracting the eigenvalues of a properly transformed matrix of interspecimen distances. The resulting vectors produce ordinations of the specimens equivalent to the projection of the data onto the principle components of the covariance matrix, but the relationship of these coordinates to the original variables is lost. Visualization of specimens associated with coordinates in principle co-ordinates space, however, can be produced by regression of the original, superimposed and homologized surfaces onto their scores on one or more

principle co-ordinate axes. As these represent vertex coordinates, they can be both visualized and exported to appropriate formats for materialization via three-dimensional printing. Examples are presented using scans of bald, human heads with over five-hundred-thousand vertices.

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A primate and a bird, sitting in a tree, c-o-m-p-e-t-i-n-g: Co-occurrence patterns of primates and their potential dietary competitors

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Birds and non-primate mammal species are likely to compete with primates over shared resources. While this has often been acknowledged, it is difficult to test the degree to which competition with non-primate taxa influences primate ecology and distribution. Community studies of geographically isolated primate communities (i.e. on Madagascar and Borneo) have shown that the potential for primate/non-primate competition can vary greatly depending on the biogeographic history and primate species richness of those areas.

Tropical Africa represents a large geographic area that is home to diverse avian and mammalian fauna, including many primate groups. We predicted that primates here would compete with non-primates more frequently than do primates on Madagascar, but less frequently than do those on Borneo. Pairwise co-occurrence patterns of primate and non-primate frugivore species were studied to determine whether primates showed a unique pattern of primate-only interaction. Sites were divided into ecological subregions based on faunal similarity, and proportions of negatively, positively, and randomly co-occurring species were measured for primate/primate and primate/non-primate pairs in each region based on checkerboard distributions. Our results indicate that interactions with non-primates could be particularly important for primates living in more arid environments in eastern and Sahelian Africa. Overall, patterns of interspecific interaction involving primates appear to be mediated by environmental and geographic factors. Research and conservation efforts focused on primate communities here and elsewhere should address the role that non-primates could play in shaping primate community structure.

How Diet Influences Mortality: Dietary reconstruction of epidemic and non-epidemic populations in 19th century Italy

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Diet and nutrition strongly influence susceptibility to infectious disease morbidity and mortality. Dietary reconstruction of epidemic populations may point to dietary heterogeneity underlying disease susceptibility. Cholera is known to be a disease that preys on impoverished industrializing populations with few sanitary regulations, but little research has investigated the effect of malnourishment on disease mortality from cholera. This study compares dietary variation of cholera victims from 19th century Benabbio with a non-cholera cemetery from Pieve dei Monti di Villa used as a "healthy" control population. The goal of this study is to characterize dietary heterogeneity underlying cholera mortality, establishing a link between diet and health in the past in context with infectious disease risk. Dental microwear analysis and stable isotope analysis were used to reconstruct diet for each population to determine if there are any significant differences between the adult diets of cholera victims and non-cholera victims. Dental features were analyzed by collecting surface images of the distal-buccal cusp at 100X magnification and counting features (e.g., pit number, scratch length) using Microwear 4.0 software. Although previously published stable isotope data indicates dietary differences between Benabbio ($\delta^{13}C$ = -19.8, $\delta^{15}N$ = 8.3) and Pieve dei Monti Di Villa ($\delta^{13}C$ = -18.8, $\delta^{15}N$ = 7.8), dental microwear between the two populations was indistinguishable. These results imply homogeneity in food preparation and cooking techniques in 19th century Italy with regional variation in food consumed. Based on this research, adult diet alone appears to have little influence on susceptibility towards infectious disease.

Dietary Survey of Captive Housed Chimpanzees (*Pan troglodytes sp.*)

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This study surveys current diets provided to captive housed chimpanzees (*Pan troglodytes sp*.), with an eye towards improving captive management and laying the foundation for a larger study examining dietary flexibility and chronic diet related diseases found amongst captive apes and humans. A Chimpanzee Species Survival Plan (SSP) endorsed survey of diets fed to zoo and sanctuary housed chimpanzees was conducted in the 2015 calendar year. To date, no other survey documenting captive chimpanzee diets in North America has been conducted. Although chimpanzees in their native habitats forage actively and consume seasonally variable and complex diets rich in fiber and polyphenols, captive chimpanzees ingest high-quality, low-fiber diets rich in monocrop domesticates. Additionally, chimpanzees in captivity often experience obesity and diabetes. While Chimpanzee SSP dietary recommendations are based on wild feeding ecology, the majority of zoos report feeding diets that are significantly higher in caloric content (T=3.08, p=.01) and lower in fiber content (T=-12.47, p<.001) than their wild counterparts and current SSP recommendations. Energy dense, low fiber diets coupled with relatively lower activity levels than those seen in the wild could be contributing to the obese and diabetic cases seen in captive chimpanzees. I suggest that following SSP recommendations and mimicking the nutrient composition of wild diets as closely as possible will lead to a reduction in obese and diabetic cases and improvements in captive management.

Experiencing Childhood at Roonka: An Analysis of Enamel Hypoplasia in the Permanent Dentition of Australian Aboriginal Hunter-Gatherers

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Little is known about childhood in prehistoric Australian Aboriginal societies. The analysis of enamel hypoplasia provides a window into the life histories of these children. We investigate patterns of enamel defects at Roonka, a large burial place along the Murray River in South Australia (7,000 BP – 200 BP). Dental enamel hypoplasia was recorded in all individuals with teeth using two methods (n=133). Hypoplasia was assessed macroscopically across the dentition in order to understand variation in the number, types, and timing of defects. Additionally, lower canines (n=66) were observed under a scanning electron microscope in order to obtain finer detail in the timing of defects.

Previous analyses of hypoplasia in this sample and elsewhere in the Murray Valley region have shown a high prevalence of defects. While the high prevalence is replicated in this research (77% in maxillary canines, n=81), the use of detailed information on the timing, type, and number of defects illuminates the complexity in the patterns of defects among individuals from Roonka. Research from Central Australia demonstrated that diversity in the number of defects per individual parallels diverse living conditions while more challenging conditions are mirrored by marked homogeneity in the timing and number of defects. We investigate how well this model explains patterns of hypoplasia at Roonka. Between 5.2 and 9 years of age, the number and timing of defects

are highly variable. We hypothesize that these defects signify a transition in the bio-cultural experiences of children as they began to forage for their own food.

The naming of Neandertals: William King, Ernst Haeckel and the rise and fall of "*Homo primigenius.*"

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The taxon *Homo neanderthalensis* was formally established by geologist William King, possibly in 1863 rather than 1864. His publications on the Neandertal calotte from the Kleine Feldhofer Grotte in 1863 and 1864 were his only works on human evolution. His motivations for conducting this study are unclear but likely involved a desire to draw attention to his career and rather "marginal" program at Queen's College in Galway (now the National University of Ireland Galway). Although lacking formal anthropological training, King's perspectives on human "racial" variation were surprisingly progressive for his time and were critical to his assessment that the Neandertal calotte was fundamentally different from skulls of recent people, even those considered "primitive." This formed the basis of his argument for specific, perhaps generic, separation of Neandertals from *Homo sapiens.*

Among alternative taxonomic names for Neandertals, Ernst Haeckel's "*Homo primigenius"* (1868) emerged as the leading competitor. Haeckel's taxonomy was largely theoretical, tied to fanciful ideas about human evolution and its reflection in living human variation. However, Haeckel's Neandertal taxonomy gained a substantial acceptance, particularly in the German-speaking intellectual sphere. I show that the rise and especially the fall of the use of "*Homo primigenius"* were tied to scientific and political factors, the latter comprising both nationalism and the influence of leading scholars. Among those scholars were Schwalbe, Gorjanović-Kramberger, Weidenreich and Weinert. Use of "*H. primigenius"* declined rapidly after Schwalbe's death in 1916 and all but disappeared with the impact of the German defeat in World War II.

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Histological age determination using the micro-anatomy of 3rd metatarsal and metacarpal bones

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We review the literature on bone histology specific to age at death determination. In general, anthropologists use histology to look at the micro-structure of bone. Anthropologists typically look at the features specific to the remodeling process: secondary osteons, intact osteons, fragmentary osteons, Howship's lacunae, and cortical area. This particular presentation will look at using metatarsals and metacarpals for assessing age at death. In doing so, we collected data on intact and fragmentary osteons, cortical area, and produced osteon population density (OPD). We compare our results between the metatarsals and metacarpals to see which one serves as a better estimate of age at time of death. In doing so, we present histological methods first outlined by Stout and Paine for assessing bone, collecting data, and preparing bone slides for histological analysis. Additional skeletal indicators provide forensic anthropologists new ways for determining age at death.

Hands and the origins of socially shared attention in human infants

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The coordination of visual attention among social partners is central to many components of human behavior and human development. Previous research has focused on one pathway to the coordination of looking behavior by social partners, gaze following. The extant evidence shows that even very young infants follow the direction of another's gaze but they do so only in highly constrained spatial contexts because gaze direction is not a spatially precise cue as to the visual target and not easily used in spatially complex social interactions. Our findings, derived from the moment-to-moment tracking of eye gaze of infants 1 to 1 ½ years of age (n=51) and their parents as they actively played with toys, provide evidence for an alternative pathway, through the coordination of hands and eyes in goal-directed action. This pathway, through eye-hand coupling, leads to coordinated joint switches in visual attention and to an overall high rate of looking at the same object at the same time, and may be the dominant pathway through which physically active toddlers align their looking behavior with a social partner. The discussion will center on the developmental links between visual attention to hands, socially coordinated visual attention to objects, joint action on objects, and early word learning.

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Disturbing the massacred dead: clues to Archaic Period socio-politics

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Previous research on intergroup violence in the large seven site mortuary sample (N = 600+) from the Late Archaic period (~2500-500 BC) in what is now the Kentucky Lake Reservoir (west-central Tennessee) revealed that half of the deliberate violence cases (i.e., inflicted projectiles, scalping, distal limb dismemberment and retrieval) occur in the geographically remote Cherry (40BN74) site sample. The site also yielded the only mass grave (N = 6) of individuals who evidently died violently. The haphazardly piled individuals of the mass grave were subsequently aboriginally bisected by a pit. The disturbance might be interpreted as the act of a later re-occupation of the site but for the circumstances of two multiple individual limb burials, Burial 41 from Cherry and Burial 23 from Oak View Landing [40DR1]), the only departures from primary interment in the seven sites. Each limb burial was accompanied by an extraordinarily large cache of grave goods. The present study osteologically identifies these as reburials. The virtual absence of reburials in the Archaic samples could arguably affirm later re-occupation of (at least) the Cherry site. To corroborate this, the field notes for all seven sites were examined for burial intrusions (e.g., pits or subsequent interment). Meaningfully, the only sites with disturbed burials were Cherry (10/71, 14%) and Oak View Landing (5/81, 6%). Rather than re-occupation, the data tentatively suggests certain sites, possibly located at political frontiers, were alternately occupied by evidently (perhaps mutually) hostile groups who possibly had no cosmological reservations (e.g., ghosts) about disturbing the dead.

Evaluating Deamination-based Approaches for Inferring DNA Methylation: Insights from Two Ancient Genomes

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Paleoepigenetics, or the inference of epigenetic marks from ancient DNA, is an emerging area of genome research. Ancient methylation data may offer insights into the past ranging from individual life experiences (diet) to events of broader evolutionary significance (species divergence). However, because various epigenetic functions operate on different scales, from single cytosines to hundreds, different resolutions of methylation data are required to evaluate various epigenetic processes. The goal

of this study was to evaluate a technique that exploits cytosine deamination to reconstruct genome-wide methylation (methylomes) in ancient samples with differing DNA preservation. This method produces low-resolution estimates of methylation over hundreds of nucleotides, but is limited by a lack of single nucleotide resolution. Here, we investigated how methylome resolution (nucleotide span over which methylation is determined) was related to DNA preservation.

We generated DNA libraries for two dental samples: one Native American (~2000 BP) from British Columbia and one individual of African descent (~180 BP) from an enslaved community cemetery in Nashville, Tennessee. Libraries were enriched for genome-wide epigenetic targets using Agilent Methyl-Seq probes, and methylation was inferred from cytosine deamination. Because the two samples differed in their extent of damage and sequencing coverage (~6-20X), we determined the minimum methylome resolution for each sample as a function of deamination frequency. Given these resolutions, we consider what epigenetic contexts (islands, DMRs, etc.) might be reliably reconstructed with this method. Our results indicate that while deamination-based methods are not suitable for fine-scale epigenetic analysis, they may be applicable to larger-scale analysis.

Cyclical Nursing Patterns in Wild Orangutans Recorded in Teeth

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Orangutans have the most prolonged nursing period of any terrestrial mammal, with cessation of suckling (weaning) reported at 5.8 - 7.5 years of age in the wild. It has been predicted that maternal lactation effort should be relatively constant over this extended period. Nursing behavior is notoriously difficult to study in arboreal primates, particularly given the tendency for offspring to suckle inconspicuously while nesting. We have previously demonstrated that trace element analysis of bioavailable elements from milk, such as barium, provides accurate estimates of early life diet transitions in humans and non-human primates when coupled with growth lines in teeth. Here we document nursing histories in three wild-shot orangutans from museum collections that were histologically determined to be 4.5 - 7.5 years old at death. Incremental features were also used to age developmental defects in tooth crowns, and laser ablation-inductively coupled plasma-mass spectrometry was used to determine micro-spatial elemental distributions across molars. Barium levels rose slowly during the first year of life, and began to decline shortly after one year of age, which is consistent with behavioral observations of exclusive suckling and solid food supplementation. After the first year, barium levels show major sustained increases on a roughly annual basis. These cyclical patterns appear to be due to increases in milk consumption and/or increases in barium levels in mothers' milk, continuing until death in all individuals, including in a 7.5 year-old Sumatran juvenile. Orangutan lactation appears to be a conservative process that reflects seasonal resource availability.

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Relative tooth size at birth in primates: Life history and dietary correlates

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Dental eruption schedules in part reflect dietary specialization; life history correlates have also been implicated. Here we examine a sample of 52 perinatal primates (28 species) to determine how soon dietary or life history variables correlate to relative tooth size. Cadaveric primates obtained from natural captive deaths were studied using serial histological sectioning. Volumes of deciduous premolars (dp2-dp4) and permanent molars (M1-2/3) of the upper jaw were calculated based on serial cross-section tooth germ area. Most variables were strongly correlated with cranial length (CL), thus residuals from CL were calculated with least squares regressions (e.g., relative dental volume). ANCOVA revealed significant differences among primates based on diet. In particular, folivorous strepsirrhines have the relatively largest M1 and total molar volume, although the difference is not significant after phylogeny was considered (PGLS). Relative dental volume significantly correlated with relative gestation length (dp3, $R=-0.50$; $p<0.05$), and relative neonatal mass (dp4, $R=-0.58$) but not relative weaning age. However, the only significant PGLS result was with relative gestation length. Results reveal a negative relationship between deciduous premolar size and gestation length (M1 has a weak correlation, $R=-0.1$), suggesting a strategy by which primates with shorter gestation lengths grow deciduous teeth more rapidly. These results might be explained by the strategy of rapid development of permanent dentition in strepsirrhines. Indeed, a plot of relative total molar volume versus relative gestation length reveals a positive association in strepsirrhines compared to a negative slope in anthropoids.

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Malaria at Amarna, Egypt: Evidence from the South Tombs Cemetery

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The Amarna Period of ancient Egypt represents a unique time when major social and political changes occurred suddenly and with little explanation. Many ancient texts recovered from this period mention epidemic diseases, which may have contributed to the extreme shifts recorded for this time. Ancient DNA evidence supports the hypothesis that malaria could have contributed to these ancient epidemics. This study assessed 417 skeletons from the non-elite South Tombs Cemetery for malarial skeletal lesions and/or patterns of endemicity to estimate the prevalence of malaria at the city of Amarna during this tumultuous time. Results revealed high rates of skeletal indicators of malaria for this sample, indicating that approximately half of the interred individuals experienced a recent malarial infection prior to death. Malarial individuals were significantly more likely to die younger than non-malarial individuals; however, the oldest age cohort contained no non-malarial individuals, perhaps reflecting lowered immunity in progressed age ($p=0.047$). The differential mortality burden inferred from demographic trends of the cemetery was higher for women and children and this is aligned with the higher risk of malarial infection and mortality of these groups in endemic areas of malaria. Increasing rates of multiple burials containing women and decreasing female stature in the cemetery suggested an event of lowered general health status for women, perhaps representing co-infection of malaria with other diseases at Amarna. The findings of this study support previous notions of high malarial prevalence in the population occupying this site during the Amarna Period.

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Procrustes-based vector-moving average models allow patterns of motion to be statistically distinguished

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Over the past few decades, Procrustes-based geometric morphometric methods (GMMs) have revolutionized how morphological data are analyzed. However, although GMMs provide notable advantages to other quantitative systems in morphology, there are limits to their analytic abilities. For instance, most GMMs require that specimens have fixed shapes or, sparing fixedness, can be set in a standardized position. Yet many morphological structures have shapes that are dynamic in time and that have clear temporal relationships with each other. In these situations, the time-ordered set of shapes, or shape trajectory, that the structure assumes may be of greater interest than individual shapes in the trajectory, *per se*. As a result, the shape trajectory is a function-valued trait, and methods to study them and quantify their variation should address the trajectory holistically.

Previous research involving simulated shape trajectories have revealed that Procrustes-based vector autogressive-moving average models (PARMA) may serve as appropriate proxies for shape trajectories, thus allowing statistical methods to differentiate qualitatively different shape trajectories. The proposed workflow involves converting morphological data into Procrustes-based variables, fitting a vector autoregressive-moving average model to each shape trajectory, and using the coefficients in the model as a representation of the data itself. Using the model coefficients as a proxy, standard multivariate statistical methods are applicable. Here, for the first time, we fit PARMA models to empirical motion-capture data of human movement. We demonstrate that PARMA model proxies can indeed lead empirical shape trajectories to be differentiated and elaborate on the efficacy of this approach.

Metabolic Bone Disease of Infancy and Early Childhood in the Pre-Historic Atacama Desert, Northern Chile (2350 – 1500 BP)

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The people of the Atacama Desert in what is now Northern Chile underwent a major transformation in subsistence strategy beginning around 2500 BP, gradually shifting from a maritime hunter-gatherer economy to a maize-based agropastoral economy. The decrease in dietary variety and increased dependence high carbohydrate foods that accompanied this transition may be associated with a higher prevalence of micronutrient malnutrition disorders, as this has been observed in modern populations undergoing similar subsistence transformations. We present some preliminary paleopathological findings from a subadult cohort (0-15 years, N= 13) from a predominantly post-agricultural transition site in the Azapa Valley (AZ 75D, 2350 – 1500 BP). This skeletal assemblage contains an unusually high prevalence of infants and children under five years of age with evidence of metabolic bone disease in the form of severe osteopenia (33.3%), craniotabes (22.2%), and lesions indicative of scurvy (77.8%). We discuss the possible causes of these lesions in light what is known about cultivated domesticates and exploited natural resources at this site. Given that two of the individuals affected are neonates, we also argue for an underlying maternal vitamin C and calcium and/or phosphorous deficiency in this population.

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The biological consequences of structural violence in a forensic sample of undocumented migrants in southern Arizona

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Over the past decade, the remains of more than 2,000 undocumented border crossers (UBCs) have been recovered from the US/Mexico border in Arizona. Despite the risks, individuals continue to cross with the hope of a better life in the U.S. Nevertheless, much of the national discourse on immigration reform has focused on the "criminality" of crossing the border, and there has been little discussion of the collective forces that compel people to cross. Many rural and indigenous communities within Latin America have been disproportionately marginalized, experiencing structural violence through systemic limited access to basic necessities. Structural violence has biological consequences that include increased susceptibility to infectious and non-communicable disease, malnutrition, and increased mortality.

This research documents these biological effects in a forensic sample of 200 UBCs examined at the Pima County Office of the Medical Examiner in Tucson, Arizona. Non-specific indicators of stress, including porotic cranial lesions, linear enamel hypoplasias (LEH), and dental abscesses, as well as stature, and non-specific infections were documented. Results reflect high levels of childhood and adult physiological stress with 58.1% exhibiting porotic hyperostosis, 10.3% exhibiting orbital lesions, 33.3% exhibiting LEHs, and 19.2% exhibiting at least one dental abscess. Additionally, mean stature estimates reveal possible growth stunting with the average male measuring 65 inches and the average female 61 inches tall. The results of this first systematic study of the skeletal health of the UBC community demonstrate how physical anthropology may contribute to an understanding of the precipitating factors and scope of a human rights crisis.

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Archaeogenomic analysis of ancient Anatolians: first genetic indication for Neolithic cultural diffusion in the Near East

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Sedentism, farming, and herding in West Eurasia first started in the Fertile Crescent around 11,500 BP. From there, Neolithic culture spread into Central Anatolia and the East Mediterranean, and eventually, reached Southwestern Europe. The demographic dynamics behind these processes has long been of interest. Recent archaeogenomics studies showed that the arrival of farming in West Europe happened through migrating Neolithic populations. But where had these migrations themselves initiated? Based on material culture studies, it has been suggested that Neolithic culture first spread from Central Anatolia to the Aegean Sea and the Balkans, by cultural diffusion. But this hypothesis has not yet been tested by genetic data. Here we address this question by screening the genomes of 15 Central Anatolian individuals from different Neolithic sites (10,000-8,000 BP). Four of these were sequenced to >0.1X coverage, and the data was combined with published Neolithic genomes. Our results indicate that Central Anatolian Neolithic individuals genetically resembled the

first migrant Neolithic populations found in Europe, rather than modern-day Anatolians. At the same time, Central Anatolian Neolithic individuals appear to cluster together, to the exclusion of other Neolithic populations. Using simulations, we evaluate demographic models that could explain these patterns. Our results suggest that the migration processes that eventually reached Southwestern Europe around 8,000 BP had their demographic roots directly within the Near East, but possibly not in Central Anatolia, in line with the cultural diffusion hypothesis. We discuss our results in the context of material cultural exchange patterns of the Neolithic period.

This study has been supported by a Scientific and Technological Research Council of Turkey (TUBITAK) grant (114Z927) to M.S.

Food Preferences and Social Change in Highland New Guinea: Biological and Cultural Implications

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The anthropological study of human food preferences has implications for multiple disciplines, including those concerned with issues of diet and health. This presentation focuses on the Dani people from the western highlands of New Guinea, and explores the factors that influence individual food preferences. By quantifying and analyzing survey data collected in the Mulia Valley of Papua, Indonesia in 1987, this study presents findings from 477 individuals from six villages representing both sexes and all age categories. Villages varied in their level of contact with Christian missionaries and the globalized economy, permitting assessments of how cultural contact has influenced food preferences across different demographic subsets. Results demonstrate that the individuals in greatest contact with foreigners were significantly more likely to state a preference for meat and peanuts, foods characterized by relatively high protein and fat contents, than were indviduals from more remotely located communities. Individuals from remote villages were significantly more likely to name sweet potatoes and other low-protein plant foods as their favorite food items. Notably, foreign contacts enabled greater access to both meat and peanuts, suggesting the importance of both accessibility and energy density in the development of food preferences. We discuss cultural and biological implications of these findings.

The Regents of the University of California (PW) and the Wisconsin Alumni Research Foundation (MJS) provided funding for the project.

Cribra Orbitalia and Porotic Hyperostosis: A Reanalysis of their Relationship

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This research project focuses on reanalyzing the relationship between cribra orbitalia and porotic hyperostosis. Previous research has linked cribra orbitalia and porotic hyperostosis, and suggested that the two share the same etiology. Recently this has come into question due to a renewed interest in reassessing skeletal markers of stress and their usage in interpreting patterns of health in past populations. To reanalyze the relationship between cribra orbitalia and porotic hyperostosis data was collected from 353 individuals in the Tennessee Valley Authority skeletal collection housed at the McClung Museum of Natural History and Culture at the University of Tennessee, Knoxville. These individuals are from four sites dating to the Mississippian Period including Hiwasse Island, Johnson Village, Mouse Creek, and Sale Creek. Preliminary data analysis has found that porotic hyperostosis occurred at a greater frequency than cribra orbitalia within these populations. Significant differences were found in the rates of cribra orbitalia and porotic hyperostosis among all individuals that were complete enough to be scored for both (t-test, $p=0.0280$). The implications of this are discussed in regards to the vitamin B_{12} deficiency hypothesis which offers an alternative to the widely accepted iron-deficiency anemia hypothesis as the etiology of these skeletal stress markers. Finally, this data is analyzed via an epidemiological method in which the concepts of sensitivity and specificity are used on a broader scale to interpret the prevalence of these stress markers within past populations.

Are we using the appropriate reference samples to develop juvenile age estimation methods for a forensic context in developed nations?

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Children in developed nations enter the subset of the population studied by forensic anthropologists (the forensic population) almost exclusively as victims of homicide. These children are at greater risk for abuse, malnutrition, and infrequent healthcare, which may impair their growth. This study compares growth between the forensic population and that of average children. Cadaver length data was obtained from 368 juvenile autopsies (219 accidents and 149 homicides) undertaken between 2002 and 2013 (birth-18 years), made available by coronial bodies in Cleveland and Albuquerque. Z-scores were calculated for height using the NCHS-1977 standards, in order to quantify each individual's deviation from the mean for age and sex. The distributions of Z-scores were then compared between the accident – used as proxy for normal population – and homicide – used as proxy for forensic subset of the population – manner-of-death groups, at varying points in the growth period. Homicide victims (average Z-score: -0.08) show consistently smaller Z-scores than accident victims (average Z-score: 0.48) in all age groups except the infants (birth to 3 years). The largest differences between the groups (average Z-scores: -0.63 and 0.76 for homicide and accident victims respectively) occur in late childhood (7-10 years for females and 7-12 years for males). Although some age groups did not show statistically significant differences in cadaver length between the forensic and overall populations, these results indicate that further work must be done to determine whether using samples representative of the overall population are adequate to develop juvenile skeletal age estimation methods.

A Mortuary Profile Analysis of Cerro de la Cruz, Oaxaca, Mexico as an Investigation into Formative Period Regional Interactions

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The current debate relating to the relationship of interactions between the Formative period (400BC-AD150) highland and lowland regions of Oaxaca, Mexico is split predominantly between two main theories: the Monte Albán Imperialism Argument (MAIA) and the Coastal Autonomy Theory (CAT). The MAIA contends that during its rise to power Monte Albán, a ruling Zapotec city of the highlands, expanded its empire by conquering surrounding areas, including the coastal lowlands of Oaxaca. Under this theory some have identified Cerro de la Cruz as the site of a mass grave, the result of warfare casualties. The opposing CAT recognizes the rise of Monte Albán in the highlands, but holds that the lowland region had developed its own seat of power, and was never taken over by Monte Albán.

Through the use of bioarchaeological methods a mortuary profile was constructed for 25 individuals from late Formative period Cerra de la Cruz. The purpose of the profile was to use new and past data to establish burial practice patterns, and to identify any incidents of trauma.

The results from this work have demonstrated that there was an established burial practice pattern in Cerro de la Cruz that varied from other regions of Oaxaca at the time, and that only one incident of trauma was present. The fairly even distributions in age and sex groups also do not support the notion that this area was impacted by warfare. Concluding

thoughts do not support the presence of war in Formative period Cerro de la Cruz.

Environmental Variation Explains Mammalian Niche Structure in Central and South America

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The role of environment has been given much consideration in shaping primate adaptation and promoting (or limiting) speciation. However, our ability to reconstruct the paleoenvironments in which these processes occurred is limited to the information available in the fossil record, thus reconstructions remain imprecise. The potential of characterizing past environments based on the mammalian communities that occupy them provides a valuable method of reconstruction, but requires broad-scale comparative data from modern communities. Here we present mammal species and climate data for 85 geographically, climatically, and taxonomically diverse neotropical localities. We find strong correlations of climatic variables (habitat) with frugivore and arboreal species richness. Principal components analyses of data reveal mean annual precipitation (MAP) and temperature seasonality to have high positive loadings on PC1 of a Principal Components Analysis. The 'Frugivore Index' (FI) and 'Arboreality Index' (AI) also have strong positive correlations with PC1 representing increasing MAP and reduced seasonality in temperature and precipitation (R^2=0.61 and 0.74, respectively), whereas the Body Size Index (BSI) indicated a weaker correlation with PC1 (R^2=.10). Even when confined to only tropical localities, with living platyrrhines, these correlations still hold (FI, R^2=.49; AI, R^2=.70; BSI, R^2=.02). Interestingly, our ecological indices show stronger correlations with canopy height (FI, R^2=.38; AI, R^2=.49; BSI, R^2<.01) than with net primary productivity (FI, R^2=.23; AI, R^2=.30; BSI, R^2=.06), suggesting that climate-induced differences in habitat structure, rather than productivity *per se*, are driving community structure in mammals.

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Using Non-metric Traits to Estimate Ancestry in the 21st Century

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With the beginning of the modern synthesis, physical anthropologists studying cranial morphology began to implement the evolutionary mechanisms of human variation rather than just categorizing individuals into different types. The development of multivariate statistical procedures during the early 20th century enabled researchers to ultimately address questions of population relationships that would later allow for theoretically-based estimations of ancestry or geographic origin. These statistical methods allowed for exploration of population variation beyond the popular three-group model and have been incorporated with over 20 groups at one time. Yet the three-group typological model still persists in the 21st century for many forensic anthropologists using cranial non-metric data, despite new methodological advances. Recent literature suggests that new methods can provide good estimates of ancestry using non-metric traits, yet these methods use three groups at most. The purpose of this presentation is to examine whether non-metric cranial traits can correctly estimate group membership when more than three groups are incorporated into the analysis.

Using a canonical analysis of principle coordinates (CAP), 55.66% of a sample of American Black (n=277), American White (n=202), Hispanic (n=186), and Asian (n=68) crania were correctly classified. Using standard cranial metric data with similar group composition and discriminant function analysis, correct classification reached 73.5%. Although the non-metric results are better than random chance, the classification rate is not as high as the metric data. However, the CAP method does account for the variation present in lieu of forcing a typological classification based on observation alone.

Revisiting carpal vibrissae: Positive identification in adult *Tarsius tarsier* and the implications for taxonomy and phylogeny

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Pelage characteristics are often used for taxonomic distinction. This includes carpal vibrissae, which are tactile hairs on the ulnar side of the distal forelimb, innervated by the ulnar nerve. Carpal vibrissae are considered a primitive mammalian trait and are not often found in mammals that only use limbs for locomotion (i.e. not for feeding, grasping, or manipulating food). Reports of carpal vibrissae in primates are mixed. Carpal vibrissae have been documented in several lemur species, but not in lorisids and haplorhines (except *Callithrix jacchus*). Although haplorhines show a general reduction or loss of facial and body vibrissae, previous studies on tarsiers and colobus monkeys suggested that carpal vibrissae are present in the fetal stages but absent in adults. Therefore, although the presence/absence of carpal vibrissae in primates has been used as a character distinguishing the two major primate lineages, this taxonomic distinction is not clear. We examined hair structures, including vibrissae, in a range of primates and we document the presence of carpal vibrissae in a number of taxa, including the first documentation in specimens of adult *Tarsius tarsier*. We established the presence or absence of carpal vibrissae through microscopic photography of museum specimens. Due to the presence of carpal vibrissae in several lineages, including flying lemurs, tree shrews, *Tarsius*, and *Callithrix*, we suggest that this hair trait is developmentally and evolutionarily malleable, and not a suitable character for taxonomic distinction.

Genetic analysis of a British colonial cemetery in Belize

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To date, the St. George's Caye Archaeological Project has identified a total of 52 historic burials from a colonial British cemetery in Belize. Ongoing analysis of burial styles, grave goods, and skeletal remains has increased our understanding of the demographic structure and mortuary traditions of the early European settlers. However, the individuals' specific ancestral populations remain unknown and it is unclear if the cemetery population is comprised of only British settlers or also includes Native American and African individuals. Framed within a broader bioarchaeological context, the analysis of genetic data at the site can enable more accurate assessments of the shifting demographic structure during colonialism.

We collected new genetic data from 20 individuals interred in this cemetery to determine matrilineal ancestral affiliations as well as biological sex. We extracted DNA from teeth, sequenced the first hypervariable region of the mitochondrial DNA (mtDNA), and determined genetic sex by assaying a length dimorphism in the amelogenin gene. Despite the inherent difficulties associated with the analysis of ancient DNA, we obtained endogenous mtDNA sequences from every individual sampled. Data from the amelogenin gene were used to confirm osteological estimations of biological sex and provide novel estimations for poorly preserved individuals. Matrilineal genetic data are consistent with a predominantly British origin for the early settlers, though a few individuals bear sequences consistent with Native American or African ancestry. We show that by

considering the genetic results in conjunction with archaeological and historic data, we can better reconstruct the changing demography of St. George's Caye.

Shape Variation in the Distal Femur of Modern Humans and Hominins

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Although the shape of the early hominin distal femur has been compared with that of modern humans, relatively little is known about the modern range of morphological variation. Here, we analyzed modern human distal femoral morphology to test the relationships between knee shape and sex and body size. The modern human sample was used as a reference to explore shape variation among seven fossil hominins (australopiths, early *Homo* and Neanderthals).

3D surface scans of 290 modern human femora, representing six populations, were identically aligned and linear measurements were taken at multiple angles of simulated knee flexion. In addition, sliding semi-landmarks were distributed across the distal articular surface using standard geometric morphometric (GM) procedures. Procrustes analysis was performed and principal components analysis was used to summarize both shape and form spaces.

Analyses of the modern morphology demonstrate that the prominence of the lateral lip of the patellar groove differs by sex and population, and may be related to bicondylar angle. The analysis of form space found that the patellar surface is anteroposteriorly expanded in larger modern humans, perhaps related to an increase in the quadriceps moment arm. The GM analyses confirm that the lateral lip of the patellar groove is less prominent in australopiths, although linear measurements reveal a high amount of variation both among the fossils and throughout knee flexion. In addition to other known shape differences, the GM analysis demonstrates that australopiths are not scaled-down modern humans, but have anteroposteriorly shortened patellar surfaces even after accounting for body size.

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Geometric morphometric analysis of strepsirrhine upper second molars

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Understanding variation in tooth shape among extant primates is important for dietary, taxonomic, and phylogenetic analysis of extinct species. I aim to answer two questions: 1) does the geometry of upper molars distinguish dietary groups, and 2) are shape changes associated with size?

I placed 12 landmarks on 114 M^2s from 30 strepsirrhine species. After Procrustes superimposition, I performed a phylogenetic Principal Components Analysis (pPCA) on species average co-ordinates. Axes summarizing more than 5% of the variance were retained for further analysis. I tested for differences among dietary groups with Phylogenetic ANOVA, and for size association with Phylogenetic Generalized Least Squares regression of pPCs on centroid size (both univariate and multivariate).

Seven pPCs were retained (80.1% total variance). Four PCs (1, 2, 4, 5) had significant variation associated with dietary groups (p-value range: 0.014 – 0.0003). Post hoc tests showed that folivores, for example, separate from insectivores on pPCs 1, 2, and 5, and from frugivores on pPC4. Three of the pPCs (2,5,7) were significantly associated with centroid size in univariate regressions, but in the multivariate regression size did not explain a significant proportion of the variance.

These results indicate that upper molar geometric shape can be used to distinguish dietary groups. Whereas part of this separation may be due to size associated shape changes, results confirm previous analyses of the lower molar that found that differences in shape between insectivores and folivores are not purely explained by either allometric shape change or phylogenetic differences.

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Entheseal changes as a reflection of activity patterns at 1st century B.C./A.D. Petra

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The residents of the Nabataean capital city of Petra, Jordan remain an enigmatic element of Near Eastern history. Most research has focused on site's architecture rather than the inhabitants living amongst the city's spectacular structures. Excavations of 1st century B.C./A.D. tombs from Petra's North Ridge in 2012 and 2014 recovered a sizeable sample (N=113) of Petra's non-elite inhabitants. This project explores entheseal attachments (entheses) to understand physical activity levels and patterns within this sample. Entheses are insertion sites where tendons and ligaments anchor to the bone, providing stability and support for musculoskeletal movement. Muscular tension at the attachment site can cause pronounced changes on the bone. New methods for scoring entheseal changes in biological anthropology and greater understanding of the clinical relationship between fibrocartilaginous entheses and activity have aided to advance the application of this technique. The Coimbra method was used to document fibrocartilaginous entheseal changes in the upper and lower limbs in this segment of Petra's population. Samples from a Nabataean-Roman community in Syria, a 9th century Great Moravian village, 19th century non-industrialized Holland, 20th century Lake Geneva cemeteries, and a 20th and 21st century U.S. human remains collection served as comparisons for physical activity levels. Results found the Petra sample to have similar activity patterns as non-industrialized settled populations, while controlling for confounders such as age and pathologies. These physical activity patterns offer a new perspective on the socioeconomic aspects of the non-elite Nabataeans of Petra, reaffirming that these residents were part of a primarily settled urban community.

The Effect of Trisomy 21 on Facial Morphology and Variation

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Down syndrome (DS) is caused by trisomy 21, which produces a unique facial appearance that can include midfacial retrusion and reduced facial growth. We quantitatively tested the hypothesis that faces of children with DS (n = 55) exhibit form and variance differences relative to age-matched (4-12 yrs.) samples of euploid DS sibling controls (n = 55) and unrelated euploid controls (n = 55). 3D coordinates of twenty anatomical landmarks were collected from 3D photogrammatic surface images and statistically analyzed. Approximately 36% of facial form measurements differ significantly between DS individuals and DS-sibling controls, whereas 46% of facial measures differ significantly between DS and unrelated controls. Nearly 14% of facial measurements exhibit significant variance differences between DS and DS-sibling controls, while 18% of facial measurements exhibit significant variance differences between DS individuals and unrelated euploid controls. Nearly all measures from the DS sample show increased variance relative to euploid controls. These results quantify a generalized pattern that statistically differentiates DS faces from euploid faces; however, variation is only slightly greater in the DS sample relative to euploid samples. Additionally, faces of children with DS are quantitatively more similar to their euploid siblings than to faces of unrelated euploid individuals, revealing the strong influence of shared alleles in facial development and growth. These observations provide indirect evidence of the strength of genetic underpinnings of morphological resemblance between siblings, regardless of changes in development caused by trisomy 21, which consistently produce a

recognizable DS facial phenotype in unrelated individuals.

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Migration in Imperial Roman contexts (ca. 1st to 3rd c. CE): a multi-isotopic investigation of human mobility at Isola Sacra and Velia, Italy

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Mobility has long been accepted as a characteristic feature of Roman society, traditionally inferred from epigraphy and artefacts. Only comparatively recently have isotopic methods been introduced to studies of Roman migration, permitting detection of individual mobility at various points of the life course.

This study contributes to discussions of Roman mobility through an isotopic analysis of 40 second molars, the enamel formation of which is completed between years 7-8, providing insight to the region of residency during childhood. Dental enamel was analyzed from individuals interred at the necropolises of Isola Sacra, near Portus Romae (n= 20), and Velia, near Paestum (n= 20), two port towns on the Tyrrhenian coast.

All of the individuals from Velia fall within the local range for $^{87}Sr/^{86}Sr$, based on bioavailable data from pigs, yet 4 of these individuals exhibit non-local $\delta^{18}O$ signatures. At Isola Sacra, 7 individuals exhibit $^{87}Sr/^{86}Sr$ values outside of the local range, with a greater number (n=12) falling outside the local $\delta^{18}O$ range.

Strontium and oxygen results suggest that significant mobility (35–60%) occurred in the region around Isola Sacra, while comparatively less mobility (20%) was taking place in the region around Velia. The discrepancy between the oxygen and strontium results suggests that the use of $^{87}Sr/^{86}Sr$ for discriminating migration on the Italian peninsula may be challenging given large regions of geological homogeneity and potential dietary contributions. The results of this study support the use of both oxygen and strontium isotopes to discern mobility.

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A geometric morphometric approach to the study of juvenile long bones from medieval Wharram Percy

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Current understandings of juvenile development are limited by the prevailing methods used to analyze growth trajectories. This study evaluates long bone interaction in a biomechanical framework (previously, neglected due to the lack of an accessible technique to adequately analyze bone shape). Size is studied through linear measurements, while shape is examined using geometric morphometrics. The introduction of this technique allows for a complete study of bone growth and morphology, instead of focusing solely on the diaphysis. This study assesses how geometric morphometrics can be applied to analyze and visualize growth trajectories in long bones.

A dataset of femora (n=25), tibiae (n=31), and humeri (n=36) from 47 juveniles and adolescents ranging from infancy to twelve years old, was collected from medieval Wharram Percy. Three-dimensional models were created for each element by structured-light-scanning and linear measurements of length and metaphyseal width were recorded. Procrustes (GPA), was used to analyze 10 type I and II landmarks and 100 semi-landmarks.

Morphometric analysis revealed there is significant (p=0.003) difference between age groups as shape development occurs in proximal and distal metaphyses (PC1: 44.7%). This is associated with a steady increase in bone length until five years of age. The curvature in the midshaft (PC2: 13.2%) becomes more developed after age five, potentially reflecting an increase in loading patterns.

By introducing morphometrics to growth and developmental studies, the potential for a richer understanding of growth from a social and biomechanical perspective is supported.

Effects of Different Family Economic Strategies on Individual Family Members' Health Among the Boat-Dwelling Shodagor

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The Shodagor are a semi-nomadic people who live and work on their small, wooden boats on the rivers of Bangladesh. Twelve months of fieldwork show that Shodagor women and men contribute to the family economy in several ways, with both mothers and fathers engaging in childcare and working outside the home, fishing and selling goods. Men's and women's modes of production and reproduction complement one another and can be organized into 4 primary family strategies: (1) father works all year, mother stays home as the primary caregiver; (2) father works during the rainy season and stays home as primary caregiver during the dry season, while mother is primary caregiver during the rainy season and works during the dry season; (3) mother and father work together and take children along, both engaging as caregivers; and (4) mother and father both work all year while another family member watches the children. This talk will use anthropometric data collected over the course of 9 months in 2014 to examine the health and nutrition outcomes of each family strategy for parents and children.

Autism related endophenotypes in a healthy random sample: En2, HOXA1 and NLGN3 common variants and differences in regional brain volumes

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Although clinical heterogeneity makes the identification of physiological biomarkers difficult, neuroimaging and genetic associations combined into endophenotypes shows potential. Single nucleotide polymorphisms (SNPs) located in En2, HOXA1, and NLGN3 were shown in animal models and humans to link to non-syndromic autism phenotypes. This study assessed the effect of these common variant SNPs on neuroanatomy using magnetic resonance imaging data from a sample of 1290 healthy adults aged 18 to 42 years.

All analyses controlled for the effects of biological sex, age , MRI scanner type, and total intracranial volume (TICV). Amygdala volumes were normalized using Total cerebellar volume (TCV). Since NLGN3 is an X-linked gene, it was stratified by sex. All analyses were performed using the R statistical software (3.2.2) and *p*-values <0.05 considered significant.

No significant associations were found between EN2 and HOXA1 SNPs on regional cerebellar, cortical gray and white matter, and amygdala volumes. However, multiple regression and ANCOVA analyses showed significant associations between NLGN3 SNP rs11795613 genotype G/A and SNP rs4844285 genotype A/G in NLGN3 and increases in total intracranial volume (TICV) (p=0.014 and p=0.019, respectively) in females. These SNPS also associated with increased left, right and total amygdala volumes; rs11795613 (p=0.023, p=0.028, p=0.014) and rs4844285 (p=0.045, p=0.045, p=0.028). X-linked genes affect males and females differently. Our sample potentially shows a heterogeneous x-linked expression and one possible autism endophenotype.

Recidivism of Traumatic Injury in the Bass Donated Skeletal Collection

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Fractures are the most common type of antemortem condition observed in forensic cases and is also a common modality of identification. Our project seeks to measure the probative value for human identification of fracture frequency

and location within the Bass Donated Skeletal Collection. This project also allows us to examine rates of trauma recidivism in the collection. The purpose of this paper is to determine if a documented sample can provide a baseline rate of recidivism that can be compared to bioarchaeological samples.

The Bass Collection includes nearly 1400 skeletons of individuals who died since 1981. A total of 1,365 adult skeletons and case files were consulted for this study. Of these, 25% of the reported medical histories contained information about antemortem fractures. In contrast, over 40% of the individuals in the sample exhibit antemortem fractures observed in the dry bones. This demonstrates that both self- and family-reported histories underreport fracture incidence. Moreover, only 11.8% of individuals with a medical history of fractures provide specific or relative dates of fractures useful to document recidivism. Females are more likely to have fractures documented in their medical history yet males are over twice as likely to exhibit one or more antemortem fractures in the dry skeleton. While over one-third of individuals observed in the Bass Collection exhibit multiple healed fractures, only a small portion have both healing and healed injuries clearly indicating multiple traumatic incidents. The results indicate that recidivism rates are difficult to capture even in documented samples.

Energy balance across the estrus cycle and its relation to reproductive function in female chacma baboons

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Baboons, among the most adaptable nonhuman primates, have demonstrated the ability to maintain year-round reproduction by altering activity budgets and feeding behavior during the energetically demanding states of pregnancy and lactation. Little is currently known about how females cope with the energetic constraints of estrus, particularly in the context of male mate guarding. Sexual swellings, high rates of received aggression, and decreased foraging efficiency can result in energetic stress during sexually receptive periods. Given the sensitivity of conception to energy availability, individual variation in how females cope with these stressors may translate into differences in reproductive success. We test this hypothesis using observational and hormonal data from 161 reproductive cycles of 32 wild female chacma baboons (*Papio hamadryas ursinus*) inhabiting the Tokai section of the Table Mountain National Park near Cape Town, South Africa. Urinary c-peptides (UCP) quantified from 659 samples indicated that mean energy balances did not differ significantly between phases of the estrus cycle, but individual means among estrous females varied widely (2.7 - 41.6 ng/mg creatinine). We use generalized linear mixed effect models to a) assess behavioral correlates of this variation, including activity budgets and the extent of mate guarding; b) quantify individual differences in glucocorticoid (GC) levels as general indicators of stress responses; and c) test whether UCP or GC variation predicts the likelihood of conception. We discuss the implications of our results for understanding adaptive female reproductive strategies.

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The application of gene tree-based phylogenetic methods to primate morphological data sets

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Gene tree-based phylogenetic methods have emerged as a widely-used method for the estimation of phylogeny across many taxa, including primates. These "gene tree/species tree" (GT/ST) approaches incorporate our understanding of the fundamental population genetics processes underlying speciation, such as incomplete lineage sorting, to better estimate species trees from gene trees. To our knowledge, these methods have only been applied to genetic data despite the assumption that morphological characters are governed by the same population genetics processes as genes. In this study, we attempted to test this assumption by exploring the use of GT/ST methods in morphological datasets. We gathered a range of primate morphological datasets from the literature, extracted a matched multi-gene dataset for each one, and utilized a Bayesian gene tree method to analyze each pair of morphological and genetic data sets. The level of correspondence between resulting paired trees was qualitatively ascertained. We found generally better agreement and more robust groupings between morphological and molecular analyses in larger, more detailed morphological character sets. These results suggest that GT/ST methods can indeed be applied to morphological data sets—including those that sample fossil taxa—potentially enabling novel inferences about human and primate evolution, such as particular instances of hybridization and incomplete lineage sorting.

Signals of loading and function in the human hand: a multi-method analysis of the external cortical and internal trabecular bone of the metacarpals

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Often studies interested in reconstructing behavior from bone remodeling have focused on a single bone and have been limited by analytical techniques that do not easily allow consideration of natural individual or species variation. These limitations may be problematic in comparative studies that address questions of recent and fossil human behavior. This is especially true in studies of the hand where missing skeletal elements can further confound our understanding of past manipulative capacities and tendencies. Here, we aim to address these problems by creating an average model of trabecular and cortical bone for each hand element to which isolated or partial skeletal remains can be compared. Using high-resolution microtomography (~30 micron resolution) of 1st to 5th metacarpals (Mc1-Mc5) from modern humans (n=32), we 1) mapped average cortical thickness to a canonical model, 2) quantified epiphyseal trabecular bone volume (BV/TV), directional anisotropy (DA), and e-modulus (*E*), and 3) mapped site-specific BV/TV to an individual mesh. We found midshaft cortical thickness to be greatest in the Mc2 and Mc3, with the Mc1 and Mc5 being comparatively thin, with thickening at muscle attachment sites. Similarly, BV/TV and *E* are relatively high in the Mc2 and Mc3 when compared to the Mc1 and Mc5, with significant differences (Mann-Whitney U,$p < .05$) between high BV/TV and *E* at the palmar aspect of the metacarpal heads in relation to the dorsal. These consistent patterns have implications for understanding manipulative behavior and provide a comparative background for studies concerned with the evolution of the human hand.

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The Complexities of Life in Death: A Comparison of Single and Multiple Burials from the Middle Tennessee Valley

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In the 1930s and 40s, the Tennessee Valley Authority excavated thousands of prehistoric remains from an area that would be inundated by the Pickwick Landing Dam, located in the Middle Tennessee River Valley. This research analyzes a sample of these remains to compare single and multiple interments from the Pickwick Basin to determine if there is any significant difference in the amount of violent death and ritual practice observed between these two types of burial. In this study, the violent death observed in the sample was determined to likely be the result of warfare, raiding parties, or associated trophy taking. All ritualistic activity observed was determined to be the result of ancestor veneration or trophy taking used in veneration.

While some of the single interments in the sample showed signs of violent death, trophy taking, or ancestor veneration, the majority of the individuals buried in a single interment did not. Similarly, double burials showed little sign of violent death and ritual activity, and were likely reserved for some other purpose, such as kin burials. However, large multiple interments of three or more individuals seemed to serve a different purpose. These large multiple interments were significantly correlated with violent death, trophy taking, and ancestor veneration. The majority of these larger multiple burials appear to have been utilized under special circumstances, including accommodating victims of warfare or raiding or to honor ancestors through veneration.

Socioeconomic status, bioarchaeology, and space: Using ArcGIS to examine mortuary behavior in a medieval Italian cemetery

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Common assumptions in Italian medieval archaeology hold that the proximity of burial locations to churches may be used to infer socioeconomic status of the deceased. However, these assumptions have not been fully tested bioarchaeologically. This project examines the spatial distribution of osteometric data to determine whether skeletal correlates of socioeconomic status correspond with 'privileged' areas of a medieval cemetery. The cemetery of *Pieve di Pava* (Siena, Italy), dating from the 8th to 12th centuries, contains most members of the local community, including members of all socioeconomic statuses. To examine the relationships between burial location and socioeconomic status, this project used femoral bicondylar length (N=63), tibial condylo-malleolar length (N=46), and the sum of the two measurements (N=43), as a proxy for skeletal stature, a sensitive indicator of socioeconomic status. All individual burial locations were incorporated into a geographic information system of the cemetery with centimeter-accuracy. Getis-Ord G Hot Spot analysis rejects the null hypothesis that there are no spatial clustering of osteometric values and results recognizing 90% confidence intervals of both high and low value clusters are considered significant. These results indicate distinct clusters of higher and lower values around the cemetery, some of which support assumptions about location of privileged burials, social positions, and access to resources. This research provides an important starting point to the integration of bioarchaeology and spatial analysis to examine mortuary behavior and health outcomes in a highly stratified society where access to resources is demarcated in both life and in death.

High Osteoporosis Risk among Physically Active Forager-Horticulturalists

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Sedentary lifestyle contributes to osteoporosis and fragility fracture risks among modern humans, but whether such risks are prevalent in physically active pre-industrial societies with lower life expectancies is unclear. Osteoporosis should be readily observable in pre-industrial societies if it was regularly experienced over human history. In this study of 142 older adult Tsimane forager-horticulturalists (mean age±SD=62.1±8.6, range=50-85, 51% female) we use quantitative ultrasonography to estimate calcaneal bone mineral density (eBMD), document prevalence of adults with low eBMD and thus high osteoporosis risk, and identify risk factors (demographic, anthropometric, immunological, kinesthetic) associated with low eBMD. Men (23%) are as likely as women (25%) to experience high osteoporosis risk, although age-related eBMD decline is attenuated for men. Adiposity and fat-free mass positively co-vary with eBMD for women but not men. Leukocyte count is inversely associated with eBMD controlling for potential confounders; leukocyte count is positively correlated within adults over time, and adults with persistently low counts have 7% higher adjusted eBMD than adults with a high count. Low eBMD characteristic of osteoporosis is common among active, energy-limited Tsimane with high pathogen burden but minimal exposure to osteoporosis risk factors found in industrialized societies.

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Skeletal adaptability in response to thermal stress: the paradox of inferring mechanisms of human adaptation

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Recent research has demonstrated that neutral evolution (population history and gene flow) is a primary influence on the skeletal phenotype, while climatic factors influence some specific aspects of variation. The interpretation of skeletal morphology as adaptive, however, is problematic. Similar patterns of morphological variation may be caused by developmental plasticity in response to stress experienced within the lifespan. Morphological correlations with inferred adaptive stressors present us with a paradox: does the morphology correspond due to intergenerational natural selection acting upon genes, or due to normal physiological processes of development and maintenance which influence phenotype in response to environmental conditions. This paper considers the paradox of interpreting skeletal 'adaptation' by investigating a classic example of human adaptability, intralimb indices. The evidence that human intralimb indices are driven by thermal stress is classic example of human adaptation. This interpretation, however, is not fully supported by evidence for rapid changes in limb proportions among migrant populations, and experimental evidence that developmental plasticity may underpin limb segment variation. The correspondence between in intra-limb indices and climate is tested among 17 globally representative skeletal populations of foragers. The results demonstrate that adult populations above 50 degrees north and south latitude show convergence in phenotype with shortened distal limb segments, as predicted by Allen's Rule. Neonates of all populations, however, have proportionately longer distal limb segments than adults, but further develop to adult proportions later in development. While this variation is 'adaptive', the pattern of development suggests it is due to both natural selection and plasticity.

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Ancient DNA and isotope analyses from Misión Salesiana, Tierra del Fuego

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Archaeological and biological data from individuals interred in the cemetery at Misión Salesiana ("Nuestra Señora de la Candelaria") in Tierra del Fuego provide insight into the social and population history of this region. The mission was established in 1893 to Christianize the remaining Selknam, and the majority of burials in the cemetery are about 100 years old. Oxygen isotope and mitochondrial genome data were collected from individuals recovered during archaeological excavations at the cemetery. Oxygen isotope data (n=10) from tooth enamel suggest that most individuals buried in the cemetery are from the local region but one individual has a non-local signature. Mitochondrial genome sequences were recovered from all 15 individuals tested, and C1b and D1g5 were the most common lineages (47% and 17%, respectively). Two additional Native American lineages, D4h3a5 and C1c4 were found at lower frequencies (13% and 7%, respectively). This last lineage has not been previously reported in natives from Tierra del Fuego and corresponds to the individual with a non-local oxygen isotope value. Surprisingly, one individual had haplotype H1c which most likely reflects the inclusion of European individuals in the cemetery. These data were compared with those from modern samples from Argentina and Chile, including five newly generated mitogenomes from northern Tierra del Fuego. Both, modern and ancient samples share the same mitochondrial clades, which are restricted to southern South America. All C1b samples share two polymorphisms in the coding region, which define a new southern Patagonian clade.

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Isotopic Analysis of Prehistoric Human Diet at Chelechol ra Orrak, Palau

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The Chelechol ra Orrak site is one of the largest and oldest cemetery sites in the Pacific Islands. Dating back to at least 2800 BP, the site contains the remains of descendant Palauan populations that may represent individuals who lived within 20-25 generations of the archipelago's first colonists dating back to between ca. 3300-3000 BP. This paper builds on pilot work at Chelechol ra Orrak and explores facets of paleodiet through stable isotope analysis of carbon and nitrogen. To date, twenty individuals have been assayed, and nineteen provide data with good collagen yields. Bone collagen results for stable carbon isotope ratios average -15.9‰ and for stable nitrogen isotope ratios 11.0‰. Bone apatite results for stable carbon isotope ratios average -8.7‰ and apatite-collagen spacing averages 7.2‰. Overall the data are consistent with a marine-based diet supplemented by terrestrial foods, as evidenced by enriched carbon and nitrogen values. Enriched values for bone apatite suggest potential consumption of dietary carbohydrates that may include sugar cane and/or seaweed. When compared to other contemporary groups in the Pacific, the Chelechol ra Orrak samples are broadly similar to early colonizing Lapita populations in Vanuatu and Fiji, which also reflect a marine based supplemented by some terrestrial resources. This paper focuses on the newly expanded dataset and integrates life history data for this population towards a better understanding of the range of dietary diversity at the site.

Multiple Paleopathological Indicators on Individuals in a Lower Status Compound of the Ancient City of Teotihuacan, Mexico

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The preindustrial city (circa 0-600 CE) of Teotihuacan, Mexico, had a dense population in the arid, highland Valley of Mexico, perhaps 80,000 - 100,000 residents. Such a large urban society could have had limited food resources and poor sanitation that would result in high levels of morbidity among the residents, especially those in poorer neighborhoods. The skeletal sample from a residence of multicraft specialists in one of the more modest neighborhoods, Tlajinga 33, had ubiquitous paleopathological indicators of morbidity for all ages. These included enamel hypoplasias on anterior teeth, porotic hyperostosis, and periosteal reactions of the tibia. These Teotihuacan residences were apartment compounds that comprised multiple families, probably linked by kin relations. Nevertheless, there were status differences among them. A question was whether higher status tended to buffer individuals from stress. One way to measure this was to compare the prevalence of multiple paleopathological indicators per individual.

The prevalence of multiple indicators in high status versus low status individuals was about equal, 45%. Thus, higher status did not particularly buffer those individuals from stress, a result which would be consistent with residents sharing very similar hygiene environments and access to food. There were differences by age with lower status subadults lacking multiple indicators. This probably indicates that there were different buffering conditions within a residence, with lower status children only surviving one stress episode and succumbing before another could be registered on the skeleton. Some high status children were more resilient, so status did matter in those ages.

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Neural basis of tool-making skill learning: structure, function and evolution

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Over 100 years of theorizing has linked Paleolithic tool-making to human brain evolution, but empirical evidence has been scarce. To address this, we have adopted an experimental neuroscience approach, training modern subjects to make stone tools and collecting behavioral and neuroimaging data. Functional imaging identified a bilateral frontoparietal network supporting stone tool-making. Some elements, including especially the right Inferior Frontal Gyrus (rIFG), respond more strongly to more complex (Late Acheulean>Oldowan) tool-making, indicating increasing cognitive demands over Lower Paleolithic technological change. Structural imaging of subjects learning to make stone tools showed that training elicits plastic remodeling of the same network, again including rIFG. We thus argued that Paleolithic tool-making not only indexes cognitive and brain changes but was also sufficiently demanding to induce adaptation through a behaviorally driven process of phenotypic accommodation (aka "The Baldwin Effect"). This hypothesis predicted that experimentally induced plastic changes should parallel derived human brain features, which was confirmed by a "virtual dissection" of human and chimpanzee superior longitudinal fasciculus showing expanded human connectivity to rIFG. Here we present new evidence that individual variation in white matter integrity (fractional anisotropy) under rIFG over the course of training predicts actual tool-making success (Oldowan productivity, Acheulean refinement). Right IFG supports cognitive control functions

(conditional response inhibition, task switching) important to complex sequential behaviors including tool-making and language. We propose that rIFG underwent adaptations for Paleolithic technology that were exapted to support the rich, proto-linguistic communication that provided the selective context for subsequent language-specific adaptations in the left hemisphere.

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A Computational Method for Age-at-Death Estimation Based on the Surface and Outline Analysis of 3D Laser Scans of the Human Pubic Symphysis

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Accurate age-at-death estimation is crucial for building individual forensic profiles and studying mortality in past populations. The pubic symphysis is the most widely used skeletal age indicator. In standard practice, symphyseal shape is visually compared to phases, whose morphological characteristics are associated with age intervals. This kind of method introduces some level of subjectivity and observer-related error. Recently two novel, objective techniques have been proposed that use a 3D scan representation of the shape of the pubic symphysis and apply computational algorithms to capture the age-related features of the surface. Both methods use laser scans from ≈ 50 modern American male skeletons with known ages-at-death. The first technique, the *SAH-Score*, measures the scan's surface variance, while the second uses the bending energy produced by the thin-plate spline algorithm to quantify surface structure. These methods are able to capture the transition of the symphyseal face from being covered by well-developed ridges and furrows, for younger individuals, to flattening with increased age. Both methods analyze the same feature of the pubic symphysis – the face. We present an alternative algorithm that measures the curvature of the ventral margin of the symphyseal scans. When applied to the original data used by the two surface analysis techniques, this new measure shows comparable results: RMSE=18.3 years and R-squared=0.19. However, when the face and margin measures are combined in a multivariate regression model, there is a RMSE improvement of about 2 years and an improvement in R-squared of over 10%.

Does puberty influence systolic blood pressure independent of the effects of adolescent growth and body size?

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It has been reported by Canoy et al. that age at menarche influences risk for cardiovascular disease in adults. However, the timing of menarche is confounded by differences in growth rate and body size during adolescence. We used 17 years of longitudinal data to tease apart the relative contributions of pubertal timing and body size on subsequent systolic blood pressure in Dogon males and females in Mali. We assessed pubertal timing using Tanner breast stage for girls and salivary testosterone assays for boys. We created a cross-lag structural equation model (in Stata 13.1) for each sex to explore the strength of the relationship between our predictor variables and adolescent systolic blood pressure. We found that pubertal timing independently increased subsequent systolic blood pressure in both girls (β=.07, p<.001) and boys (β=.05, p<.01); however the effect sizes were small. Specifically, a one *SD* increase in breast stage or testosterone only increased blood pressure by 0.83 mm Hg and 0.61 mm Hg respectively. Somatic capital also increased adolescent systolic blood pressure (girls: β=.21, p<.001; boys: β=.31, p<.001) and the effect size of somatic capital was significantly stronger than that of pubertal timing for both sexes (girls: z=3.16, p<.001; boys: z=4.97, p<.001). A one *SD* increase in somatic capital increased later systolic blood pressure by 2.48 mm Hg for girls and 3.79 mm Hg for boys. In conclusion, retrospective data on the timing of menarche may obscure effects that are actually caused by body size.

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Changing Economic Landscapes in Late Antique Tuscany: Osteological Analysis of Burials from an Abandoned Workshop

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The purpose of this presentation is to report on the preliminary analyses of skeletal remains recovered from an extended-use Roman workshop complex at the site of Spolverino, located near modern-day Alberese, Italy. The site was excavated in 2010-2013 by the Soprintendenza per i Beni Archeologici della Toscana and the University of Sheffield's Alberese Archaeological Field School as part of a regional investigation into Roman era economic and settlement trends. Located strategically at the mouth of the Ombrone River at the intersection of multiple trade routes, the workshops manufactured glass, metal, and bone goods over four centuries of continuous use. Following the abandonment of the complex in the late 5th century, it was repurposed as a small necropolis prior to its conversion to agricultural fields. Four single-inhumation tombs were found in three rooms and were of three different types.

Osteological analyses included those for demographic information and paleopathological conditions. Analysis revealed the presence of two subadults and two adult males. All individuals expressed indicators of active stress, including moderate cribra orbitalia in the subadults and active periosteal reactions in the adults. Of note was one male who expressed evidence of rhinomaxillary syndrome in conjunction with other pathologies.

The burial of these individuals at Spolverino represents a key phase of transition in the transformation of the landscape from thriving manufacturing district to agricultural fields that persist today. Spolverino's abandonment and conversion into a necropolis provide insight into the collapse of the Late Antique settlement network along the Ombrone.

Application of Stable Isotope Analysis to Questions of Status and Dietary Disparities at Chalcatzingo, Morelos, Mexico

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The Formative period site of Chalcatzingo in Morelos, Mexico (1150-450 BCE) represents a socially complex society and contains the only Olmec-style monumental architecture in the region. Evidence for social stratification at Chalcatzingo includes differences in burial location and unequal distribution of rare artifacts. Significant debate surrounds the potential Olmec cultural influence on status formation and social stratification throughout Formative period Mesoamerica. To assess the degree of non-local influence at the site, and to investigate status-linked dietary differences, this study applies stable isotope analysis of bone mineral apatite and collagen to excavated skeletal material. Oxygen stable isotope values of the human remains at Chalcatzingo are used to assess whether individuals were local to Chalcatzingo or emigrated from the Gulf Coast region. Archaeological and isotopic evidence from ancient Mesoamerica support the idea that differential access to preferred food resources - particularly animal protein and maize - is characteristic of social inequality. Because there is evidence for social stratification at Chalcatzingo, unequal distribution of animal protein and maize is expected. Stable carbon and

nitrogen isotope analyses were performed on the human remains and subsequently compared to status indicators in the archaeological record. Preliminary data suggest that elites were consuming slightly more animal protein and maize than non-elites.

Nonhuman Primate Migration: Phylogeny, Demography, and Social Consequences of Dispersal

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Immigration and emigration directly affect the size and composition of primate social groups, and therefore influence levels of intra- and intergroup competition and cooperation. At the same time, competition and cooperation can drive migration patterns as individuals either act to escape from unfavorable conditions within their groups or unite in solidarity against other groups. Whether groups consist of unrelated adults or extended networks of female or male kin is thus a function not only of whether dispersal patterns are bi-sexual or male- or female biased, respectively, but also of the degree to which deviations from these patterns in response to local conditions can occur. Previous analyses have tended to focus either on the strong phylogenetic signal that primate dispersal patterns exhibit, or on the social, ecological, and demographic dynamics of groups in which co-residence facilitates opportunities for close biological relatives of the same or opposite sex to interact with one another during most or all of their adult lives. Nonetheless, considerations of the nature and frequency of intergroup encounters, which vary largely as a function of population size and density, may provide additional insights into the conditions that permit or constrain both secondary dispersal and the ability of kin to maintain ongoing relationships outside of their natal groups. Expanding our models of primate dispersal patterns to include population characteristics also highlights how anthropogenic activities are affecting primate behavior and the continuities between primate and human migration patterns.

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The Microbiome and Primate Conservation: New Tools and Applications

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Many primate populations are rapidly declining around the world. Conservation strategies require a multifaceted approach. We suggest that microbial analyses and microbial ecology of primates offer an important perspective on host species health and conservation. Microbes affect primate physiology and play fundamental roles in both preventing and causing disease. Thus, microbial communities profoundly affect primate health, through relationships that range from commensal and mutualistic to pathogenic, with important implications for conservation. Recent advances in DNA sequencing now make it feasible and economically viable to identify and compare microbiomes across primate species. Microbial communities demonstrate clear spatial (e.g. biogeographic niche specificity both within the anatomical regions of the host body as well as in the geographic location of the host) and temporal (e.g. seasonal, ontogenetic) patterns in their distribution. Microbial communities are also sensitive to alterations in external environment, correlating positively with habitat quality, with direct health consequences. Incorporating an understanding of microbial host and biogeographic niche specificity holds great implications for both forest corridor assessments and reintroductions and this framework can be applied more broadly across other organisms. Studies also indicate that the majority of infectious zoonotic diseases involve bacterial pathogens transmitted between humans and wild populations. The application of microbial ecology to conservation is currently in its infancy, yet understanding the patterns of microbial diversity and recognizing early signs of impending microbial disruptions provide a novel tool for informing conservation strategies and monitoring and preserving primate (including human) health.

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Early-Life Stress and Adult Mortality Patterns During Natufian Economic Intensification: The Linear Enamel Hypoplasia Evidence

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In the Fertile Crescent of Near East, Pleistocene mobile foraging gradually gave way to early Holocene agro-pastoral food-management systems. This study presents a new analysis of linear enamel hypoplasias (LEH) in the region's largest Final Pleistocene hunter-gatherer skeletal series, from the Natufian archaeological culture in the southern Levant (ca. 15,000-12,000 BP). Compared with earlier, more mobile Epipaleolithic foragers, Natufian hunter-gatherer populations subsisted more extensively on smaller game and wild plant food types, which were often expensive to capture or process. Some Natufian groups settled long-term sedentary hamlets. Considering this context of economic intensification, we test the hypothesis that Natufian populations underwent significant young adult mortality selection, prior to the advent of agriculture.

We analyze LEH occurrences observed in teeth from 138 individuals interred in primary and secondary burial features across seven sites. The sample spans the Early (ca. 15,000-13,000 BP) and Late/Final Natufian (ca. 13,000-11,700 BP). Associated dental and skeletal data support age-at-death estimates into juvenile, young adult (ca. < 30 yrs), and old adult (ca. > 30 years) categories. G-test and Fisher's exact tests warrant rejecting the null hypothesis that LEH markers of early childhood stress associate similarly with all survivorship categories. We find consistent evidence in support of higher LEH prevalence among young adults, when compared with both juveniles and old adults. This constitutes novel Pleistocene population-level evidence for the DOHaD (developmental origins of health and disease) hypothesis, involving heterogeneity in early-life stress shaping adult mortality risks.

Regional variation of bone properties within the human lumbar vertebrae

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Within a single bone, trabecular bone structural morphology has been shown to be site-specific, presumably in response to local strains. Because left-right directional asymmetries have been documented in both lumbar vertebrae height and lumbar musculature, we tested the hypothesis that there would be local asymmetry in bone microstructure within the L4 vertebra. Trabecular structure was quantified from micro-CT (46 μm) images of the L4 vertebral body from three populations presumably engaged in active lifestyles – males (age 15-30, n=10) from the hunting/fishing Libben population (800-1100 CE); white males (age 18-42, n=13) from the Hamann-Todd Osteological Collections (1910-1940); and white males (age 24-40, n=7) from the Bass Osteological Collections (1981-present). The Bass individuals had documented active occupational lifestyles. Although occupation is unknown for the Hamann-Todd individuals, they were European immigrants with stature, body mass, and limb skeletal indicators consistent with overall health prior to sudden death. Asymmetry in bone volume fraction was found in the Hamann-Todd vertebrae (right greater than left, $p=0.003$), but no asymmetry was detected in either the Libben or Bass vertebrae. Interestingly, compared to Libben and Bass, the Hamann-Todd vertebrae had significantly lower bone volume fraction ($p<0.001$), thinner trabeculae ($p<0.001$) and reduced degree of anisotropy ($p<0.001$).

Although the asymmetry hypothesis was only partially supported, the results of this study

support the utility of bone microstructure in reflecting high activity occupations during life. The relatively poor bone health of young males represented in the Hamann-Todd collection suggests caution for its use in comparative studies of bone microstructure.

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From foraging to Facebook: Market integration and health among the Shuar of Southeastern Ecuador

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Initiated in 2005, The Shuar Health and Life History Project examines the effects of socioeconomic and ecological variation on life history and health, to better understand both our evolved biology and current global health problems. Shuar are experiencing rapid but varied market integration (MI): e.g., portions of the Shuar population remain dependent on foraging and horticulture, while others are regularly on Facebook. We discuss how we attempted to construct locally valid MI measures, as well as measures useful in cross-cultural comparisons. These include style of life measures based on material ownership of goods, livestock, household structure and infrastructure, income and sources of income, schooling, food frequency and foraging frequency among others. We identify conceptual challenges with operationalizing MI using these measures. We summarize main findings indicating utility of these measures for examining effects of MI on health (e.g., glucose, lipid profile, blood pressure, overweight, hemoglobin, helminth infection, inflammation, growth) for a sample of 1121 individuals from 351 households located in two regions of Shuar territory: 7 communities from the Upano Valley with generally greater MI, and 6 from the "interior" less market integrated trans-Cutucu region. Findings illustrate challenges in using locally valid vs more cross-culturally generalizable measures of MI, and trade-offs between collecting cross-sectional data across a broader region vs collecting longitudinal data across a smaller sample, particularly in the face of extremely rapid socio-ecological and health change.

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The relationship between patterns of subchondral bone apparent density and trabecular bone structure in the hominoid knee

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Studies of hominoid knee function often focus on the external morphology of the lateral compartment because of its role in joint flexion and rotation, with apes exhibiting features thought to confer greater mobility and humans exhibiting features that maximize stability for the bipedal extended knee. The goal of this study is to investigate the patterns of subchondral bone apparent density and the underlying three-dimensional (3D) trabecular architecture in the hominoid knee joint as they relate to joint movement during locomotor loading. MicroCT scans of paired femora and tibiae for 14 humans and 6 chimpanzees were collected. Subchondral apparent density was calculated using a radial maximum intensity projection method for the distal femur and an orthographic projection method for the proximal tibia. Subchondral apparent density revealed a general trend of a posteriorly-positioned dense region in humans and a larger swath extending anteriorly and posteriorly in chimpanzees on the lateral condyles. Trabecular volumes of interest (VOIs) were extracted anteriorly and posteriorly within the condyles. Results showed that humans have significantly greater bone volume fraction in the posterior VOI, while chimpanzees have no significant difference between VOIs. These results suggest that the hypothesized increased mobility of the ape lateral condyle is reflected in the more extensive region of density tracking across the lateral condyle. On a smaller scale, the combined analysis can track the habitual movements of the femoral condyle on the tibial condyle, and on a larger scale, it can provide information about joint mobility, posture and locomotor differences among hominoids.

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Ancient genetic diversity and an evolutionary medicine perspective on Neandertal extinction

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The Eurasian sympatry of Neandertals and anatomically modern humans has long sparked anthropological interest in the factors that potentially contributed to Neandertal extinction. Among many different hypotheses, one extinction model is that modern humans and Neandertals were disproportionately affected by exposure to novel infectious diseases that were transmitted during the period of spatiotemporal sympatry. A history of genetic admixture and thus direct contact between humans and Neandertals has recently been confirmed by comparisons of new archaic hominin paleogenome sequences with modern human genomes. Analyses of these data have also shown that Neandertal nuclear genome genetic diversity was likely considerably lower than that of the Eurasian anatomically modern humans with whom they came into contact, perhaps leaving their innate immune systems relatively more susceptible to novel pathogens. In this study, we compared levels of genetic diversity in genes for which genetic variation is hypothesized to benefit pathogen defense among Neandertals and African, European, and Asian modern humans, using available exome sequencing data (six chromosomes per population). Genetic diversity was estimated based on the number and allele frequencies of observed single nucleotide polymorphisms (SNPs) per population. We observed that Neandertal genetic diversity was relatively low in 73 innate immune system genes. In contrast, Neandertals and humans have similar levels and patterns of genetic diversity in nine major histocompatibility complex (MHC) genes. Thus, Neandertals may have been relatively more susceptible to some novel pathogens; differential pathogen-resistance should be considered as one potential contributing factor in their extinction, albeit cautiously.

Arm swing in bipedally walking chimpanzees

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Human walking is characterized by coordinated out-of-phase movement of the arms and legs. Arm swing is likely produced passively by the momentum of the legs (that it also counteracts), but with active tuning by shoulder muscles. The aim of this study was to determine if the fundamental mechanisms of arm swing extend to bipedal non-human primates. We measured electromyographic activity of the anterior deltoid, posterior deltoid, trapezius, triceps, biceps, pectoralis major, and latissimus dorsi muscles, and quantified the 3D kinematics of arm movement in two chimpanzee subjects during bipedal walking. Interlimb coordination was the same in chimpanzees as in humans, with

the upper arm being extended at the ipsilateral heelstrike and flexed at the contralateral heelstrike. We found consistent phasic muscle activity occurring at ipsilateral heelstrike, in the latissimus dorsi for both subjects, and the triceps for one subject. We also found almost constant low-level activity for the posterior deltoid in both subjects. Therefore, like in humans, the forward swing in chimpanzees is mostly passive while the backward swing may in part be produced by the latissimus dorsi. Most human studies have also observed extensor activity, but a few report additional low-level activity in anterior deltoid and biceps (<3% maximum contraction). Ranges of humeral motion in the sagittal plane were 16–30° with significant abduction and humeral rotation. This range overlaps with the 27° of mean sagittal plane motion reported for humans. These results suggest that the basic pattern, and potentially function, of arm swing extends to facultatively bipedal chimpanzees.

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The use of dye staining methods to distinguish between erythrocytes and fungi in ancient tissue histology

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Reports of structures consistent with erythrocytes (i.e., same cell size and approximate shape of modern, healthy erythrocytes) in ancient skeletal tissue have been critically assessed because postmortem contaminants, such as fungi, have a similar morphology. It has been argued that to state definitively that erythrocytes are present they must be verified by the presence of specific proteins using immunohistochemical staining; however, immunohistochemical staining only demonstrates that the protein itself is present. If the protein is degraded on the surface of the erythrocyte, the researcher may misclassify an erythrocyte as a contaminant. This results in a loss of data.

The methods outlined in our research do not rely on the proteins necessary for immunohistochemical studies to be preserved. Instead, we provide an alternative staining approach that can verify erythrocytes in the absence of the cell-surface proteins. This method requires less time and is not as costly as the more complicated immunohistochemical studies. Paraffin-embedded bone sections from archaeological contexts and control *Aspergillus* slides were stained using haematoxylin and eosin (H&E), PAS staining with a Schiff reagent to detect carbohydrates (fungi), and an iron-specific stain that detects hemosiderin in degraded erythrocytes. Our research demonstrates that it is possible to distinguish between erythrocytes and fungi using a combination of these staining techniques.

Comparing Methodologies for Documenting Commingled and Fragmentary Human Remains

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Commingled and fragmentary human skeletal assemblages are a common occurrence in both archaeological and forensic contexts, but only recently have methods been created to manage the complexities of these assemblages. Conventional methods for calculating the Minimum Number of Individuals (MNI) for these types of assemblages, such as is detailed in *Standards for Data Collection from Human Skeletal Remains,* rely on the tabulation of specific portions of skeletal elements (for example the distal 1/3rd of a radius). This method while widely used and accepted is highly subjective and limits the ability of future researchers to use and interpret these estimates. More recent developments in techniques for the recording and analysis of these assemblages have repurposed zooarchaeological zonation methods. One such method, developed by Anna Osterholtz also uses a visual-based recording system, tabulates MNI through the presence of bone features, and incorporates additional data about the bones in a database.

This study identifies any significant differences in MNI calculation results using *Standards* versus Osterholtz's methods. The assemblage of fragmented, commingled remains recovered during the 2012 season of the Petra North Ridge Project (preliminary MNI = 30), previously recorded using *Standards,* has been reanalyzed using Osterholtz's methodology and the results compared. The MNI based on Osterholtz's visual-based system was not significantly different from that using *Standards*. Therefore, the precision of the two methods combined with the better metadata in Osterholtz's system suggests that this method should be the choice for individuals working with commingled and fragmentary remains.

Variation in Lateral Plantar Process Position and Functional Implications in Living Humans

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The lateral plantar process (LPP) is an inferolateral tuberosity on the posterior body of calcaneus. It has been hypothesized that the presence of the LPP increases the volume and mediolateral breadth of the human calcaneus, thus better distributing the ground reaction forces. Due to its hypothesized importance for modern human bipedalism, it has been suggested that the position of the LPP is an important structure in hominin locomotion, though it's functional role remains in question. Therefore, this study provides a quantitative analysis of LPP position in a population of modern humans for which gait data are available.

LPP position was measured in 16 healthy, adult participants using MRI data. Anatomical positioning for the calcaneus was established by orienting the Achilles tendon in line with the sagittal plane. The measure of the dorsoplantar positioning of the LPP was taken as a ratio of the height of the calcaneal body (mm) versus the distance from the base of the calcaneus at the LPPs most lateral point (mm). There is considerable variation in LPP position, with a mean ratio of 15.3 and standard deviation of 4.2 (max=23.2, min=8.7). Variation in LPP position was used to test hypotheses relating LPP position to foot posture and function. These results have implications for how the LPP can be understood to influence the mode of bipedalism in modern human populations, as well as our interpretation of the variation observed in fossil hominin calcanei.

Lead Uptake in the 19th Century: High Resolution Imaging Uncovers Details Associated with the Franklin Expedition and Contemporary Populations

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In 1845, the goal of the Franklin expedition was to map the route of the Northwest Passage. Using two ships, Sir John Franklin and a crew of 128 men set sail from England in May of that year never to return again. Questions continue to surround the events that led to the deaths of so many people. Previous analyses of bone and hair samples indicate that crewmembers had high lead (Pb) levels, and this finding suggested that Pb poisoning was a major factor in the loss of the expedition. One promising method for clarifying the timing of Pb exposure is high

resolution synchrotron imaging where Pb deposition patterns are identified and matched with bone remodeling events. Our objective was to image bone samples from individuals associated with the Franklin expedition as well as from individuals in contemporary populations. Similar Pb deposition patterns would suggest that Pb poisoning was not a cause of the Franklin tragedy. Our study included bone samples from an early 19th century Royal Naval Hospital cemetery in Antigua, West Indies, and samples from Stirrup Court, a middle 19th century cemetery near London, Ontario, Canada. The results identified similar Pb deposition patterns, which indicates that many individuals were chronically exposed to Pb during the 19th century. This study supports recent conclusions that Pb was not a unique factor in the downfall of the Franklin expedition.

Measurement Strategies in Dental Metrics: Caliper Measurements versus Computer Measurements Taken from Photographic Images

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Metric assessments of dental remains are significant to biological anthropologists because of their potential ability to discriminate between the sexes, and provide insight into the phylogenetic relationships between different hominin and hominid groups. Anthropologists most commonly use sliding calipers in order to take dental measurements, but with recent advances in biometric technology, new image-processing programs are being created which can potentially give researchers the ability to take accurate measurements from photographic images. This study aims to examine the potential of biometric programs as an alternative to traditional caliper measurements by comparing the software ImageJ with caliper measurements. The buccolingual and mesiodistal diameters of the first and second maxillary molars of 93 individuals from the Hamann-Todd Collection were taken first with digital calipers, and then again with ImageJ using photographic images of the same samples in order to test whether or not measurements are consistent with each other. Intraobserver error was calculated for both the caliper and ImageJ measurements and was determined to be 0.99% and 2.83% respectively. A paired sample t-test was performed using SPSS which determined that ImageJ and caliper measurements are statistically different within a 95% confidence interval. In light of these results, the author suggests that measurements taken from photographic images are useful in some contexts, but may skew the results of a study if used in conjunction with caliper measurements or in a study which aims to measure very small intraspecific differences.

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Trabecular mapping: Leveraging sliding landmarks for analyses of bone microstructure

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Grounded in Wolff's Law, studies of primate bone microstructure have sought to elucidate the adaptive significance of bone microarchitecture, often with equivocal results. Analyses of the mandibular condyle have focused on the relationship between trabecular structure and food material properties and/or differences in feeding behaviors among taxa. These studies frequently analyze the entire condyle as a volume of interest (VOI), despite evidence suggesting that trabeculae are not uniform across joint surfaces, at least in humans.

Here we present a method for evaluating variation in bone microstructure across articular surfaces by leveraging sliding landmarks to sample multiple VOIs. 83 landmarks (82 sliding) were distributed across the mandibular condyle of *Cercocebus atys* (n=12). Following implementation of standard geometric morphometric procedures, landmarks were used to locate the positions of 83 VOIs in the trabecular structure deep to the cortical shell. VOIs were extracted and trabecular properties measured for each VOI using BoneJ. We address two questions: 1) are microstructural variables homogeneous across the condyle? and 2) if microstructure is not homogeneous, are higher values of microstructural variables concentrated on the lateral pole, as predicted by prior models of TMJ function?

Results suggest that microstructure is not homogeneous across the mandibular condyle. Bone volume fraction and trabecular thickness are highest along the center of the condyle and the medial pole. These results suggest that further investigations are warranted regarding variation in microstructural properties across the condylar surface, and that similar investigations of other articular surfaces may reveal more nuanced variation in trabecular architecture.

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Northern genomes: Ancient mitogenomes and Arctic prehistory

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The North American Arctic archaeological record supports multiple migrations beginning approximately 6,000 years BP, thousands of years after the initial colonization of the Americas. Modern Iñupiat/Inuit peoples are the descendants of a recent (~800 ybp) and rapid (<200 years) migration by the Neo-Eskimo Thule. Archaeological research, and reduced genetic diversity in modern arctic peoples, suggests a west-to-east migration. Ancient populations of the North Slope, however, the likely place of origin for the Neo-Eskimo, have been under sampled. Partial and/or complete ancient mitochondrial sequences are lacking, so clear links with extant mitochondrial diversity are equivocal.

We examine how Arctic mitochondrial genetic diversity has been shaped over time after these successive migration waves at two prehistoric Alaskan archaeological sites with human burials. Nuvuk is a long-term Thule village at Pt. Barrow, AK, with radiocarbon dates spanning from Early Thule to modern Iñupiat. Igliqtiqsiugvigruaq is a more recent and interior sub-Arctic site adjacent to the Kobuk River and dating indicates an age near the turn of the 19th century.

We report 40 hypervariable region sequences and three selected whole mitochondrial genomes from Nuvuk, previously typed as D4b1a2a1a(D3) and A2. We additionally selected three individuals from Igliqtiqsiugvigruaq previously typed as A2b. Our archeological and genetic analyses of ancient Iñupiat from two Alaskan North Slope sites demonstrate continuity between prehistoric Neo-Eskimo Thule populations and extant Arctic populations.

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The neural correlates of multimodal communication in chimpanzees *(Pan troglodytes) and bonobos (Pan paniscus)* and their implications for the evolution of human language

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The study of communicative behavior in nonhuman primates is critical for understanding the evolutionary origins of human language and the biological substrates that support these

competencies. However, data from the species with the closest phylogenetic relation to humans, chimpanzees and bonobos, are relatively scarce. Previously, we have used anatomical and functional imaging, in conjunction with behavioral observations and experiments, to examine the neural correlates of communicative behavior in the two extant species of *Pan*. In this talk, I will review these data in relation to the hypothesis that continuities exist among the communicative behavior of chimpanzees and bonobos and components that are fundamental to human language. In terms of production, the data indicate that both chimpanzees and bonobos produce manual communicative gestures in conjunction with vocalizations. In chimpanzees, the production of these signals selectively activates the Broca's area homologue, suggesting that this critical human language region was involved in multimodal communicative signaling prior to the split between humans and chimpanzees some 5 million years ago. Species differences have been identified at both the behavioral and neuroanatomical levels as well. Specifically, bonobos tend to rely more heavily on vocalizations as compared to chimpanzees. In addition, preliminary data suggest that bonobos may show greater overall volume, and greater local interconnectivity in the Broca's area homologue when compared to chimpanzees. These data will be examined in relation to the hypothesis that species differences in vocal signaling between chimpanzees and bonobos are associated with differences in cortical organization.

Homeotic transformations in the human vertebral column – global or local

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Researchers differ in their interpretations about whether cranial and caudal shifting (i.e., homeotic transformation) in the vertebral column affects the entire vertebral column or only a regional segment – global vs. local. This study considers homeotic transformations of the sacrum and adjoining vertebrae. Modally, humans have 24 presacral (PSV), 5 sacral, and 4 coccygeal vertebrae. Cranial and caudal shifts result in 23 and 25 PSV, respectively. With cranial shift, 24th and 29th vertebrae (modally, last lumbar and last sacral) are transformed to sacral and coccygeal, respectively. Conversely, with caudal shift, 25th and 30th vertebrae (modally, first sacral and first coccygeal) are transformed to lumbar and sacral, respectively. Skeletons of 990 individuals, ages 18 to 39 years, from Hamann-Todd and Terry Collections were analyzed. Individuals with 24 PSV (n=897) show these prevalences for number of sacral vertebrae (S): <1% S4, 64% S5, 33% S6, and 2% S≥7. Individuals with 23 PSV (n=37) and 25 (n=56) differ significantly from those with 24 PSV in prevalence of number of sacral vertebrae: (1) 23 PSV – 27% S5, 70% S6, and 3% S≥7; (2) 25 PSV – 9% S4, 77% S5, 12% S6, and 2% S≥7. With caudal shift, vertebra 26 (S1 for these individuals) is not fully transformed; individuals with 25 PSV have significantly narrower sacrum than those with 24 PSV. Results suggest that homeotic transformation of the sacrum and adjoining vertebrae is incomplete for both cranial and caudal shifting, and that homeotic transformation is more local than global.

Using geometric shape for subfamily level taxonomic attribution in mixed, unassociated fossil cercopithecoid postcranial samples

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Fossil cercopithecoids are an important component of South African Plio-Pleistocene fossil communities, including multiple species of the colobine *Cercopithecoides,* and a variety of cercopithecine taxa including species of *Papio, Parapapio* and *Theropithecus* (among others). Aside from their own intrinsic value, they serve as model organisms for understanding hominin ecology, landscape use and in-deposit biostratigraphy. While craniodental remains have been well studied, there has historically been less research on postcrania given the limitations of attributing unassociated postcranial elements to a particular taxon. Without confident taxonomic attributions, reconstructing locomotor habits and understanding niche partitioning in this diverse group is challenging.

Here we present an approach using three-dimensional shape to allocate cercopithecoid postcranial remains to a subfamily. We collected landmark coordinates on the most frequently preserved portions of the postcranial skeleton across a broad spectrum of modern cercopithecoids, fossil colobines, and on the mixed cercopithecoid samples from four South African fossil localities: Kromdraai A and B, Coopers' A, Swartkrans Member 1, and Haasgat. A discriminant function analysis developed from these data was used to attribute unknown fossil individuals to subfamily. Our results indicate that the proximal femur, proximal ulna, distal humerus and calcaneum are the best areas for discriminating between subfamilies (> 85% correct classification on cross-validation for the most part), and most known fossil colobines were classified correctly. These results demonstrate that the complex morphology in these regions records both adaptive and phylogenetically relevant data, and that the method shows promise for taxonomically sorting unassociated postcranial remains at these sites.

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Comparisons of strength and predictability of Neanderthal and modern human femora under loading conditions simulating traumatic loads

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It has been hypothesized that the distinctive anatomy of the Neanderthal femur may be an adaptation to withstanding traumatic loads associated with a physically demanding lifestyle. This hypothesis was tested using finite element analysis, in which finite element models of Neanderthal and modern human femora were subjected to simulated traumatic loads. Resulting data allow an assessment of femoral strength in each species, as well as the degree to which shape affects the predictability of the stresses experienced by the femora.

The Neanderthal and human femora were initially each subjected to identical loads, but the Neanderthal was also subjected to scaled loads such that differences in stress between the human and Neanderthal reflect differences in shape but not size. As a baseline, traumatic loads were applied at the moment of heel strike during normal bipedal walking. Analyses explored the consequences of three traumatic load scenarios: 1, a direct hit to the anterior surface of the femur; 2, a hit to the lateral surface; and 3, a postero-lateral hit. Results indicate that the Neanderthal femur is not especially well configured to withstand traumatic loads. The scaled Neanderthal model is weaker than the human model at nearly all locations during two of the three traumatic load experiments, at some locations in the third experiment, and is less predictable, on average. Neanderthals may or may not have had a lifestyle that exposed them to a high risk of trauma, but regardless, their femora appear not to have adapted to those risks.

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Neanderthal Introgression to Western Asian Human Populations

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Neanderthals contributed genetic material to ancestors of all Eurasians. Neanderthal admixture occurred at least once in Western Asia during the out-of-Africa migrations of modern humans, followed by additional admixture events in Asia and in Eastern Europe. Here, we specifically test the hypothesis that the initial

admixture event that occurred in Western Asia might continue after humans spread to rest of Eurasia, with the implication that humans from present-day Western Asian populations would carry higher proportions of Neanderthal ancestry in their genomes when compared to present-day Europeans. To test this, we sequenced whole genomes of 10 present-day Europeans, Africans and Western Asians and analyzed available whole genome data from various other populations, including 16 genomes from present-day Turkey. Our analysis found no significant differences in Neanderthal introgression rates between Western Asian and European populations. We further found that present-day Turkish population carries lower proportions of Neanderthal ancestry as compared to European populations, which is in contrast with our initial hypothesis but in congruence with previously suggested sub-Saharan African ancestry in the Turkish population. Overall, we conclude that either (i) interbreeding between Neanderthals and modern humans did not continue after the dispersals of humans into rest of Eurasia; or (ii) genetic drift and migrations have diluted the traces of additional Neanderthal introgression events. We are now resolving the Neanderthal-introgressed haplotype structure and distribution of Neanderthal introgressed structural variants in Western Asia. These new results will refine the evolutionary and demographic dynamics that led to contemporary distribution of Neanderthal haplotypes.

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Investigating the relationship between cranial superstructures and activity in modern humans

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Human cranial robusticity is generally characterized by cranial size and thickness, as well as the presence and expression of features such as tori, crests, and tubercles. These cranial superstructures are known to vary among sexes and population groups in modern humans, and are often utilized to examine evolutionary relationships in fossil hominin taxa. Consequently, researchers have focused their efforts on understanding the potential factors influencing cranial superstructure expression, investigating variables such as cranial shape and masticatory stresses. Baab et al. suggested that activity levels may influence these cranial features; however, this hypothesis has yet to be evaluated.

This study investigated this potential relationship by comparing levels of cranial superstructure expression to external long bone dimensions, which have been shown to be significantly correlated with activity levels in modern humans. Ten cranial traits were scored according to Lahr and Wright and Baab et al. and external shaft dimensions of the femur and humerus were collected from a sample of U.S. White individuals (n=120) from the Hamann-Todd Collection. Measures of postcranial robusticity were compared to the cranial trait scores using Spearman's rank correlations. Of the numerous pair-wise comparisons, few demonstrated statistical significance and in those cases only weak positive correlations were obtained. These preliminary results indicate a lack of a meaningful relationship between cranial superstructures and postcranial robusticity, suggesting that activity levels likely do not play a major role in cranial trait expression. Future research should incorporate more direct measures of physical activity and utilize a more diverse sample.

Fiber phenotype of the jaw adductors in the hard-object feeding sooty mangabey (*Cercocebus atys*)

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Fiber phenotype is an important determinant of the contractile properties of a muscle fiber and is crucial for understanding physiological characteristics such as endurance and velocity of shortening. Here we present novel data on fiber phenotype of the jaw adductors in adult male (n=4) and female (n=4) sooty mangabeys (*Cercocebus atys*). Using immunohistochemistry, we quantified the distribution and proportion of type I and type II myosin heavy chain (MHC) isoforms in the superficial (SM) and deep (DM) masseter, and the superficial anterior (SAT), deep anterior (DAT) and superficial posterior (SPT) temporalis muscles.

Results demonstrate that *C. atys* masticatory muscles express an abundance of MHC alpha-cardiac (Iα) and an unexpected paucity of MHC IIm in all regions except the SAT and SPT. Iα fibers produce more rapid forces compared to Iβ fibers but are roughly equivalent in endurance. In comparison with *Macaca mulatta* and *Papio anubis*, *C. atys* show a predominantly fatigue resistant phenotype for the ASM, DM, SAT and DAT. Habitual resistant-object processing is a key component of *C. atys* feeding ecology. Frequent high bite forces generated by *C. atys* have the potential to fatigue type II motor units. The comparatively slower fiber phenotype of *C. atys* may thus serve to maximize endurance while maintaining a moderate contraction rate and force per motor unit. Our findings suggest that Iα fibers may be more prevalent in primate jaw adductors than previously appreciated, providing a fiber population that is fast yet has greater endurance at lower cost than type II fibers.

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Profiling caregivers: hormonal variation underlying allomaternal care in wild red-bellied lemurs

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Allomaternal care (AMC) is present in all major primate radiations, and is abundant in primates relative to other mammals, suggesting strong selective pressure for AMC early in primate evolution. Despite this, we know little about what led to the expansion and diversification of AMC throughout the Order, including the proximate mechanisms promoting and maintaining it. We investigated potential hormonal correlates of AMC in the red-bellied lemur (*Eulemur rubriventer*), a seasonal breeder with facultative AMC. We studied 13 groups during two consecutive birth years (August-April 2013; June-April 2014; 2,107 observation hours) in Ranomafana National Park, Madagascar. AMC first occurred 35 days post-partum (±24.9 SD) and individuals varied in how much they contributed to the total time infants were carried (0 - 37.6%; mean: 4.3% ± 8.85 SD, n=24 individuals). We compared the change in fecal androgens (n=12 individuals) from the post-partum period (PPP) to the infant carrying period (ICP). The PPP spanned the first four weeks following the birth of a group infant. The ICP spanned the first four weeks after AMC was observed. We used the mean number of days after birth that AMC occurred to determine ICP for non-helpers. The percent change in androgen levels across periods was more variable and significantly greater in helpers (M=-312.94, SD=297.01) than non-helpers (M=-31.34, SD=89.74); independent samples t-test, $t(10)=2.03$, $p=0.035$ (one-tailed). Similar to mice, prairie voles, and baboons, helpers' androgen levels unexpectedly increased during the ICP. These results may be due to the aromatization of androgens from estradiol, which can stimulate infant care.

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Patterns of Violent Crime and Injury Recidivism in Southern Nevada

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Injury recidivism has become of great interest in the clinical, medical and forensic literature. The evidence of individuals who repeatedly are victims of violent trauma is ubiquitous and demonstrates similar demographic patterns on a world-wide basis. Limited research has been done on contemporary morgue samples to explore the demographic characteristics for those who died a violent death. This study examines all homicide deaths from Las Vegas and Southern Nevada that have been examined by The Clark County Office of the Coroner/Medical Examiner from January 2015 to July 2015 to determine demographic patterns and to identify instances of injury recidivism. Las Vegas presents a unique location to examine violent death due to its heterogeneous composition. Patterns in death reveal that of a total of 73 individuals killed during this time period, 53 (73%) were male, and 41 (56%) belonged to an ethnic minority, 47 (64%) were under 45. Two individuals display evidence of repetitive trauma, and this reveals important information about how injury recidivism works in this context. Both individuals deviated from the normal recidivist profile (both were white males over 45). This study also presents hypotheses about why injury recidivism may be difficult to track based on autopsy and police reports of those recently killed, versus the clinical and medical literature that reports injury recidivism for cohorts of living people. This study concludes with suggestions for how data on the medical history of victims can be enhanced to include possible predictors (such as injury recidivism) of increased violence.

Bioarchaeological approaches to the study of early-life stress: the potential of human skeletal and dental remains to studies of life history theory

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Methodological and theoretical developments over the past 20 years have introduced a lifespan perspective to the study of stress and mortality in human populations. These studies reveal that stressors experienced early in life may have profound consequences on future developmental pathways, altering growth, disease resistance, and mortality schedules. Theoretical explorations suggest that this feedback system reflects developmental plasticity and constraint, plasticity insofar as the body has the capacity to reorient energetic resources to surviving stress events and constraint inasmuch as future energetic investments in growth, maintenance, and survival are diminished. There is great potential in bioarchaeological research to address these questions because the human dentition and skeleton provide an indelible record of stress events that occur early in development, growth faltering, disease profiles, and mortality. In addition, because the mortuary record provides a structural and symbolic window into individual identities, it is also possible to contextualize how social structure may mitigate or exacerbate the influence of early life stress on future energetic investments in growth, maintenance, and survival. Studies of the human dentition and long bone growth in hunter-gatherers from Japan and Siberia demonstrate that individuals who experienced growth disruptions early in development were at a significantly greater risk for future growth disruptions and early mortality (age at first enamel hypoplasia formation: $p < 0.013$, $p < 0.043$; long bone growth: $p < 0.043$; $p < 0.027$) . These results suggest that the lifespan perspective adopted by bioarchaeological research is an important component to understanding the consequences of early-life stress.

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Musculoskeletal Stress Markers of Humerii from Two Lower Mississippi Valley Populations: Implications for Subsistence-Based Activity Patterns

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Wolff's Law states that bone is laid down where it is needed; therefore, mechanical factors, including subsistence-based activities, play a role in bone biology. One of bone's responses to strain is the development of musculoskeletal stress markers (MSMs) at entheses, the sites at which soft tissues attach to bone. Although numerous factors contribute to MSM development, they can be used to make inferences about the general work load and specific, albeit hypothetical, activities of past populations' subsistence behaviors. The following study examines eight MSMs of the proximal humerii from the Tchefuncte (circa [ca.] 1,000 B.C. – A.D. 1) and Greenhouse (ca. A.D. 700 – 1,200) sites in Louisiana. The MSMs were segregated into muscle groups (flexion, extension, and abduction), scored and tested statistically for bilateral asymmetry, sexual dimorphism, and inter-populational variation to provide insight into handedness, the division of labor, and diachronic changes, respectively, as related to subsistence activities. The MSM scores were also tested for a correlation to body size. The results of this analysis indicate that MSMs are neither bilaterally asymmetric, nor do they have a significant relationship to body size among these skeletal populations. The Tchefuncte males have significantly higher MSM scores than their female counterparts and the males from the Greenhouse site. These findings suggest that variation of subsistence-based activities may be manifest in MSMs, perhaps related to the ecological/environmental setting and the sociopolitical organization of their respective societies.

Eating seeds or cracking hard food? Mechanically-informed dietary categories and the dental topography of anthropoid primates

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Teeth are usually depicted as tools adapted to specific challenging food. Still, classical dietary categories (folivore, frugivore etc.) may encompass very different dental challenges. Here, we test alternative categories based on the food hardness/toughness and on the actions performed to access/process it. We expect these categories to better describe tooth shape than the frugivore and omnivore categories, that group very different items. Leaves are much less diverse, hence folivore category should have similar predictive power.

Using a micro-CT scanning device, we extracted both dentine and enamel surfaces of 70 unworn upper second molars (M2s), from 18 genera of anthropoid primates. Computation includes enamel relative thickness (RET), relief (RFI), occlusal complexity (OPC) and curvature (DNE).

Post-hoc comparisons of the means performed on a one-way ANOVA show that both folivores ($p<0.002$) and tough food-shearers ($p<0.005$) possess a high relief and curvature. On the other hand, the enamel is thicker in primates that crack and grind hard food ($p<0.005$) or crack structurally tough food ($p<1e-06$). They have more complex M2s ($p<0.01$) and a lower enamel relief ($p<0.005$). In contrast, the analysis fails to isolate seed predators from folivores except with RET ($p<0.001$).

Influence of seasonal food is also noticeable. Omnivore and frugivore species that grind and shear tough fallback food have more complex M2s (OPC, $p<0.01$). Frugivore primates that fall back on soft and tough insects, like *Callicebus*, show higher DNE values ($p<0.01$). Mechanical categories thus appear to support the assumption that challenging fallback foods play a major role in tooth adaptation.

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Windover: An Overview of the Past 30 Years

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Over the past 30 years the Windover site (8BR246) has been a source of information about the lifeways of archaic Native Americans. This 7,200 (BP) year-old mortuary pond housed intentional human burials that, due to anaerobic conditions, provided near optimum preservation of not only the skeletal material but an amazing array of normally perishable organic artifacts. The excavated portion of the site contained 168 individuals, evenly divided between males, females, adults and subadults. The relatively large cemetery (for its early time) provides an almost unrivaled opportunity for paleodemographic, isotopic, and paleopathological study of prehistoric lifeways and health in this early 'quasi-Mesolithic' period in the New World. The inventory of handwoven fabrics is striking and researchers are witness to the technological sophistication of early groups which normally is unappreciated and generally unknown. The wooden, bone, dentary, and antler tool inventory coupled with diverse multidisciplinary research strategies highlight the importance of wet sites in informing us about the past. This study reviews the accomplishments of research from the Windover collection since its discovery. Some of the most unique and unexpected aspects of this hunter-gatherer group, are the unusual amount of dental crowding, the earliest case of spina bifida, and the lack of upper limb asymmetry.

Big questions, microscopic solutions: the utility of linear enamel hypoplasia to studies of stress over the past 30 years

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This study examines the ways in which dental anthropologists analyze linear enamel hypoplasia (LEH) and how the incorporation of microscopes as a standard instrument has shifted the way in which LEH can be interpreted. Over the last thirty years, LEH research has been a central component of inquiry for dental anthropologists, especially in terms of understanding the prevalence of biological stress in past human populations. Historically, macroscopic analyses were the primary method used in this specific area of research, and the focus was primarily on LEH prevalence. Microscopic technology allows for greater resolution of factors surrounding stress exposure. Specifically, studies among the pre- and proto-historic inhabitants of Japan and Peru reveal that stress chronology, periodicity, and duration are possible to estimate using incremental microstructures of enamel. For example, microscopic studies found no differences in stress episode duration between Jomon foragers from different regions of Japan. Stress chronologies reconstructed from tooth enamel in Japan and Peru correspond to the period following up to age-at-breast-feeding cessation, while LEH periodicity estimates in Japan were on average 8-months shorter than those reported from earlier macroscopic studies. Social aspects of stress can also be explored, with prehistoric Jomon foragers experiencing the greatest number of LEH (90 percent confidence intervals) during the period of ontogeny associated with childhood. Results obtained from these studies suggest that microscopic evaluation of LEH provides dental anthropologists an opportunity to answer questions of historic theoretical importance using methods that provide increasingly higher levels of resolution.

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Investigating primate cuboid shape within the context of adaptive evolution, allometry, and locomotion

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Variation in cuboid form across Primates may be diagnostic of habitual foot use and locomotor behavior. However, morphological variation cannot be directly attributed to function without first testing for phylogenetic effects, or accounting for size-related differences and other factors. We test hypotheses about the effects of phylogeny, adaptation, and allometry on cuboid shape and size in a sample of 432 individuals from 70 primate species. Cuboid shape was quantified using dense semi-landmark grids placed on the proximal and distal facets. First we test the hypothesis that phylogenetic effects are the primary determinant of cuboid shape using a phylogenetic mixed model assuming a Brownian motion model of random evolutionary change. While the phylogenetic effect varies across different components of cuboid size and shape, we find a residual correlation among some aspects of shape indicating that adaptation or other non-phylogenetic effects structure species differences in shape. We also used the Stochastic Linear Ornstein-Uhlenbeck models for Comparative Hypotheses to compare models that included terms reflecting both phylogenetic and adaptive evolutionary processes. We used an indicator of arboreality as a predictor of adaptation. Log centroid size and arboreality explained 42% of the total variance in the first component of shape and fit marginally better than a model that only included centroid size (ΔAICc -3.4). Thus, while phylogeny has some effect, much of the among-species variation in cuboid shape is determined by size and the degree of arboreality.

Understanding child obesity risk at the household level: The influence of parental and grandparental health beliefs and practices in Chinese families

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The home environment is an important factor shaping child health and development. Less clear is how caregivers' health beliefs and practices influence child weight, particularly in countries with changing family and socioeconomic environments. Thus, this study examines how parents' and grandparents' health beliefs and food- and physical activity-related behaviors influence the risk for central obesity in Chinese children aged 6-18 years. Data come from over 2000 two- and three-generation households participating in the 2009 wave of the China Health and Nutrition Survey. Multilevel logistic regression models were used to examine the impact of parental and grandparental feeding practices and child health beliefs on child central obesity (waist-to-height ratio (WHtR) >0.5), controlling for household and child characteristics. Parental, but not grandparental, central obesity was a risk factor for high child WHtR (mothers: OR: 2.39; 95%CI: 1.32-3.76; fathers: OR: 2.85; 95%CI: 1.71-4.75). Food and health beliefs differed significantly between generations within the same households. Grandparents were more likely than parents to believe that diets high in sugar and fat were healthy. Grandparent, but not parent, participation in household food preparation was associated with greater risk of child obesity. Parental beliefs about the importance of healthy child diets and physical activity were inversely associated with child WHtR, suggesting that Chinese parents' diet and health beliefs may arise in response to their child's obesity. Overall, these results highlight the importance of the home environment in shaping child health and suggest that understanding household dynamics is important for stemming child obesity.

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Congenital Conditions and Genetic Traits in the Prehistoric Middle Tennessee River Valley

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In the late 1930s and early 1940s, the Works Progress Administration (WPA) conducted archaeological excavations along the Tennessee River in northern Alabama for the planned construction of hydroelectric dams. In 2015, collaborative efforts between The University of Alabama Office of Archaeological Research and Department of Anthropology resulted in the osteological analyses of nearly 1200 sets of remains from a select sample of WPA sites. The bioarchaeological evidence for congenital conditions and genetic traits is examined for inheritance and familial affiliation at the intersite and intrasite levels. Examination of these data indicate individual and communal relationships of prehistoric populations in the Middle Tennessee River Valley. Some genetic traits, including depressed inions, proved to be ubiquitous being recorded at moderate frequencies at numerous sites throughout the river valley. In contrast, cases of conditions that included genu valgum and Klippel-Feil syndrome were sparse and geographically isolated. Interestingly, craniosynostosis, while limited in frequency when examined at the intersite level, was recorded in several individuals at the intrasite level. By examining these data in this manner, it can be determined that some gene flow was occurring throughout the river valley, while at the same time and at specific locations, there is greater isolation between the sampled populations.

Frontal plane trunk mechanics in humans and chimpanzees, and implications for the bipedal gait of the last common ancestor

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The human trunk, during locomotion, must create a stable base for the head and sensitive cranial organs. Yet, the trunk must also move mediolaterally to shift the center of mass (CoM) of the body over the stance-side foot. Trunk stability in modern humans is facilitated by a valgus knee angle and narrow step width, which reduces the mediolateral distance the CoM must travel each step. The ankle of *Ardipithecus ramidus* suggests that the earliest bipeds, and likely the *Pan-Homo* last common ancestor (LCA), may have lacked valgus knee angles—unlike later australopithecines. Here we investigated the relationship between trunk motion, step width, and CoM mechanics in chimpanzees and humans. We found that chimpanzees and humans use distinctly different strategies to control frontal plane CoM motion.

Chimpanzees rotate (list) their entire trunk, and especially thorax, laterally to achieve a CoM placement near their laterally placed stance-side foot. Humans shift their trunk laterally as a unit, and with only small angular deviations. Within the trunk, the small thoracic list that does occur in humans primarily counteracts swing-side pelvic drop. In chimpanzees, the angular excursion of the thorax (beyond that which is due to list of the pelvis alone) is correlated with increased CoM motion (P<0.01), which is in turn correlated with increased mediolateral mechanical work (P<0.001).

These results suggest that if pre-australopithecine bipeds lacked valgus knee angles, their bipedal locomotion would have been characterized by wide step widths, pronounced thoracic angular motion (with consequences for head stability), and increased mechanical work.

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***Homo naledi* strides again: preliminary reconstructions of an extinct hominin's gait**

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In this preliminary reconstruction of *Homo naledi*'s gait we begin with the null hypothesis that it walked similarly to modern humans, as the overall anatomy of this extinct hominin's lower limb, especially its foot, is mostly modern human-like. We note the following characters as modern-like: dorsally-canting metatarsophalangeal joints facilitating toe-off, locking transverse tarsal joint implying a rigid midfoot during stance, flat subtalar joint limiting ankle pro- and supination, talocrural joint oriented orthogonally to the substrate, valgus knee, thick patellae increasing the moment arm for quadriceps femoris, and well-developed thigh muscle attachment sites throughout the femur. These characters suggest *Homo naledi* was well-adapted to a striding bipedal gait. However, we also note the following less modern-like characters: curved pedal phalanges, low sustentaculum tali and likely a low fundamental longitudinal arch, pronounced tubercular insertion of the pes anserinus tendon on the proximomedial tibia, long femoral neck with a marked medial encroachment of the obturator externus, posteriorly positioned ilium relative to the acetabulum, flared iliac blades, broad lower ribcage, and characters of the lower thoracic vertebrae and lower rib suggesting robust hypaxial muscles. We offer our initial functional interpretations of the cumulative postcranial morphology, which suggests different trunk stabilization from modern humans but is consistent with orthogrady and an obligate bipedal locomotor regime. Given the anatomy of the upper limb, *Homo naledi* demonstrates co-existence of both bipedalism and climbing adaptations in one hominin taxon.

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Metabolic Limits and Adaptation in Humans: Daily Energy Expenditure in *Race Across the USA* Athletes

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Ecological studies using doubly labeled water (DLW) comparing energy expenditure in populations of humans and non-human primates have found no significant difference in total energy expenditure (TEE) among active vs. less active populations. Such similarity in TEE suggests bodies adapt to long-term increases in physical activity, maintaining TEE within a narrow range, but the timing and limits of metabolic adaptation are not well understood. We examined short- and long-term metabolic response to extremely high levels of physical activity in six subjects (5 male, 1 female, age 32-73 y). Subjects ran more than 26 miles per day, 6 days per week, for 20 weeks as part of the *Race Across the USA* transcontinental running event. Using the DLW method, we measured TEE prior to the start of the Race, and then during week 1 and week 20 of the Race. Week 1 TEE (25.0 ±5.2 MJ) was near the highest measured for humans, and the elevation from pre-Race TEE (11.0 ±6.0 MJ) matched the increase expected from running workload. For the four subjects who finished the Race, week 20 TEE was 3.9 ±3.5 MJ lower than week 1, indicating metabolic adaptation to long-term high activity levels. We discuss the implications of these results for reconstructing daily energy requirements from activity budgets in humans and other primates.

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Stabilizing selection and optimal group size in geladas

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Group size is a fundamental component of primate socioecology and is thought to reflect the costs and benefits of female sociality. However, empirical data to test hypotheses about the causes and consequences of group size within a species are rare. Here we take advantage of the unusual social structure of geladas (*Theropithecus gelada*) to study variation in group size. The core groups in gelada society are one-male units that aggregate into larger groups (bands) allowing us to simultaneously study multiple social groups ranging in size from 1-12 adult females. We analyzed 9.5 years of reproductive data from a population of geladas living in the Simien Mountains National Park, Ethiopia (33 one-male units, 187 adult females). When we examined reproductive success, we found strong evidence for stabilizing selection. Specifically, females in mid-sized units (5-7 females) had significantly higher reproductive success than females in both large (8+ females) and small (1-4 females) units. Variation in success was largely due to differences in infant survival, with infanticide causing a majority of deaths. Several lines of evidence suggest that females prefer, and actively seek, an optimal group size. First, many of our largest units were observed to fission. Second, a few of the smallest units were observed to fuse with another small unit. Third, females in mid-sized units had the lowest levels of glucocorticoids. Fourth, females in mid-sized units exhibited the strongest grooming relationships. Together these results represent some of the first intra-specific data on how and why group size varies in primates.

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Intrapopulation Variation in Craniometric Ancestry Proportions of a Modern Cuban Sample

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Multiple populations came in contact in Cuba during colonization, which has differentially influenced the genetic makeup of the living population. The objectives of this paper are to determine the relationship of the craniometrics and published genetic data of modern Cuban individuals from Havana, Cuba, primarily in relation to three samples that are used to represent ancestral groups. This paper also examines the intrapopulation variation of the craniometrics in relation to the three ancestral groups by assessing the population as a whole, as well as by sex. Craniometric data from modern Cuban individuals were collected from the Museo Antropológico Montane in Havana, Cuba (n=95), which were compared to craniometric data from individuals included in samples from indigenous Caribbean groups (Native American), Spain (European), and West Africa (African). A normal mixtures cluster analysis (NMA) was conducted to determine the mean ancestral proportions for all individuals in the Cuban sample. The results demonstrate that the highest mean ancestral proportion is European (73.60%), with 71 individuals clustering closest to the European center, followed by African ancestry (18.41%; n=18) and Native American ancestry (7.98%; n=6). Based on the NMA results, a ternary plot was created to demonstrate the intrapopulation variation among the Cuban individuals in relation to the ancestral centers, including the variation among the male and female individuals. This paper incorporates the population history to further understand the intrapopulation variation present in the craniometrics of modern Cuban individuals.

A comparative study of human and howler monkey Toll-Like Receptor 7 under the selective pressure of yellow fever virus

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Human and non-human primates (NHPs) share many genetic similarities, particularly loci coding for immune responses. We looked at genetic changes in immune genes using a novel comparative approach that focuses on humans and NHPs sharing an environment and pathogenic exposure. Our comparative model was humans and howler monkeys (*Alouatta palliata*) in Veracruz, Mexico. We studied genetic polymorphism in TLR7, a highly conserved innate immune gene, under the pathogenic pressure of the Yellow Fever Virus (YFV). Research has shown that howler monkeys are much more sensitive to YFV than humans. This may reflect differential abilities to respond to immune challenge. Microbiome composition has also been linked to disease susceptibility; therefore we also examined the microbiomes of humans and howler monkeys. We hypothesized that 1) regional pathogenic selection pressure on TLR7 has led to DNA sequence differences in humans and howler monkeys and 2) microbiome composition is associated with TLR7 genotypes. We collected fecal samples from howler monkeys in three forest fragments surrounding Veracruz, Mexico and from humans in in two nearby villages. Sequence analysis revealed that the coding region of TLR7 has functional nucleotide differences when species are compared. Further analysis is needed to understand whether microbiome composition differences between the two species, beyond those due to phylogeny, are responsible for YFV susceptibility. In the future, we aim to compare human and howler monkey TLR7 sequences and microbiomes to those living in regions with recent YFV outbreaks and in regions that are not threatened by this pathogen.

Examining the Variation of Orbital Shape in Modern Human Populations Using 3D Geometric Morphometrics

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In forensic anthropology, one of the most commonly used methods for assessing ancestry is the shape of the orbital opening. Angular, rounded and rectangular orbits are considered as characteristic of European, Asian, and African populations, respectively. The development of new technologies allows these categories to be visualized and examined in more detail. A 3D geometric morphometric analysis of 83 specimens from Europe, North Africa, South and Southeast Asia, Australia, and North, Central and South America was undertaken to study geographic variation in orbital shape. Orbital shape variation was visualized using 49 standard osteometric landmarks and 20 semilandmarks around each orbit.

The results of principal components analyses confirmed the characterization of angular orbits for Europeans and rounded orbits for Native Americans and Asians, while suggesting rectangular orbits in the Australian population. This study suggests that changes in orbital shape reflect shifts of orbital landmarks and rims in three dimensions. Specifically, the medial placement of orbitale and superior placement of ectoconchion cause a rounder appearance, whereas the lateral placement of orbitale and inferior placement of ectoconchion cause a more angular appearance. Additionally, rectangular orbits result from the posterior displacement of lateral relative to the medial orbital rim combined with low orbital height. Although these traits clustered according to geography, there was a substantial amount of overlap among populations, demonstrating that orbital shape is a continuous, not discrete, characteristic.

Wearing the marks of violence: Unusual trauma patterning at Coyo Oriente, northern Chile (AD 400-1000)

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Previous studies of violent injury in San Pedro de Atacama during the Middle Horizon (AD400-1000) have shown that wealth and influential interactions did not create peace. Cemeteries reveal 8-17% of adult individuals displaying evidence of cranial trauma. Interestingly, our recent analyses of the Coyo Oriente cemetery (n=217), revealed significantly higher rates of cranial injury with over 40% (n=88) of the individuals showing evidence of cranial fracture. There was no significant difference between the sexes (38F, 40M). Just over 90% (n=80) of injuries involved the nasal region. The remaining eight injuries were distributed across the cranium and included projectile and potential blade injuries as well as one that appeared perimortem. Several individuals had multiple healed injuries, frequently involving other parts of the face.

Fracture patterning suggests that this violence may have been structured. Others have suggested ritual battles for the patterns at Coyo Oriente. When compared to other Middle Horizon cemeteries these data are unusually patterned, but also are higher rates of violent injury and number of females involved in altercations. Analysis of grave goods does not reveal a preponderance of weapons, and in fact those in the grave can almost all be tied to subsistence or economic practices. The injuries we documented may reflect some form of hand-to-hand combat or opportunistic weaponry, rather than warfare. We suggest that these data are perhaps tied to Coyo's postulated role as a burial place for individuals tied to mining and metallurgy and may reflect labor related injury in addition to sanctioned conflict resolution.

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Geometric morphometrics of sexual dimorphism and pulmonary kinematics in *Homo sapiens*

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Previous research has demonstrated sexual dimorphism in the size and shape of the human cranial airways and of the postcranial skeletal part of the human respiratory apparatus. The purpose of this study is to extend this research to soft tissue morphology, breathing kinematics, and functional anatomy. Virtual 3D models of lungs were reconstructed from computed tomography (CT) data of 19 males and 21 females in maximal inspiration (Total Lung Capacity, TLC) and expiration (Residual Volume, RV). On these 80 lung models we digitized 415 landmarks and semilandmarks for 3D geometric morphometrics analyses of variation in size and shape related to sex and breathing kinematics. Results of mean comparisons show significantly greater pulmonary size in males than in females both in inspiration and expiration. Also, principal component analysis in Procrustes form space reveals that the prismatic morphology of female lungs differs clearly from the pyramidal lung shape of males. Mean comparisons of Procrustes distances between sex-specific lung shapes in inspiration and expiration reveal a significantly greater pulmonary deformation in males. These findings suggest morpho-functional differences in the human respiratory apparatus of males and females. The caudally divergent shape of the male lungs suggest a diaphragmatic contribution to breathing kinematics that contrasts with the more prismatic lung shape of females that could indicate a predominant intercostal muscle action during breathing. We speculate that pulmonary shape differences may explain differences in respiratory capacity, which could have implications for understanding the evolution of hominin thorax shape.

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Enamel defects in *Paranthropus robustus* relative to other South African hominins

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Studying enamel defects can provide insight into the health, diet and environmental stresses of past populations. Previous research has focused on differences in enamel hypoplasia frequencies in and between a range of populations, including South African hominins. Here we build on this research by analyzing the interaction between different forms of enamel defects, including pitting and linear enamel hypoplasia (LEH). The number of teeth affected by LEH is similar across species and sites, ranging from 9.6% in *Paranthropus robustus* to 14.8% in *Homo naledi*. There are however considerable differences in enamel pitting frequencies. *Paranthropus robustus* has particularly high rates, with 14% of the permanent teeth and 47% of the deciduous teeth affected compared to 4.3% and 6.7%, respectively, for all other South African hominin teeth. In both the permanent and deciduous teeth of *P. robustus* the severe pitting often covers large areas of the crown and is characteristically made up of numerous relatively uniform small depressions. When pits do not cover the whole crown, they are typically more defined and prevalent toward the occlusal surface. Interestingly no linear enamel hypoplasia is found on any *P. robustus* deciduous teeth. Research on severe enamel pitting in deciduous teeth in modern humans covers a range of causes, from high fluoride levels in drinking water and vitamin D deficiency through congenital diseases and genetic disorders related to malnutrition during pregnancy. A differential diagnosis concerning causes for the high rate in *P. robustus* is presented, including the potential for a genetic, developmental, or environmental component.

A New Quantitative Method to Analyze Geospatial Variations in Speech and Vocalization

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Vocalizations play an important role in the social structure and development of many species of animals including hominins, apes and, especially, humans, in whom vocalization has evolved and diversified so far that it has become nearly 7000 informatically complex and immensely diverse languages. Studying how these vocalizations change and evolve is a central pursuit in understanding the social structure, behavior and evolution of all animals, including humans. Furthermore, spatial variation is a well documented, and often very pronounced, form of vocalization variation and may play a role in reproductive isolation and thus, speciation. Here, we present a new method for analyzing geospatial trends in animal vocalization using frog calls as a model organism to demonstrate the utility of our method. Unlike previous methods, ours does not rely upon the use of spectrograms. Rather, we analyze the signal directly, avoiding some of the issues with spectrograms.

To develop and demonstrate our method, a sample of 187 mating calls of the Cope's Gray Treefrog (*Hyla Versicolor*) were downloaded from a Cornell repository. These calls were then aligned using a modified form of Generalized Procrustes Analysis after being cleaned to remove noise. The aligned calls were then run through a dimension-reduction method and related to the GPS coordinates in UTM format using spatial regression. Using both simulated

test data, as well as the real data from our model organism, we show that our method is a reliable and powerful way to quantitatively analyze the geographic variation in vocalization patterns.

This study is indebted to the Macaulay Library of the Cornell Lab of Ornithology for generously allowing us to download and use their frog calls for our research.

Only the men will do. Exploring sex and gender in Andean mass death assemblages

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While many feminist anthropologists invite us to broaden our theoretical approach in the construction of gender in bioarchaeological investigations of past societies, there may be cases where there is overwhelming evidence for explicitly male-dominated skeletal assemblages. Researchers also identify the key difference between massacres as acts of indiscriminate mass slaughter compared to mass killings where perpetrators select victims with specific intent. Several case studies from the ancient Central Andes include large quantities of skeletons whose remains are marked by patterned perimortem trauma consistent with a massacre event (Kuelap, n=106), regular human sacrifices (Túcume, n=116), and a reprisal execution (Punta Lobos, n=~180). Yet, in all three contexts osteological analyses identify similar demographic profiles. While each collection includes a fair proportion of juveniles, all of the adults are males, except in the case of the massacre, which includes only seven females. This paper argues that biological estimates of sex serve to highlight a consistent pattern of men as victims of social violence. Each example occurred within separate cultural contexts serving distinct social, religious, and political purposes yet all demonstrating the use of violence to evoke a specific cultural change.

Crural index of immature *Homo naledi*

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Crural index (100 x tibia/femur length) is a potentially revealing measure of climatic adaptation in hominins. Generally, across modern human populations, higher indices are positively correlated with mean annual temperature. The high crural index of the *Homo erectus* specimen KNM-WT 15000 (88.6) has been taken as evidence of a thermoregulatory adaption to a warm climate, while the lower, more Neandertal-like crural index of Dmanisi *H. erectus* (80.3) may correspond to the lower winter temperatures of the Caucuses. The lower limb sample of *Homo naledi* from the Dinaledi Chamber of the Rising Star cave system in South Africa is extensive, but quite fragmentary and intermingled; however, three nearly complete immature lower limb bones, including a right femur and a left and right tibia, were discovered in close proximity to one another inside of the chamber and may offer insight into the femorotibial proportions of the species. While the diaphyseal dimensions of each of the three immature elements are approximately 80% that of adults in the assemblage, supporting the hypothesis that these bones belong to a single individual, femorotibial diaphyseal proportions fall outside of the 95% CI for modern humans, perhaps due to the pronounced platycnemia of the Dinaledi tibiae. Treating these immature *H. naledi* long bones as belonging to a single individual results in a crural index of ~96, suggesting marked tibial elongation relative to the femur and warm climate adaptation (following the human pattern), though further analysis of element relatedness is necessary to confirm this value.

The distribution of the C677T allele of the MTHFR human gene in Eurasia: evidence of two distinct clines

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The high frequency of the C677T mutation in the MTHFR gene has been the subject of selective proposals because in the homozygote state, it is associated with strokes, and with increased probability of producing neural-tube defects (NTD) offspring. The latter pregnancies result from the fact that C677T homozygotes have impaired folate metabolism, a known causal factor of NTD. Lucock et al. note that the intensity of solar radiation at conception influences MTHFR allele frequencies, thus supporting the "folate-vitamin-D-sunlight-hypothesis" previously proposed by Jablonsky. To test the proposal that MTHFR gene frequencies are associated with solar radiation, we obtained samples taken from the ALFRED data base which provide the sample's coordinates. We found continental differences in frequencies of the T allele, where the Sub-Saharan region has a mean frequency of 0.06, Asia of 0.27 and Europe of 0.37. A Spearman correlation between latitude and T frequency in Europe yields r_s=-0.74 ($p<0.001$, n=24; as latitude increases, the frequency of the allele decreases). In stark contrast, the Spearman correlation between the frequency of the T allele and latitude in Asia is r_s=0.64 ($p<0.0001$, n=32; as latitude increases, the frequency of the allele increases). The correlation between latitude and T frequency in Africa was not significant. The fact that the results for Europe and Asia are so different suggest that if there is a selective force involved in the high frequency of the T allele, it is likely associated with folate dietary sources rather than with folate radiation-associated depletion.

Asymmetric Femoral Torsion Among the Oneota of Illinois

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Skeletal indicators of posture can allow us to reconstruct behavioral patterns in the past. While some indicators have a biological basis, others are indicative of cultural behaviors. Individuals of the Norris Farms skeletal collection were members of a tribal subsistence agricultural group who briefly occupied the landscape around 1300AD. The collection consists of 132 adults, of which 83 had both left and right femurs intact; these individuals were selected for femoral torsion measurement. Femoral torsion is a twisting of the femoral shaft, which affects placement of the knee and ankle. Among this population, asymmetry of the femurs was found to relate to sex (p-value = 0.00) but had no correlation with age (p-value = .207). Finding such a strong correlation to gender, suggests that this asymmetry is not a biological trait but rather is stimulated by cultural practices. Wescott et al. (2014) studied the Arikara of North Dakota dating to 1600AD and noticed a similar trend. Their research suggested that women's posture while working and sitting was habitually maintained enough to cause femoral torsion. Ethnographic documentation and photographs from European contact show women working with their legs swung off to the side. While the photographic documentation cannot confirm this explanation for femoral torsion, this allows for the potential explanation for the phenomenon viewed among the Norris Farms Oneota. The interplay between behavior and biology is an important aspect of understanding past cultures, such as those buried at Norris Farms.

Investigating musculoskeletal health and limb biomechanics in Mandena, Madagascar: A quantitative approach to understanding normal and pathological gait patterns

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A variety of factors including loading patterns, geography, and nutrition impact skeletal form and health across populations, yet little is known about worldwide variation in limb function, especially in the face of changing work roles and diet globally. Madagascar is

undergoing rapid epidemiological and dietary transitions, which may lead to increasing chronic musculoskeletal conditions; however, no data have been collected on mechanical patterns in Malagasy populations. To test the hypothesis that joint dysfunction is present in this changing population, we collected self-reports of joint pain and measured ground reaction forces for 95 individuals living in Mandena, a village in northeastern Madagascar (n_{female}=55, n_{male}=40). Participants completed a joint pain survey and walked freely across a force platform embedded in the ground. The shape of the vertical GRF curve is influenced by joint pathology and pain, changing in form and adding an additional force peak in certain pathological gait patterns. To characterize and compare the shape of waveforms across populations, Fourier analysis was used to generate coefficients that describe the curves. Select coefficients were found to differ between those reporting painful versus normal joint functionality. While there were no gender differences in reported joint pain, the force curves contained a third force peak in one-third of both normal males and females but in 66.7% of pathological males and 23.8% of pathological females (p=0.0041). This analysis provides new insights into the relationship between cultural, occupational, and dietary shifts and joint pathology globally, highlighting the importance of musculoskeletal function in global health.

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The impact of a natural disaster on physical and mental health: Offspring morbidity and crop loss as mediators of paternal testosterone, cortisol, and depression among Bolivian forager-farmers

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Natural disasters impact all populations, yet impoverished indigenous populations may be more vulnerable and less able to recover. Here we examine impacts of catastrophic flooding on a subsistence population with limited support from formal institutions (e.g. government, NGOs, insurance). Immediately following a devastating 2014 flood that impacted >75% of Tsimane communities, we conducted structured interviews (n=655 households, 2327 individuals) examining material losses, morbidity, and mental health in 25 Tsimane villages. A subset of 421 individuals provided saliva specimens which were analyzed for cortisol and testosterone. More than 99% of households interviewed reported some degree of crop loss, and 70.6% reported injuries or illness. We hypothesized that males who do the majority of horticultural labor would experience greater psychological distress from crop losses, while women who do the majority of child care would experience greater distress from child illness. Men with more crop losses reported problems sleeping at night (p=0.013) compared to men reporting fewer losses; for women crop loss was not associated with depressive symptoms. Child morbidity was associated with paternal sadness (p=0.033); mothers reported the same depressive symptoms as fathers as well as nervousness, crying, and changes in sleep patterns (all $p \leq 0.05$). For males, lower levels of testosterone were associated with higher severity of crop loss (p=0.038) and child illnesses (p=0.024); cortisol was also lower in men with more severe child illness (p=0.001). Disasters eliminate crops, kills animals, and flood homes, creating intense psychosocial stress, thereby impacting health, sleep, and the ability to mobilize and recover from disaster.

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Sailors lost in time: A Pathological study of Dead Man's Island

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Dead Man's Island was located in San Pedro, California. The island was used as a burial ground during the early to mid 19th century; according to local legend, it was mainly used for sailors. The island became part of an artificial harbor; the jetty amplified tidal action, which started to erode Dead Man's Island. Workers were sent in to remove the exposed burials and reinter the individuals on the main land. However, not all individuals were removed. From 1928-1930 the area was dredged and the island destroyed. A supervising archaeologist collected any archaeological remains during the entire process. The collected material is stored at the Los Angeles Natural History Museum. The aim of this project is to determine MNI, organize excavated material, assess demographic information, and observe pathological conditions. Based on analysis, the MNI of excavated material is four individuals. However, is there any evidence to support the local legend that these people were sailors through their demographic information and health status? The individuals, as well as miscellaneous bags, were sexed to be young males, ranging from adolescent to late twenties. All four of the individuals presented with destructive fibrocartilaginous and/or fibrous entheseal changes, most likely resulting from acute trauma (possibly overuse injuries) or infectious disease. Other signs for trauma and infectious disease were present in these individuals as well. As these were young males with traumatic and/or infectious injuries, this supports (but does not verify) the local legend of these individuals being 19th century sailors.

Systemic patterns of trabecular structure in *Homo* and *Pan*: Evaluating inter- and intraspecific variability across anatomical sites

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As trabecular bone remodels during life in response to load, it can be an indicator of joint loading during bone use. However, some comparative studies have been unable to link variation in trabecular architecture with joint function within and between species. One unexplored explanation is that there may be systemic, species-specific patterns of trabecular structure that complicate assessments of trabecular bone across joints of the same individual and within the same joint across species.

We investigate trabecular variation across the skeleton in arboreal/quadrupedal *Pan troglodytes verus* (N=7) and bipedal *Homo sapiens* (N=4). Using a whole-epiphysis analysis, we quantify trabecular thickness (Tb.Th), bone volume fraction (BV/TV), structure model index (SMI), connectivity density (Conn.D), and degree of anisotropy (DA) in the humeral head, third metacarpal head, proximal femur, distal tibia, talus, and third metatarsal head. We find species-specific characteristics that are consistent across the skeleton. *Pan* has a higher mean BV/TV and Conn.D in all anatomical regions. However, no other parameters differ consistently between the two species. There are some similarities between *Pan* and *Homo* in how trabecular parameters vary across joints; there is a common systemic pattern in Tb.Th and Conn.D, whereas BV/TV and DA have divergent patterns likely reflecting variation in joint function. Trabecular variation between the proximal humerus/femur, and between the metacarpal/metatarsal head may reflect differential fore- and hindlimb loading between species.

Understanding the systemic pattern of trabecular architecture in *Pan* and *Homo* aids identification of functional differences, and may allow targeted analysis of trabecular bone in fossil hominins.

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Micro-anatomical features specific to metabolic problems found in the 6th left rib: A comparison among samples from the Raymond Dart and the RRP collections

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Thin sections from the left sixth rib are examined histologically from individuals whose cause of death ranges from alcoholism, cancers, heart failure, non-specific malnutrition, and pellagra. The goal of this project is to better understand the impact of a range of metabolic circumstances that affect micro-anatomy of bone. The sample consists of 24 individuals with a mean age of 46 and a range of 27-73 years. The samples are divided into groups specific to health conditions; minimally, comparing results between healthy individuals and individuals with chronic health conditions. Data was collected for the following variables: cortical area, cortical thickness, osteon population density (OPD), the number of forming osteons, the number of double zonal osteons, the number of type II osteons, the number of drifting osteons, osteon area, Haversian canal area, and finally, number and size of Howship's Lacunae. This data was also collected regionally: posterior, anterior, inferior, and superior.

The data shows there are specific patterns identifiable in bone micro-anatomy in size and frequency between healthy and non-healthy individuals. The findings help support the notion expressed by Paine and Brenton who found that malnutrition slows the remodeling rate in human ribs. In this project, the following trends have been observed: chronically ill individuals show a higher frequency in drifting osteons than those in the healthy group; likewise, double zonal osteons exhibit a higher frequency in chronic individuals; and cortical thickness and cortical area is diminished in the chronic group.

Osteochondritis Dissecans, Osteoarthritis, and Enthesopathies: Physical Activity and Microtraumas among a post-Wari Population from the Peruvian Andes

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Long term physical activity and microtraumas can contribute to pathological conditions such as osteochondritis dissecans (OCD), osteoarthritis (OA), and enthesopathies. We examine those frequencies among an Andean population that lived in the aftermath of Wari imperial collapse ca. AD 1100. These data are used to evaluate whether labor demands and microtraumas were significantly higher relative to other ancient Andean populations. The post-Wari skeletal remains were recovered from the former capital of the Wari Empire (Huari) in the 1970s, and they were recently found in the Huari site museum storage room. Radiocarbon dates show that they date to AD 1275–1400. The skeletal remains were dismembered and commingled *in situ*, so lesion frequencies are reported for each joint surface. The correlation between each lesion type is also examined.

Results: OA is most common in lumbar vertebral bodies (32%; N=456) and thoracic vertebral bodies (28%; N=842); those frequencies are similar to other post-Wari populations, but significantly higher than Inka-era groups (AD 1450 – 1532). The elbow joint shows the next highest frequencies of OA: distal humerus (R=17%, N=77; L=15%, N=66) and proximal ends of the ulna (R=26%, N=102; L=29%, N=107) and radius (R=11%, N=112; L=14%, N=73). The right proximal humerus exhibits significantly more OA than the left (p=.002, N=143); this was the only joint surface with a significant bilateral difference in OA. OCD was most common on the distal surface of three bones: humerus (16%), radius (17%), and tibia (16%); they were not strongly correlated with expressions of OA or enthesopathies.

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Reassessing the Genus Homo on the Island of Java through Virtual Reconstruction

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Recently several new species of human ancestors have been in the news including DH1 in South Africa, LD 350-1 in Ethiopia, and LB1 on the island of Flores. The discovery of LB1 or *Homo floresiensis* in Indonesia is just the most recent claim for a need to rethink the phylogeny of human ancestors in Southeast Asia. This project presents the reassessment of remains recovered from the island of Java, which similar to the fossils from Flores, seem to represent multiple taxa based on metric and nonmetric characteristics of the cranial and dental morphology. Virtual reconstruction of the casts aided in the reanalysis of each fossil hominin specimen. Three-dimensional (3D) models were generated using two unique methods. First, a desktop laser scanner (NextEngine 3D HD®) because this technique provides measurements that are more precise. Second, high-resolution photography and photo modeling software (Agrisoft PhotoScan Professional®) because it can create a denser point cloud with greater surface fidelity. Using both modeling techniques it is possible to show the overall geometry of specific anatomical features, making it easier to assess similarities and differences between these fossils and other hominin specimens in the region. The results of the analysis support the prior assertion that the fossil specimens on the island of Java may represent two distinct hominin species. This is most apparent with the presence of a double sagittal ridge associated with Sangiran 31, which is morphologically different from the ridge found on the Sangiran 17 fossil specimen, classified as *Homo erectus*.

Inner ear morphology of the Cioclovina early modern European calvaria from Romania

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The morphology of the human bony labyrinth is thought to preserve a strong phylogenetic signal and to be minimally, if at all, affected by postnatal processes. The form of the semicircular canals is considered a derived feature of Neanderthals and different from the modern human anatomy. Among other hominins, European Middle Pleistocene humans have been found to be most similar to Neanderthals. Early modern humans have been proposed to show a pattern that is distinct, but most similar to that of Holocene people. Here we examine the inner ear structures of the Cioclovina calvaria, one of the earliest reliably dated and relatively complete modern human crania from Europe, in the context of recent and fossil human variation. Bony labyrinths were virtually extracted from CT scans of recent Europeans and Cioclovina. Using univariate and multivariate methods, measurements of the semicircular canals were compared with published measurements of other fossil specimens. Our results suggest that Cioclovina's inner ear morphology falls within the range of modern variation, with affinities to both Late Pleistocene modern humans and recent Europeans. Results agree with previous work showing that Cioclovina exhibits fully modern cranial morphology. Using discriminant functions, the sex of the Cioclovina specimen is estimated as male.

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Musculoskeletal manifestations of diabetes mellitus in the William M. Bass Donated Skeletal Collection

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Diabetes mellitus is an epidemic in today's society. It is a complicated disease that involves almost the entire body, but its effect on bone is not well understood. To evaluate if diabetes-associated musculoskeletal disorders could be seen in skeletal material, I conducted a comparative study of diabetic (n=34) and non-diabetic (n=33) individuals for twelve disorders commonly associated with diabetes to build a predictive model.

Following the statistical analyses from a similar study, the results showed that hyperostosis frontalis interna and osteoporosis were positively correlated only with females (P<0.000, P=0.004, respectively). Diffuse idiopathic skeletal hyperostosis, osteoarthritis, and periodontal disease were correlated with age (P=0.034, P=0.051, P=0.042, respectively) and diabetes (P=0.003, P=0.003, P=0.033, respectively). Peripheral neurarthropathy and lower extremity amputation were correlated only with diabetes (P<0.000, P=0.018, respectively). Five variables were dropped due to lack of observation – adhesive capsulitis, flexor tenosynovitis, limited joint mobility, carpal tunnel syndrome, and gout. Because of their relationship to just sex, the variables hyperostosis frontalis interna and osteoporosis were dropped from further analysis. For the predictive model, stepwise analysis suggested peripheral neuroarthopathy, osteoarthritis, and diffuse idiopathic skeletal hyperostosis together were the best predictors of diabetes in this collection.

This study builds on Shannon May's demonstration that no single variable can be used to predict diabetes mellitus in this collection. The three-variable predictive model established in this study could be applied to forensic, historical, and archaeological skeletal remains to evaluate the presence of diabetes mellitus.

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The relationship between social status, body size, and salivary hormone levels among Garisakang forager-horticulturalist men of lowland Papua New Guinea

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Social hierarchy is a robust phenomenon that exists within all human societies. Over the past several decades, a growing body of evidence from industrialized Western populations has suggested that social status is closely related to individual measures of stress, health, and many other fitness-related traits. Data regarding such relationships, however, remain rare among small-scale subsistence societies, preventing a clear understanding of the importance of social position for fitness cross-culturally. Here we contribute to this area of research by exploring the relationship between adult male social status, BMI, and levels of salivary testosterone and diurnal cortisol among Garisakang small-scale forager-horticulturalists of lowland Papua New Guinea (N = 32). Three measures of individual social status – Respect, Dominance and Prosociality – were extracted from principal components analysis of photo-rank data for locally valued male traits (e.g., sociability, hunting ability, community influence). Preliminary results from multiple regression models controlling for age suggest complex relationships between social status, body size, and salivary hormone levels among the Garisakang. Male Dominance is positively related to BMI ($p < 0.05$) but not with salivary hormone measures, while greater male Respect is associated with reduced salivary cortisol ($p = 0.06$) but not testosterone or BMI. Prosociality, conversely, is not significantly related to any evaluated measure. We discuss the evolutionary implications of our findings, with a focus on future directions for investigating the biocultural interface of health in this population.

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Short bones, short life: Subadult selective mortality in Tirup Cemetery

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Stress on children's skeletons is sometimes difficult to identify, as children who succumb may not have the indicators that signify survival or recovery, and there are no surviving children of the same age for comparison. The goal of the present study was to compare the stature at death of children to the stature of adults to determine if there was selective mortality present in children, using the skeletal remains of Tirup Cemetery (Denmark) as the test case. Estimated stature calculated from adult (N=116, using Trotter & Gleser formulae) and subadult (N=65, using Ruff formulae) femur lengths were compared to World Health Organization Growth Standards (http://www.who.int/childgrowth/en/), with age-at-death estimated independently using dental development. All adults were within the expected 5th to 95th WHO percentiles, although the means for both sexes were below the 50th percentile. For dental ages of 2 years and older, all of the children's calculated heights were below the 50th percentile expected, given the distribution of heights of the adult population. The older the child, the more marked the deviation from the expected height at that age, with the majority of children between the ages of 8 and 15 below the 5th percentile. It appears that young children (under 2 years) were vulnerable to more acute stressors than the older children. Growth faltering was thus a significant predictor of mortality, and the sub-adult remains are not a representative sample of the children in the community.

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Valid/relevant correlates and meaningful outcomes: How has market integration affected the Toba/Qom of Argentina

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The C.A.R.E. Program has been working with Toba/Qom communities for 18 continuous years. Originally hunter-gatherers, these communities now live in a spectrum of geographical and social situations from remote rural areas to urban barrios. I will present a summary overview of what we have found to be relevant correlates of market integration and results from our studies on how these variables have shaped current trends in human biology, health, and behavior.

Among others, these correlates are geographical proximity to urban centers, sedentary lifestyle, participation in local politics, and access to wage labor, formal schooling, processed foods, mechanized transportation, western health care, housing plans, and alcohol/drugs. Among the outcomes, our studies show that market integration is associated with an increase in the prevalence of cardiovascular disease risks (e.g., 75% of the adults are overweight or obese), a reshaping of life history trajectories (e.g., younger ages at first birth, higher parity), changes in reproductive and parenting behavior, and the incorporation of new therapeutic itineraries.

The meaning of wellbeing and how to incorporate this concept to our understanding of the lived experience in these transitioning populations will also be discussed. In the spirit of this symposium, I aim at generating debate on possible common themes across populations, but also on unique situations that deserve further attention. Finally, I would like to take this opportunity to prompt a dialog among the symposium presenters on the value and implementation of mixed-methods approaches that goes beyond the formulaic phrase we use in our grant applications.

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Effect of habitat type and sex on morphometrics and body mass of the silvery-brown tamarin (*Saguinus leucopus*)

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Habitat loss and fragmentation may lead to significant changes in species biology, ranging from shifts in behavior to changes in diet, home range utilization, and movement patterns. Habitat degradation can also potentially affect body condition and reproductive success. Understanding how habitat characteristics influence intra-specific variation in body mass and morphometrics may help researchers identify species specific responses to habitat fragmentation and set conservation priorities in human-modified landscapes. In this study we examine variation in body size and morphopmetrics from live-captured wild silvery-brown tamarins inhabitating different forest types in Caldas, Colombia (degraded: n=12; conserved: n=19). Overall, adult tamarins inhabiting early succesional forests were smaller and weighed less than those inhabiting secondary forests (487 ± 53 gm and 502 ± 56 gms respectively, X^2=0.647, p=0.42). However, the sexes responded differently to habitat degradation. While the average mass of both females and males was slightly smaller in degraded forests than in conserved forests, this difference was not significant (p = 0.90 and p = 0.40, respectively). Females in disturbed forests were smaller in some linear dimensions, while males showed no morphometrics differences between forest types. Despite the fact that we did not find significant differences in body mass and size between habitat types, this may be due to our small sample size. Data from more individuals in different forest types are needed to further evaluate whether habitat type has an effect on tamarin morphometrics and body mass.

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Dispersal, constraint, and the evolutionary niche of early *Homo*

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The relationship between geographic disperal and hominin evolutionary divergence in the Pleistocene is a critical element in establishing the pattern of evolution across recent hominin lineages. One approach to examining this issue is to look at the relative significance of random evolutionary processes, such as genetic drift, versus adaptive changes shaped by natural selection in the morphology of fossil samples. This paper examines fossil samples at the geographic and/or temporal periphery of Pleistocene human evolution in attempt to examine the relative significance of these two processes. Our results suggest that even in the presence of strong evidence for adaptive changes in certain aspects of the hominin cranio-dental complex, the action of genetic drift plays a major role in shaping the pattern and distribution of metric and non-metric cranio-dental variation in the Lower and Middle Pleistocene. Working from these findings, we consider several alternative inferences about the nature of the evolutionary niche of *Homo* in the Lower and Middle Pleistocene and their role in shaping patterns of speciation.

How primates move seeds: movement ecology and dispersal kernels in a Cercopithecoid community

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Non-human primates are important endozoochorous seed dispersers in tropical forests. Seed dispersal is considered successful when seeds reach suitable germination and establishment sites, often away from parent trees and other conspecifics, although little is known how species-specific primate home range use, feeding ecology, and digestive physiology impact dispersal patterns. Here, we evaluate spatial patterns of seeds dispersed by five sympatric monkey species, including 3 cercopithecines (*Cercopithecus ascanius, C. mitis, Lophocebus albigena*) and 2 colobine species (*Colobus guereza*, *Procolobus rufomitratus*) at Kibale National Park, Uganda. 788 fecal samples (n = *C. ascanius*:158, *C. mitis*:188, *L. albigena*:187, *C. guereza*:42, *P. rufomitratus*:213), containing 665 non-fig and at least 1305 fig seeds of >20 species, were collected (1999-2002). Defecation locations were recorded and, using ArcGIS, assigned to 25x25 m cells by converting point to weighted (by seed quantity) raster datasets. We used Kernel Density Estimation (KDE) and Inverse Distance Weighted (IDW) interpolation methods to evaluate spatial distributions. Colobines, especially *P. rufomitratus*, dispersed few seeds to restricted areas; *C. guereza* dispersed more seeds to more locations. Overall, cercopithecines dispersed seeds in relatively denser clumps than colobines. Dispersal by *C. ascanius* and *C. mitis* was also more spatially continuous, although >50% of KDE-predicted cell values were still around zero. *L. albigena* seed dispersal was spatially coarser, and occurred at a large scale, spanning diverse habitats. Results demonstrate that movement ecology, digestive strategy, and feeding biology are important factors influencing seed dispersal kernels and have implications for interpreting differential impact of cercopithecoid species on forest regeneration.

Brain size evolution in primates - testing effects of social vs. ecological complexity

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Various drivers of brain size evolution in primates have been proposed, which can be divided into two main domains – social and ecological complexity. The first domain, often referred to as the Social Brain hypothesis, suggests a link between the complexity of social systems and enlarged brains. More recently, propositions of the ecological domain such as the Technical Intelligence hypothesis or the Cognitive Buffer hypothesis have also found support in comparative studies. However, no study so far has tried to explain brain size variation by systematically combining potential effects of the two non-exclusive domains. Therefore, the aim of the current study is to broaden the perspective by looking at a wide set of social and ecological factors across a large sample of primate species. We differentiate between factors that facilitate the evolution of increased encephalization and factors which are direct consequences of enlarged brains, and hypothesize ecological complexity to fall mainly in the first, and social complexity in the second category.

Regarding consequential factors of relatively large brains, our results show a strong correlation between the social and ecological domain, supporting the idea of general behavioral flexibility as a close associate of enhanced cognition. Regarding facilitators, we find a stronger correlation between brain size and ecological factors, which supports our initial prediction. These findings underline the ecological perspective of brain size evolution and support the notion that social complexity could only become prominent in lineages where ecological benefits had already allowed for the evolution of larger brains.

Primitive pelvic features in a new species of *Homo*

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In the hominin fossil record, pelvic remains are sparse and are difficult to attribute

taxonomically when they are not directly associated with crania. Here we introduce the pelvic remains from the Dinaledi Chamber in the Rising Star cave system, Cradle of Humankind, South Africa which belong to the newly discovered species, *Homo naledi*. Though this species has been attributed to *Homo* based on crania and lower limb morphology, the pelvic remains are australopith-like in many ways, including a marked iliac flare and an anteriorly oriented iliac pillar. Derived, *Homo*-like traits in this species include robust iliopubic and ischiopubic rami and a shortened ischium. While the sample described here represents multiple individuals in different age categories, they are not complete enough to make definitive claims about locomotion or the birth process in this new species. Nevertheless, a primitive ilium combined with a derived ischium and pubis is functionally consistent with this species' ribcage and femoral anatomy. We conclude that the overall similarity of *H. naledi* pelvis to those of australopiths means there was more variation in pelvic form within *Homo* than previously believed.

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Comparative analysis of the growth and development of the temporal bone in mice and humans

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Mice are used as an experimental model to study human growth despite obvious anatomic differences. This study considers growth of the temporal bone and asks whether relative growth of the component parts of the temporal bone are comparable in humans and mice. Linear measurements of the human temporal bone have been reported in the literature for multiple time-points in fetal development (14wks, 20wks, 30wks, 40wks). Measurements included squamous height, squamous width, squamous length, and tympanic ring diameter. Comparable measurements were collected from mice at embryonic day 17.5, and four postnatal time-points (1day, 1wk, 2wks, 4wks). Mice grow at a faster rate than humans, and these stages encompass the range of proportional growth reported for humans. In order to standardize measures for comparison across taxon, we calculated measures as proportion of observed values in adults. MicroCT data for 4-5 individuals at each stage were reconstructed in Amira; measurements were collected bilaterally and averaged to reduce measurement error. Despite difference in growth rate, relative developments of these measures were generally similar in humans and mice. Results show that squamous height approach adult size first in both taxa, and that squamous length developed more slowly. Growth of the tympanic ring differed between taxa. In humans, this reaches its maximum value earlier in development, but then becomes obscured by growth of the external auditory tube. Comparative study of growth in the temporal bone is vital in understanding whether mouse models can be used to examine the temporal bone of humans in future studies.

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Reproductive history of three generations of women from the municipality Plaza de la Revolución, Havana, Cuba

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The aim of this paper is to compare the reproductive history of three generations of women residents in the municipality Plaza de la Revolución, which tend to have lower fertility in Cuba. The first generation of grandmothers, are ten women between 59 and 64 years, selected form a previous investigation, with the approach that they had daughters of 45 years or more (ten women of the second generation) and granddaughters older than 15 years (ten women of the third generation). The questionnaire about reproductive history was the same for all the women. A descriptive analysis of the continuous variables and distribution of frequencies for the discreet ones was performed. ANOVA tests were used to compare the means, with a significance level of $p<0.05$. The mean of menarche age was 13.0 years in grandmothers, 11.9 in daughters, and 12.0 in granddaughters, suggesting a positive secular trend. The average age of first sexual relationship was 16.1 years in grandmothers, 17.2 in daughters, and 15.22 in granddaughters, with sexual initiation in adolescence. The average age of first pregnancy was 17.4 years in grandmothers, 20.88 in daughters, and 18.75 in granddaughters. None of the grandmothers interrupted her first pregnancy voluntarily, while half of the mothers and all granddaughters did. The granddaughters have the biggest precocity in the event of the reproductive history. Due to the increase in the practice of induced miscarriage in each generation, this provides a possible contribution to the drop in fertility in the municipality.

A primate viewpoint on mandibular reduction in *Homo*: the impact of allometry and encephalisation

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The reduction of the masticatory apparatus is recognized as a major trend in human evolution: dietary shifts and changes in food processing have been claimed as possible causes. Also, the trends toward a larger body mass and big brains have been validated in the genus *Homo*. Nonetheless, the role played by body mass and encephalization in the evolution of hominin mandible remains unclear. We look at humans as members of the primate clade to test for the impact of allometry and encephalisation on mandibular size and shape, using Geometric Morphometrics. 3D landmarks were recorded on the mandible and neurocranium of 45 species of catarrhines (including *Homo*) to quantify shape and size changes at an interspecific scale. Morphological integration between mandible and neurocranium was tested. Phylogenetic structure in the data was taken into account using Phylogenetic Generalized Least Squares (PGLS). Body mass significantly influences mandibular size (R^2=0.83, slope=0.29) in catarrhines regardless of phylogeny. In catarrhines as a whole, changes in mandibular ramus height are correlated with size variations. When only a sample of the genus *Homo* is considered, mandibular size reduction correlates with the anterior projection of the chin. *Homo* also shows a higher level of integration between mandible and neurocranium (RV=0.62) when compared to catarrhines ($0.38 < RV < 0.52$). In *Homo*, mandibular shape changes may be related to variations in body mass and neurocranium restructuring. Allometry and encephalization acted as structural constraints on the mandible in the genus *Homo*.

Linking individual foraging and residential mobility: testing the marginal value theorem with data from southeast Asian tropical rainforest foragers

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Mobility is a central element of the hunter-gatherer lifeway. Ethnographic accounts demonstrate that the nature of individual foraging heavily influences the movement patterns of residential groups, yet an absence of quantitative data has precluded a direct connection between the individual and group levels. One framework for addressing this question is the marginal value theorem, developed by Charnov, which predicts that foragers should leave a patch when the marginal return rate in a patch declines to the environmental average. Here we test whether the marginal value theorem accurately predicts camp movements by a population of hunter-gatherers.

Our analyses are performed on a historical dataset collected by Kirk and Karen Endicott in 1975-1976 on the foraging behavior of nomadic Batek foragers in Peninsular Malaysia (n = 91 days). During this time the Batek subsisted largely on foraged foods and moved camp 11 times. Cumulative return rates at the individual level were collected on a daily basis. We fit depleting deterministic functions to these foraging returns for several resource sets (meat, tubers, and rattan) and used the marginal value theorem to predict camp departure times. The marginal value theorem produced a remarkably accurate correspondence between predicted and actual leaving times (range of coefficient of determination: 0.7-0.95), indicating that hunter-gatherers are highly attuned to resource depletion.

Elbow morphology and substrate use in the fossil primate community at Hadar, Ethiopia

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Forelimb morphology of Old World Monkeys has been linked to substrate use patterns in extant and fossil taxa. Univariate and multivariate analyses have been used in retrodictions of whether fossil cercopithecines were terrestrial, arboreal, or mixed substrate based on measured variation in morphology and behavior in extant species. While a previous study focused specifically on morphology and behavior in extant and fossil Cercopithecinae from the *Australopithecus* bearing Hadar Formation, here we supplement previous findings by incorporating a more taxonomically focused comparative sample to better capture the potentially transitional behavior exhibited by taxa evolving near the base of the cercopithecine clade in Africa.

Multivariate analyses were performed using measurements designed to capture variation related to substrate use from distal humeri and proximal ulnae of 22 extant African cercopithecine and five extant African colobine primate species. This comparative sample was then used to retrodict likely substrate use of fossil cercopithecoids, including potential colobines, from the Hadar Formation, Ethiopia.

Results of PCA and DFA suggest that a taxonomically focused comparative sample successfully captures the relationship between morphology and behavior in the elbow of closely related cercopithecine and colobine species, and that many of the Hadar taxa exhibited mixed or transitional substrate use through time. From an ecological perspective, the fact that the Hadar Formation primate community used mixed substrates has important implications for how they responded to environmental changes, and also how they shared resources with *Australopithecus afarensis*.

A search of human beta-globin polymorphisms in ancient DNA of European populations

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Abnormal haemoglobin variants, including β-Thalassemia, are the most common genetic defects in humans, their high frequencies most likely resulting from natural selection by malaria. The recovery of the mutations responsible for these hemoglobinopathies in skeletons would indicate a history of endemic malaria in a population. In this study, a search of β-Thalassemia mutations was performed on 40 Medieval and Modern Age samples from two former endemic malaria regions, Sardinia and Corsica, and on 40 Medieval samples from an area where malaria was only seasonally epidemic, Switzerland. A PCR method was designed and optimized to amplify part of the *beta-globin* gene, where the majority of the known mutations responsible for β-Thalassemia in the Mediterranean area are located. Sequences for different fragments of the *beta-globin* gene were recovered, and for two individuals it was possible to obtain the full sequence of the first half of the gene. None of the studied individuals contained the mutations known to be responsible today for β-Thalassemia. However, in one Corsican sample a T to A substitution in the codon 10 of exon1 was observed. Further functional studies are needed to verify whether this mutation could be responsible for abnormal haemoglobin. We believe that this method can be successfully used to identify beta-globin abnormalities and consequently to trace malaria history within a population.

Mäxi Foundation

Genome from Early Holocene Remains from Patagonia Suggest Demographic Shift, Supporting the Material Culture Transition

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The Fuego-Patagonia region of southern Chile and Argentina is the geographical end of the migratory journey that was the peopling of the Americas. Archaeologists have estimated the earliest evidence of settlement in Patagonia to be around 11,500 years before present (ybp). However, the routes followed by these early settlers (hunter gatherers) and the late-arriving marine-dependent populations are still not well understood. Our study presents the genomic results of a 7,200 year-old skeletal sample unearthed in Chilean Patagonia, west of Tierra del Fuego. The complete mitochondrial genome shows the sample is haplogroup C1c, yet it is not part of any of the known branches (C1c1 – C1c8) of the Native American lineage. Further, C1c is uncommon among modern South Americans and has not been found among the more than 150 modern Fuegians and Patagonians. Although C1c occurs in South America, it occurs in low frequency (<5%) and predominantly in northwestern regions (Peru, Colombia, and Venezuela). The lineage is common in Mesoamerica. This pattern suggests a possible regional replacement of C1c by other regional lineages such as C1b, C1b13, D1 and D4h3a. Further sampling is needed to test the hypothesis.In addition, preliminary genomic results show the sample shares biogeographical components with both Andean and Amazonian populations. This pattern could be indicative of a genetic homogeneity across the continent in the early Holocene. The early homogeneity was followed by regional isolation and genetic drift, or a separate migration and gene flow event that reached Patagonia in the mid-to-late Holocene.

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Cranial dimensions as predictors of phenotypic integration in the primate basicranium: implications for hominin evolution

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Recent modern humans are characterized by low magnitudes of integration (MI; covariation) in the cranial base. Low MIs are thought to have contributed to the evolution of modern human craniofacial anatomies. However, the correlates of MI remain largely unexplored. Multiple authors have posited that brain size, facial size, and masticatory robusticity may play a role, due to interactions between these craniofacial regions. I tested MI in the cranial base of seven primate genera including lorises, galagos, indriids, lemurs, and siamangs (n=499). These taxa represent a variety of locomotor behaviors, brain sizes, and diets. My results indicate that MI in the cranial base is linked to the height of the cranial vault relative to the length of the vault (R^2=0.610, p=0.038), such that taxa with relatively taller vaults display reduced integration. MI is also linked to the proportion of overall cranial length accounted for by the cranial base (R^2=0.608, p=0.039), such that taxa with relatively longer cranial bases display reduced MI. Postorbital constriction (R^2=0.468) and mandibular robusticity (R^2=0.457) may also be linked to MI across taxa,

but relative vault volume (R^2=0.001), a proxy for brain size, is not. Within strepsirrhines, overall cranial size may also play a role (R^2=0.581), suggesting multiple compounding factors are involved in MI. These results suggest that, in hominins, highly reduced MI was tied to the appearance of more globular vault morphologies and not to large brain sizes themselves, and likely emerged in the direct ancestors of *Homo sapiens* prior to facial reduction.

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Exploring the limits of approximate Bayesian computation as a method for human demographic analysis

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An increased depth in genetic data quality has produced a demand for new forms of statistical analyses which are both powerful and simple to use. Bayesian model testing methods have become more prevalent because they can accommodate comparisons of multiple complex models; however, understanding of these methods remains highly specialized.

Here, we explore approximate Bayesian computation (ABC) applied to human demography in the hopes that the basic mechanics of such methods become more familiar among anthropological geneticists. ABC is form of model fitting which can approximate solutions to biologically complex problems for which traditionally analyses lack power. As a disadvantage, poor selection of parameters can lead ABC to report uninformed solutions. To help address these concerns, we developed a form of statistical power analysis designed to inform parameter selection which can be performed *previous* to empirical data analysis.

We simulate mitochondrial sequence alignments typical of ancient DNA (aDNA) studies representing 400 variants of a demographic event taking place in the Holocene. We use our power analysis to test between parameter options including sampling schemes, summary statistic selection, and the inclusion of aDNA. We find that the inclusion of aDNA sampling improves success by 7%, and that success is further improved by the inclusion of longer sequences (up to 14% by using full coding region data), but not by including additional samples. Furthermore, we find that different demographic events have vastly different likelihoods of being reported correctly (between 28%-52%), further strengthening the benefits of parameter testing prior to empirical analysis.

Spatial variation in paleovegetation in the Turkana Basin: implications for hominin niche shifts in the mid-Pliocene

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Did early hominins expand their dietary niche and develop novel behaviors, such as stone-tool use, as savanna environments expanded? To gain insight into this question, this study explores spatial variation of the paleovegetation in the Turkana basin through the study of stable carbon and oxygen isotopes from pedogenic carbonates collected above and below the Tulu Bor tuff (TBT), which is dated to 3.42Ma. Pedogenic carbonates were extracted from contemporaneous paleosols, over a 78km region in East Turkana, Kenya (n=79) and isotopic values are compared across space as well as between East and West Turkana (n=15) using t-tests. Though statistically different (p=0.02), mean $\delta^{13}C_{pc}$ values both above (-5.96‰) and below (-7.06‰) the TBT in East Turkana are consistent with wooded grasslands, though a greater range of open environments is found above the TBT. Above the tuff, environments are more heterogeneous with open grasslands found at the northern part of the basin and primarily closed to open woodlands within the central and southern landscapes. Differences are apparent in the hydrologic regimes within East Turkana, measured from $\delta^{18}O_{pc}$ values (p<0.001), above the TBT but not below it. Across all time intervals in both East and West Turkana hominins are associated with more closed and wooded grasslands, with a significantly greater relative abundance of hominins on the west side of the lake, which is a more open woodland as compared to East Turkana above the TBT, from which the majority of hominin fossils are derived.

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A comparative analysis of evolutionary changes in human physiological traits

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Human health is shaped by our evolutionary past, and understanding the links between our evolutionary history and health increasingly informs medical practice. We investigated the evolution of physiological traits along the human lineage, with the goal to assess whether some traits have undergone "exceptional" evolution in humans compared to non-human primates. We considered 43 physiological reference values, such as white blood cell counts, which are commonly used to assess both human and animal health. For some traits, we tested specific predictions related to hypotheses that humans show adaptations for long-distance running and infection with more diverse pathogens, as compared to our close evolutionary relatives. We used two recently developed Bayesian phylogenetic analyses; one is based on predicting trait values in humans using phylogenetic generalized least squares, and the other is based on explicit modeling of evolutionary regimes with an Ornstein-Uhlenbeck model.

We identified five traits with strong evidence for a recent evolutionary increase (amylase, monocytes, hematocrit, phosphorus, and blood urea nitrogen), and two traits with strong evidence for a recent decrease (neutrophilic bands and alkaline phosphatase). The increase in amylase is not surprising given high levels of starch in the human diet; other results, such as the increase in monocytes but not other leukocytes, are more unexpected and warrant further research. Investigating the mechanisms that underlie changes in these traits may improve understanding of the evolutionary tradeoffs that have occurred in human evolution, and thus may contribute to a deeper understanding of human health and disease.

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Supermarket Produce Nutritional Properties across Socioeconomic Areas and Seasons

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Individuals of low socioeconomic status are more likely to have poor health than those of high socioeconomic status. The federal government has responded with policies designed to increase access to supermarkets and fresh produce in low socioeconomic areas. One implicit assumption underlying such policies is that grocery store produce does not vary appreciably across socioeconomic boundaries, but there has been relatively little explicit consideration of this assumption.

Here, we provide data from a pilot study investigating this question, in which macronutrients (e.g., Crude Protein, Fat), major minerals (e.g., Ca, Mg), and trace minerals (e.g., Fe, Cu) were determined from a suite of supermarket produce from disparate socioeconomic areas within the same region over time. Preliminary results do not support the assumption that grocery store produce is nutritionally equivalent across time and space, as differences in macronutrient and micronutrient profiles are apparent.

Strategic trade-offs between immune and reproductive functions during the ovarian cycle: Empirical tests of an evolutionary hypothesis

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Life history theory predicts trade-offs in the allocation of finite resources to the various components of an organism's somatic and reproductive functions. Notably, acute inflammation is a non-specific immune response to foreign cells including, potentially, sperm or a conceptus. Thus, natural selection may favor context-specific transient shifts in inflammation during the ovarian cycle that increase the probability of conception while minimizing decreases in immune defenses.

We tested several predictions of this evolutionary hypothesis with hormonal and other data collected during two consecutive ovarian cycles from 61 nominally healthy Bolivian women not using hormonal contraception. C-reactive protein (CRP), a marker of inflammation, was assayed in 639 dried blood spot samples collected during weeks 2 and 3 of each cycle.

Controlling for age, BMI, and socioeconomic status, our analyses supported ($p<0.05$) the following predictions:

(1) High CRP early in a cycle predicts anovulation, consistent with the argument that natural selection favors *not* conceiving in a cycle in which elevated immune defenses are needed.

(2) In the ovulatory cycles of heterosexually active women, CRP is highest during early and late cycle phases but lowest during the peri-ovulatory period, consistent with the argument that natural selection favors increasing the probability of conception at the cost of temporarily dampening inflammatory immune response.

(3) In the ovulatory cycles of sexually abstinent women, CRP does not vary significantly during the cycle, consistent with the argument that natural selection does not favor the temporary dampening of inflammation in women who are not at risk for conception.

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Applying modern human population models to estimate variance/covariance structure in bioarchaeology: assessing drift and selection in prehistoric skeletal populations

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Investigations of evolutionary processes in bioarchaeology are impeded by the fragmentary nature of skeletal remains and small sample sizes, making it difficult to estimate underlying phenotypic variance/covariance (V/CV) structures. In paleoanthropology these problems are overcome by using V/CV parameters derived from appropriate extant primate taxa. Here we propose that the same logic be applied in bioarchaeology, whereby modern human parameters be substituted in the case of prehistoric specimens. We utilize the Howells craniometric dataset to test the equivalence of human V/CV matrices based on 14 cranial measurements. In order to avoid bias in estimating V/CV structure due to sexual dimorphism and sample size, we focused on 15 populations with male sample sizes $\geq$ 50. Population V/CV matrices were estimated for both raw (form) data and size-adjusted shape data. Results based on Random Skewer analyses found that all 15 population V/CV matrices showed significantly correlated ($r = 0.77$-0.92) responses to 10,000 random selection vectors, indicating strong similarities in V/CV structure among all groups. However, application of Flury's hierarchical analysis suggested that some populations differ in terms of the details (e.g., proportionality, equality, common principal components) of their cranial V/CV structures. Finally, we test null hypotheses of neutral divergence (using Lande's drift test) among a sample of prehistoric populations represented by single specimens. The results of the drift tests were consistent irrespective of which Howells V/CV matrix was employed, suggesting that extant human population V/CV matrices can profitably be applied when investigating the effects of drift and selection in prehistoric skeletal populations.

Paternal investment and child well-being in two small-scale human societies

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Cross-culturally, father presence is only infrequently associated with child health and does not always improve child socioeconomic success. Precisely how and when paternal investment affects child well-being remains unclear since the mechanisms underlying the impact of fathers are not well understood. Furthermore, the research on fathers is dominated by studies from urban, industrialized societies, where direct investment by fathers is typically perceived as beneficial to children's development. In two small-scale societies (Tanna, Vanuatu and Tsimane of lowland Bolivia), we interviewed mothers and fathers and examined children's behavior on two experimental procedures to compare several measures of paternal investment with measures of child health, attachment security, and behavior with peers. Preliminary analysis indicates that children's attachment behavior is similar to that of urban Western children and is associated with direct paternal investment. Indirect paternal investment is more closely tied to child health, including anthropometrics of weight and height. We also investigate whether effects of paternal investment are moderated by consonance with local norms surrounding fatherhood, child sex and age, access to additional allocare, and fathers' relationship with the mother. This project is unique as it examines fatherhood with a multi-faceted approach in two small-scale societies. By applying this approach across different (non-Western) societies, we hope to contribute to a more unified theory of fathers' roles in child development.

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Neanderthal ancestry in Yemeni populations

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Analyses of the Neanderthal genomes are strongly consistent with the idea that early modern human populations interbred with Neanderthals in the Near East soon after their successful dispersal out of Africa. However, it is unclear which part of the Near East this dispersal first crossed through, and few studies have assessed Neanderthal ancestry in Near Eastern populations,

We assayed 90 Yemenis sampled from across the country using the Affymetrix Human Origins array. We merged our data with previously published datasets from around the world as well as data from Neanderthal and Denisovan genomes in order to estimate archaic ancestry in modern populations. We also conducted ADMIXTURE analyses on a more regionalized dataset in order to infer ancestral components in Near Eastern populations.

Consistent with other studies, we found that North African and Near Eastern populations (including the Yemeni) generally have less Neanderthal ancestry than other western Eurasian populations. However, our ADMIXTURE results indicate that a subset of Yemeni samples from the Mahra governate share a very high level of ancestry (~85%) with a single Near Eastern component. Interestingly,

these individuals have Neanderthal ancestry estimates that are greater than estimates from almost all Near Eastern and North African populations and are more consistent with estimates from European and South/Central Asian populations, suggesting that eastern Yemen may be an area of elevated Neanderthal introgression in the Near East. Greater sampling of Near Eastern populations is needed to better understand variation in Neanderthal ancestry and the site(s) where modern humans and Neanderthals interbred.

Samples used in the study were collected with support of NSF grant BCS-0518530 and genotyped with support of NSF grant BCS-1258965

Relative length of the immature *Homo naledi* tibia U.W. 101-1070: evidence for elongation of the leg

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It is largely held that the transition from *Australopithecus* to the genus *Homo* involved a shift in overall body proportions, including a relative lengthening of the lower limb, though the degree to which hominin limb proportions changed and the proximate causes thereof remain contentious topics. The overall poor preservation of most articular surfaces and predominately fragmentary diaphyses in the mature Dinaledi lower limb long bone sample preclude a definitive assessment of lower limb proportions based on this material alone. The U.W. 101-1070 immature tibia is the most complete *H. naledi* lower limb element recovered to date, measuring 278 mm from the eminence of the tibial spines to the distal extent of the medial malleolus, and preserving nearly the entire medial condyle. To assess proportions, we evaluated tibia medial condylar dimensions relative to tibia maximum length in U.W. 101-1070, other fossil hominin tibiae, and an ontogenetic sample of humans, chimpanzees, and gorillas. Results indicate that the U.W. 101-1070 tibia is very long relative to joint size – markedly differing from all extant species and comparative fossil hominin tibiae. The combination of an exceptionally small tibial articular surface (like many australopiths) and moderately long tibia, in *H. naledi*, appears autapomorphic in the hominin fossil record. Though the specific implications of this finding are partially dependent on the geological age and phylogenetic position of *H. naledi*, U.W. 101-1070 provides an example of bone length/joint size decoupling relative to the human pattern.

New data on female maturation milestones indicate longer development in wild chimpanzees

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Published reports of maturation milestones in female chimpanzees are typically derived from captive populations, in which development is known to be accelerated. Data from wild populations reflect development subject to evolutionary pressures and should be prioritized for use in modeling hominin evolution. But because most females transfer before breeding, precise age at first birth is rarely known in the wild and data from known-aged females come from a small number of non-dispersing individuals. Here we report maturation milestones and explore sources of variance for 36 wild female chimpanzees of known age, including seven dispersing females, born in Gombe National Park, Tanzania. Using Kaplan-Meier survival analysis including censored intervals, we find an average age of 11.6 years for first maximal sexual swelling (which is generally closely associated with menarche) and 14.9 years for first birth. These values exceed previously published averages for wild chimpanzees by one or more years. Even in this larger sample, age at first birth is likely underestimated due to the disproportionate number of non-dispersing females, which, on average, give birth two years earlier than dispersing females. Log-rank comparison tests show that age at first maximal sexual swelling is delayed in firstborn females and those either orphaned before 8 years or born to low-ranking mothers. Age at first birth is also delayed in females orphaned before 8 years. These data provide improved estimates of maturation milestones in a population of wild female chimpanzees for use in anthropological study and indicate the importance of maternal factors in development.

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Bilateral cortical bone mass and distribution in the human appendicular skeleton

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Wolff's Law suggests habitual use of the dominant side should be in evidence via greater bone mass on that side. To test this hypothesis, the humeri, radii, ulnae, femora, tibiae, fibulae and clavicles of a single individual were collected. The individual had been a carpenter in life, and died at the age of 65. It is hypothesized that the lower limb will not show asymmetry, while the upper limb will. The femora, humeri, radii, and tibiae were each sectioned at 10% intervals of length of each. For each of the resulting sections, geometrical properties, including Imin, Imax and cross sectional area were calculated using the BONEJ plug-in for IMAGEJ software. No significant differences were found between the left and right femora, humeri, radii, and tibiae (alpha < 0.05). While there is a tendency for the right humerus to be slightly more robust than the left, it does not reach statistical significance. At midshaft, left and right humeri are nearly identical. This is likely due to rugosity of muscle attachments on the right distal humerus. The basic form remains identical on right and left sides. Geometrical cross sectional properties are not significantly different side to side in the radius. This reflects results found in other vertebrates. While bilateral asymmetry in bone mass is noted in elite athletes, for example, this is not in evidence in this individual. Future research will include the fibulae, unlae, and clavicles, and will examine histomorphology as well.

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Operational sex ratio, dominance rank and mating success of group and non-group male ring-tailed lemurs (*Lemur catta*)

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Sexual selection theory states that male mating success depends on intrinsic male qualities, but mating success can also be impacted by extrinsic factors. Male mating success is known to be impacted by the operational sex ratio (OSR) in several diverse species. We examined the relationship between OSR, dominance rank, and male mating success in four groups of ring-tailed lemur (*Lemur catta*) at Berenty Reserve Madagascar based on data collected in three mating seasons. We found significant relationships between the OSR during mating (calculated based on whether males were present and engaged in competition for the

estrous female) and thrust duration (Mann–Whitney $U = 0.0001$, $n_0 = 4 < n_1 = 11$, $P < 0.001$ two-tailed), as well as OSR and female rank (R=-0.603, N=17, P=0.010). Incidence of ejaculation was shown to correlate with thrust duration (R=0.704, N=15 mating bouts, P=0.003). Alpha males copulated (thrusted) for longer durations than lower ranking group males (Mann–Whitney $U = 0.0001$, $n_0 = 5 > n_1 = 4$, $P < 0.016$ two-tailed). When non-alphas of the estrous female's group were considered, extra group males were more likely to ejaculate than group males (R=0.828, N=11, P=0.002). These findings show that variation in the OSR during a female's estrous period impacts male reproductive success as higher levels of male-male competition inhibit ejaculation and raise questions about the value of group membership for non-alpha males.

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Human female pelvic dimensions are adapted for load carrying

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Among humans, males are absolutely bigger for many morphological variables; however, when pelvic variables are scaled against size, females have relatively wider pelves, particularly in the bi-trochanteric measure. What is the function of this sexual dimorphism? From a locomotor energetics perspective, males are often touted as 'efficient'—moving for a smaller cost per kilogram of body mass or per distance traveled; whereas females are 'economical'—a given locomotor task costs absolutely less energy. Here we investigate whether this is true during a task involving walking while carrying a load. We recruited 12 people, six men and six women, who followed typical sexual dimorphism patterns. They walked overground at four speeds (slow to fast) while carrying an 11kg load in three different positions: a weighted belt, a manikin carried on the side, and the manikin sitting on the shoulders. These twelve conditions were accomplished in a randomized order while gas exchange was monitored using indirect calorimetry. Cost-of-Transport curves were calculated for each individual at the three carrying conditions, and from these curves, the minimum-cost-of-transport (MinCoT) was determined. Though MinCoT increased significantly with the manikin carried on the side (p=0.003), the per kilogram cost of carrying the manikin was not significantly different between men and women at any condition, meaning that women carried relatively more mass for the same energetic cost. This may be due to women's relatively larger bi-trochanteric breadth (p<0.001), and its associated relatively longer stride length (p=0.1). This suggests that women are both economical and efficient during load carrying.

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Trabecular bone adaptations to arboreal and terrestrial environments: experimental evidence from mice

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Differences in trabecular bone structure in the limb elements of arboreal and terrestrial primates are often thought to reflect functional adaptations of bone tissue to distinct mechanical environments. However, direct evidence indicating that functional loads associated with arboreal and terrestrial lifestyles have varying effects on trabecular structure is lacking. To investigate this issue, an experiment was conducted in which growing mice were housed for 2 months in enclosures designed to simulate either an arboreal or terrestrial environment (n=25/cage type). In the "arboreal environment", animals were impelled to cling to a suspended wire mesh apparatus and all locomotion consisted of climbing. In the "terrestrial environment", locomotion was limited to plantigrade movement on a flat surface. After the experiment, trabecular bone structure was quantified in the humeral head with micro-CT. We found that, relative to the humeri of terrestrial mice, arboreal mice had humeri with 9% fewer trabeculae (p<0.01), 9% thinner trabeculae (p<0.01), and 18% lower trabecular bone quantity (p<0.001). Significant differences were not detected, however, in either the degree of trabecular anisotropy (p=0.22) or connectivity density (p=0.21), indicating that group divergence in bone tissue amount was not coupled with differentiation in tissue organization. These results provide empirical support for the hypothesis that arboreal and terrestrial lifestyles can result in distinct patterns of trabecular bone structure. The precise mechanical parameters affecting these patterns remain unknown but may relate to the influence of substrate compliance on limb force magnitudes and/or differences in how gravitational vs. muscle forces are transmitted to the skeleton.

The woman in blue: using modern analytical methods to investigate a Viking Age burial from Iceland

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This study presents a multi-disciplinary perspective on a Viking-age (9th/early 10th century) woman whose grave was discovered at Ketilsstaðir, eastern Iceland, in 1938, and whose skeleton was very incomplete and poorly preserved. The woman from Ketilsstaðir wore typical copper-alloy Scandinavian oval brooches, one of which was in direct contact with her face, resulting in significant soft tissue and textile preservation. The soft tissue remains were contained in a jar with a formalin solution until recently and have since been transferred into light paraffin oil. The grave contained a typical array of Viking Age grave goods, beads, jewelry, a touchstone, iron tools, wooden fragments, and a semi-precious stone. The recovered textiles represent the woman's garments.

This paper will present the results of scientific analyses undertaken on all aspects of this individual's burial, including her physical remains and material culture. Stable isotopic analyses have demonstrated the woman's non-local origin, migration patterns, health, and dietary changes through life. Strontium analysis on the wool from her textiles, combined with microscopic analyses, fibre identification, and dye analysis has determined that her wool was local and that the textiles were woven according to combined weaving traditions from both Scandinavian and continental Europe or the British Isles. AMS dating has also demonstrated that this woman and her textiles date to the earliest phase of the settlement of Iceland. This research aims to shed light on the cultural complexity of the North Atlantic settlement process, as well as to stress the significance of such multidisciplinary case studies.

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Urbanization and Mortality Risk in Late Medieval London

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Urbanization is often associated with declining health and increased mortality. Studies investigating health and urbanization have primarily examined raw frequencies of pathological lesions or differences in mean age-at-death between urban and rural skeletal samples, interpreting higher levels of pathologies or decreased mean age-at-death in urban samples as direct evidence for deteriorating health. Paleodemographic analyses of mortality using hazard analysis, however, address issues associated with traditional methods (e.g. heterogeneity in frailty and selective mortality) and can provide a better understanding of the relationship between urbanization and mortality. This study uses hazard analysis to assess differences in adult mortality between the urban St. Mary Spital cemetery in London (*n=333*), and the semi-rural St. Peter's cemetery in Barton-upon-Humber, Lincolnshire (*n=150*) in medieval England (*c.* 1120-1539). "Urban" is modeled as a covariate affecting the Gompertz hazard of adult mortality. The estimated effect of the urban covariate, when sex is pooled, is positive, suggesting that individuals in London experienced increased risks of dying compared to individuals in the more rural environment. The results also indicate that females faced increased risks of dying in the urban environment, while the risk for males was the same in both environments. These results suggest that urban environments known for high population density, unsanitary living conditions, and precarious food supplies, may be more detrimental to health, at least for females, than contemporaneous rural environments. Further, migrants to urban centers, such as London, may have not been suited for the urban environment and could have faced increased risks of dying.

Data for this study come from a project funded by the National Science Foundation (BCS-1261682), the Walker Institution and the Department of Anthropology of the University of South Carolina.

Social Organization and Biological Relatedness of the Burials from Naton Beach Site, Tumon Bay, Guam

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Data on the mortuary patterns, grave goods, and biological relatedness are examined to suggest social organization of two prehistoric cultural groups from Tumon Bay, Guam. The Naton Beach site has provided us with an unprecedented number of the Pre-Latte individuals from Guam's early prehistory. Latte individuals from the later prehistoric period were also recovered from this site. Statistical comparison using dental nonmetric traits indicate that the Pre-Latte and Latte to be separate biological groups. Mortuary patterning recorded for the two groups is similar with both groups found in discrete locations, possibly associated with residential structures. However, the two groups have a significantly different number and type of grave goods. The mortuary data is correlated with biological data to suggest social organization for both prehistoric culture groups.

Does male rank trajectory influence male-female associations in olive baboons?

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Data on various primate species indicate females attempt to associate more frequently with dominant males. Few studies, however, consider whether male rank trajectory (or potential for males to change ranks over time) influence male-female interactions. Although it can be difficult to assess rank trajectory in species expressing infrequent rank-turnovers, the Elo rating system offers a numerical measure of both rank and rank trajectory and is an important new tool for evaluating primate social structures. We use this method to assess dominance hierarchies in olive baboons (*Papio hamadryas anubis*) from approach-retreat interactions, and test whether females preferentially associate with males gaining rank in their social groups. We recorded all interactions between focal females (n = 19) and adult males (n = 29) in three groups at Gombe Stream National Park over two study periods. Generalized linear mixed models were employed to test for an effect of rank, rank trajectory, age, and parity on behaviors indicative of mate choice in this species. Male rank trajectory had the strongest effect on female approaches (n=105, $F_{2,94}$=4.381, p=0.015) and grooming bouts (n=105, $F_{2,94}$=5.093, p=0.008). Surprisingly, females affiliated more frequently with males categorized as "neutral" (i.e., neither increasing nor decreasing in rank) based on trajectory scores. These males also tend to be more aggressive towards females (n=109, $F_{3,98}$=2.228, p=0.090). Our data provide further evidence of the interactions of male-male competition and female choice in this species and indicate rank trajectory should be considered when assessing social interactions in primate species more generally.

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Skulls of Orangutans with unilateral divided zygoma

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Typically the zygoma is a single bone in the facial skeleton whose shape uniquely copes with loads associated with mastication. Rarely but naturally, the zygoma is divided into two or more parts by supernumerary sutures. These extra sutures are located at an area of critical morphological and biomechanical importance, yet their impacts have not been studied. In this study, the morphological influences of the supernumerary sutures were investigated in orangutan skulls with the divided zygoma using CT images. Among 206 examinable orangutan skulls from six museums around the world, nine specimens (five unilateral and four bilateral) had divided zygoma (incidence of 4.4%). Among four of five skulls with unilateral supernumerary sutures, the zygoma was transected by the intrazygomatic suture that arises perpendicularly from the facial aspect of the maxillo-zygomatic suture and runs dorsolaterally, separating the zygoma into a superior division and an inferior division. When compared to the normal side, the superior division was slender with the weaker muscle/fascia attachment markings on the frontal process, while the inferior division was more robust, with a thicker temporal process. The bones on the affected side that articulated with the inferior division also demonstrated signs of bony strengthening, including a thicker zygomatic process of the temporal bone contributing to a more robust zygomatic arch, and thickening of the lateroinferior part of the zygomatic process of the maxillary bone. The morphology of the affected side demonstrates how the disturbance of the integrity and modularity of zygomatic development has consequent functional adaptations.

Body shape and hominin origins

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The transition to the hominin body plan is most commonly thought to have had African ape-like beginnings—long pelvis, short, stiff lumbar spine, cone-shaped rib cage—in which case the pelvis became shorter to facilitate balance during bipedality, the back became more flexible to attain lordosis, and the rib cage became more barrel-shaped with the abandonment of arboreality. However, the growing evidence for homoplasy in hominoid postcranial form challenges the traditional hypothesis. We consider 3D data on rib cage and overall torso shape gathered from reconstructed CT scans combined with linear and landmark data from 225 skeletons with associated ribs, vertebrae, sternum, and pelvis to characterize variation among extant anthropoids. Data reveal different patterns of variation among torso elements than previously appreciated, and do not support the idea that reorientation of the shoulder to facilitate suspensory locomotion led to uniform modification of the torso. Iliac morphology is not tightly coupled with rib cage shape but is broadly related to maximum rib cage breadth and lumbar form, and upper and lower portions of the rib cage are not tightly

integrated and appear to respond to different adaptive constraints. This, coupled with new fossil data, suggests a crown hominoid body plan reflecting orthograde, suspensory locomotor adaptation that is less specialized than that of extant great apes. These new lines of evidence suggest that hominins, and chimpanzees, evolved from an ancestor with a more generalized, flexible body plan, painting a very different picture of the origin of terrestrial bipedality than previously considered.

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Insights into developmental stress exposure from the bony labyrinth

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Adult body size reflects both genotype and environmental conditions during development. Using body size as a marker of developmental stress exposure in past populations may therefore be confounded by genetic differences. The auditory bony labyrinth completes growth by the 19th fetal week, so may reflect genetic growth potential. Previous studies show that labyrinth dimensions correlate positively with body size in primates and in humans. To test whether environmental stress during development influences this relationship, and is thus an indicator of potential versus actual growth, we compared bony labyrinth dimensions and estimated body size of the el-Badari and Kerma skeletal populations from the Nile Valley. Previous research suggests the Neolithic el-Badari were subjected to significantly greater stress (linear enamel hypoplasia) than the later agricultural Kerma population. We hypothesized that the relationship between body size and bony canal dimensions would be stronger in the Kerma and disrupted in the el-Badari.

Our results yielded no significant correlation between linear or volumetric measurements of the bony labyrinth and body mass or stature. When analysed by sex, several significant negative correlations were found ($p<0.05$). Developmental exposure to stress within both populations may have influenced the relationship between adult terminal body size and labyrinth dimensions. While the el-Badari and Kerma populations differed in their frequency of LEH, they had similar levels ($p>0.05$) of fluctuating asymmetry in the bony labyrinth, cranial base, vault, and face, suggesting similar levels of developmental instability. Further research connecting bony labyrinth and body size will elucidate how developmental stress influences adult morphology.

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Children's Health and Social Changes in Ancient Albania

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This study tests the null hypothesis of no changes in childhood health from the Prehistoric to Late Antique periods at Apollonia and Durres, Albania. Durres and Apollonia were initially occupied by local Illyrians, but were later colonized by the Greeks (c. 600 B.C.) and Romans (c. 250 B.C.). We chose to study subadults because their skeletons are often underrepresented in the archaeological record, but are full of information about how environment and lifestyle affect a population. Subadult remains were scored for non-specific stress indicators (including cribra orbitalia, porotic hyperostosis, and linear enamel hypoplasia) from 100 individuals from Durres (n=47) and Apollonia (n=53). Non-specific stress indicators are not indicative of specific diseases; instead, they show signs of physiological stress that have occurred in a person's life due to nutritional deficiency or illness. Our results indicate that the majority of subadults (55%) died between ages 0-5 years (68% of subadults from Apollonia and 40% of subadults at Durres). No clear patterns of change in skeletal stress through time or between the two sites emerged, which supports the null hypothesis. However, prevalence of cribra orbitalia decreased with age (62% of subadults aged 0-5 had cribra orbitalia in contrast to 33% of subadults who survived to 16-20). This may suggest that infants who experienced stress early in life were less likely to survive to adulthood. Interpretations of these results and comparisons with other Mediterranean sites will be discussed.

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Using extant taxa to model variation in hominin hybrid populations

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Current models of hybridization based on mouse and baboon skeletons indicate extreme cranial size and size-related shape (or heterosis) for first generation (F1) hybrids compared with their parents, an intermediate-to-parental cranial shape, and occasionally the presence of transgressive phenotypes. However, the likelihood of an F1 hybrid being discovered in the hominin fossil record is small, making the application of such single-generation models to understanding and detecting hybridization in the hominin fossil record limited. Here we use various hybrid and purebred mouse strains combined with resampling-based modelling to explore the range of variation likely to be present in a multigenerational recombinant hybrid zone. 95% confidence intervals of means and variances for potential mixed groups are determined to better understand what to expect in a mixed population or hybrid swarm. Results indicate that F2 hybrids are intermediate to F1s and parents, although >80% more closely resemble F1s. Backcrosses and subsequent generations are more likely to exhibit a parental phenotype. However, considered in a multigenerational context, when 35% of individuals in a population exhibit some degree of admixture, the population has significantly greater average cranial size and variance than that of the pooled parental populations. Results are consistent with morphology of the Oase 1 mandible, a known recombinant with Neanderthal ancestry (4-6 generations prior), which nonetheless is more similar to Early Upper Palaeolithic modern humans. Examination of metric and non-metric trait variation in the Krapina Neanderthals also reveals a suite of features consistent with the model presented here for a hybrid population.

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Autopod scaling relationships between primate groups

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Developmental integration may have played a significant role in primate limb evolution, in that selection is constrained by genetic boundaries of the corresponding limb. Despite variation in locomotor modes, primate groups reflect phenotypic patterns of coevolution between fore- and hind-limb elements. Here we focus on metapodial elements, by measuring maximum length of metacarpals and metatarsals III and V in 5 hominoid, 2 catarrhine, and 7 platyrrhine primate species. As phenotypic proxies of autopod coevolution, results reflect patterns of limb evolution and diversification between primate groups.

Metapodial III data indicate small-bodied monkeys demonstrate strong correlative relationships of metapodial proportions

(R^2=0.95), with longer metatarsals than metacarpals. The great ape data show a less correlated relationship with metacarpals longer than metatarsals (R^2=0.76), corroborating research that suggests greater limb individuality follows decreasing quadrupedalism. Compared to metapodial III, metapodial V data indicate stronger metapodial scaling relationship in great apes (R^2=0.97), suggesting differential selective pressures on the lateral foot compared to the midfoot. Additionally, metapodial V data demonstrate monkey and human metapodial proportions align rather than deviate (R^2=0.94). Metapodial V data for *Ardipithecus ramidus* are also included, and demonstrate *Ardipithecus* had less ape-like autopod proportions, and was more aligned with patterns seen in humans and large bodied monkeys.

The conserved metapodial proportions within great ape and monkey groups is inconsistent with the notion that several separate instances of independent limb evolution occurred, although this cannot be ruled out. The differences between mid- and lateral-foot proportions suggest varying degrees of selective pressures, likely related to locomotor specializations.

Evidence of C_4 plant intake and dietary heterogeneity in Late Prehistoric burial populations of Spain and Portugal

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In the Late Neolithic through Early Bronze Age (c. 3500-1500 BC) of the Iberian Peninsula agricultural settlements flourished and the archaeological record provides evidence of large population aggregations around fortified and ditch-enclosed settlements that are associated with emerging craft specialization and long distance trade. Past studies of these settlements have assumed that subsistence practices were based largely on Near Eastern plant and animal domesticates. However, stable isotopic analyses of bone apatite and dental enamel samples from 210 individuals from 23 different Neolithic-Early Bronze Age burials sites throughout Spain and Portugal found evidence in 44% percent of some C_4 plant consumption. This suggests that millet may have been traded into the area earlier than previously thought or that humans may have been consuming some (thus far) unknown local C_4 plant(s). When comparisons of the isotopic data are made by site, a larger than expected amount of dietary heterogeneity was found across the peninsula as in some of the sampled burials no evidence of C_4 plant consumption is evident while at others a majority of sampled humans exhibit signs of some C_4 plant consumption. This difference was even found between geographically close burials, suggesting that subsistence practices may have been more variable in these late prehistoric communities than commonly thought.

Sex, topography, and anatomical variation in the femoral notch: non-contact ACL injury in evolutionary perspective

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Structural elements of the knee joint represent derived features distinctive to modern bipedal locomotion. Little research has addressed the intercondylar fossa (femoral notch), yet narrower notch widths have been linked to increased risk for non-contact anterior cruciate ligament (ACL) injuries in modern populations. Here, we test the hypothesis that variation in femoral notch width index (NWI) is linked to human evolutionary functional anatomy and is relatively consistent over time and across populations. We measured external dimensions on 321 skeletally mature (15+ yo) femora from five contemporaneous prehistoric sites from the Southwest US, including *FHD* and *FBL* (to calculate body size) and *FBW* and *FNW* (to calculate NWI). Comparisons of NWI were conducted using ANOVA and paired-samples *t*-tests.

An analysis of modern NWI values from sports medicine literature suggests measurable differences across modern global samples (i.e., US=0.197±0.03 vs. Japan=0.310±0.04). Similar comparisons in bioarchaeological samples identified significant differences in NWI between sites (F=12.049, df=4, p<.001) and by physiographic province (t=6.213, df=319, p<.001) but not between sexes (t=.576, df=307, p=.565) or body size (r=.088, N=240, p=.176). We reject our original hypothesis and instead suggest that developmental plasticity plays a larger role in the size and geometry of the femoral intercondylar fossa than selection associated with bipedal locomotion. We propose a model of phenotypic modularity for the knee joint in which developmental contributions to notch width may result in disadvantageous injury of the ACL in modern populations. These results have significant implications for preventative training in athletes during critical developmental stages.

Relationship of dominance ranks to age and coalition formation among male chimpanzees at Ngogo

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Male chimpanzees (*Pan troglodytes*) compete for status and form dominance hierarchies. Attaining high rank leads to reproductive payoffs. Males also form alliances with which they can improve and maintain their ranks, and alliance formation can influence mating opportunities. I used data on the unusually large Ngogo chimpanzee community, collected between 1995 and 2015, to investigate how ranks vary with age and with variation in coalition networks. Data on decided agonistic interactions, analyzed with MATMAN, yielded linear hierarchies for each year. The relationship of rank to age followed an inverse U-shaped trajectory described by a polynomial regression with age and age^2 as predictors (F = 201.52, r^2 = 0.41, $p < 0.001$). Males attained their maximum ranks, which varied considerably, at a mean age of 32y, long after growth completion.

I used data on coalitions to calculate four measures of coalition network centrality and power with UCINET (Bonacich power; eigenvector centrality; degree centrality; node betweenness). I used these plus age, age^2, and male identity as predictors in a mixed-effects GLM examining variation in male ranks. A model including Bonacich power, age, and age^2 (all with significant effects) provided the best fit (Wald χ^2 = 980.09, $p < 0.001$) and performed significantly better than one including only the age variables. Overall, results show that males at Ngogo queue for ranks and that participation in coalitions influences male status.

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Admixture and adaptation in wild and domestic canids

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Wolf-like canids have remarkably fluid genomes. Hybridization is especially widespread among gray wolves and coyotes and between gray wolves and domestic dogs. For the latter pairing, admixture confounds simple reconstructions of demographic history and has contributed to adaptation in both species. In North American wolves, black coat color is common and due to a beta-defensin variant that evolved in domestic dogs and was transferred uniquely to North American wolves probably through interactions with Native American dogs. After this admixture event, the black coat allele was swept by natural selection to high frequencies in North American wolf populations. However, the function of the black coat color is not straightforward, and probably relates to immune response rather that coat color. For example, black wolves have a heightened resistance to canine distemper which in turn, is more common in wolves where nearby dogs provide a reservoir for the disease. Consequently dogs are both a genetic source for resistance and disease, which might explain the persistence of the black coat color variant in North American wolf populations. Wolf-dog admixture has also facilitated hypoxia adaptation in Tibetan gray

wolves and mastiffs. Finally, admixture has produced substantial phenotypic diversity in coyotes and gray wolves, and hybrid zones in the Great Lakes area and southeastern US comprise an intermediate-sized canid, sometimes considered a distinct species. I integrate these observations into diagnosis of how admixture assists and hampers the process of evolution in wolf-like canids.

National Science Foundation, American Kennel Club

Do disparities in ex vivo strain data for the human fibula reflect heterogeneous load conditions or limitations of experimental designs?

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Our laboratory is assembling a large histomorphological data set for interpreting load histories of primate and non-primate limb bones where in vivo strain data are unavailable. We find it nearly impossible to correlate our histomorphological analyses of transverse sections of modern human fibulae with published ex vivo strain data (no in vivo data exist). This is because the "best" studies are highly inconsistent, leading to different load history interpretations. We systematically examined the experimental protocols of all published studies of strain distributions of the human fibula diaphysis to determine if any can be considered more reliable than others. Most cited: Lambert (1971); n=5 limbs, ages not reported. Most rigorous: Thomas et al. (1995); n=9 limbs, 66-94 years. Despite each study using 2-3 strain gauges at mid-diaphysis of fibulae loaded through the tibia, shifts in the neutral axis (separating "tension regions" and "compression regions") are dramatic in Lambert and much less in Thomas (who found consistent anterior [tension] to posterior [compression] bending). Lambert's bones were from limbs amputated for peripheral vascular disease and were loaded without varying foot/ankle position. Thomas used cadaver legs and examined different positions of the foot/ankle with and without loading through the femur. Although Lambert's data are deemed less reliable/realistic, it is possible that some findings reflect true heterogeneity of the strain distribution. Therefore in view of available strain data (all ex vivo), we consider the fibula to be in an "intermediate complexity" load category. This interpretation is consistent with our collagen fiber orientation data.

Using geometric morphometric visualizations of directional selection gradients to investigate morphological differentiation

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Human paleontologists and primate morphologists strive to identify the evolutionary processes that have lead to skeletal differentiation among humans, extant non-human primates, and extinct fossil taxa. We would like to distinguish neutral evolutionary processes (genetic drift, mutation) from natural selection, and in situations for which selection is implicated, identify the aspects of morphology on which selection acted most strongly. The directional selection gradient, first introduced by Lande and Arnold (1983), provides an effective way to investigate these topics, because it relates empirical patterns of differentiation (quantified by between-group differences) and integration (quantified by within-group variance/covariance) to quantitative evolutionary theory.

Here we present novel approaches for visualizing selection gradients based on the landmark and semi-landmark data typically collected by physical anthropologists; and for comparing these gradients to those expected for neutral differentiation. Landmark data are challenging to work with in this context because there are many variables, there are often more variables than cases, and the variables cannot be considered separately from each other. However, because landmarks directly reflect the geometry of the object, they allow for intuitive visualizations of selection gradients.

We explore these approaches with a dataset of 347 3-D landmarks and semi-landmarks recorded on the crania of 260 individuals (112 humans, 67 common chimpanzees, 36 bonobos, 45 gorillas). Preliminary results indicate, perhaps surprisingly, that neutral differentiation results in very plausible selection gradients. Nonetheless, the gradients calculated between humans and the other taxa can be confidently distinguished from neutral gradients.

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Gait ontogeny and the avoidance of impact forces

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Humans habitually employ a heel-striking walking gait, although not consistently before three years of age. This study explores the ontogeny of a walking heel-strike (HS) to better understand why this hallmark of adult locomotion is not reliably present in early gait development. Research suggests that avoiding a heel strike while running can significantly reduce violent impact forces known as the impact transient (IT). Our earlier research has shown that non-heel-strike (NHS) waking in adults also reduces IT forces (HS_{IT}=0.56±0.13BWs; NHS_{IT}=0.14±0.22BWs, p<0.0001). We collected kinematic and kinetic data from a sample of children aged 11-102 months (n=27) and examined changes in impact forces with age and foot posture. A mature (>42 months, n=14) and immature (<42 months, n=13) gait group were separated based on gait developmental timelines to examine patterns in foot posture, highlighting significant variation in ground contact location in young children. While walking, children generated ITs higher (on average) than adults ($mature_{IT}$=0.77±0.23BWs, p=0.005, $immature_{IT}$=0.77 ±0.21BWs, p=0.004). Location of ground contact (HS vs. NHS) predicted the magnitude of impact force in the immature group (R^2=0.54, p=0.004) before (in the mature group) average foot posture converged upon that seen in adults. Therefore, it is possible that early in locomotor ontogeny, children avoid HS gaits to reduce these violent impact forces, possibly protecting their developing skeletal anatomy from high loads. Further, we discuss implications for the development of adult foot morphology and the impact of HS walking on hominin pedal morphology.

A Morphometric Approach for Assessing Cranial Vault Modification in Middle Cumberland Region Crania

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Cranial vault modification (CVM) has long interested anthropologists as a physical manifestation of the intersections between culture and biology. Traditional diagnosis of CVM has concentrated on location and means of flattening; however, this is a subjective method dependent upon observer assessment of shape. In many cases it is difficult to distinguish modification from natural variation. This project provides a more empirical method of CVM determination through morphometric analysis of cranial landmarks, specifically 3D scanning. This project examines CVM within the Arnold (n=20) and Averbuch (n=60) late prehistoric skeletal samples from the Middle Cumberland Region of Tennessee. A NextEngine 3D Scanner is used to create high-resolution cranial models with accurate shape data. Both midline and lateral cranial landmarks are used to examine the degree and asymmetry of cranial flattening. A Procrustes analysis is performed in order to translate, rotate, and scale the landmark data, followed by a Jenks natural breaks method for detecting categories within the sample. Preliminary analysis of relative position of point data indicates that quantifiable spatial differences can be observed between the landmark distributions of modified and unmodified crania. The implications of this project's method may more accurately capture differences produced by CVM and provide a

more empirical basis for archaeological interpretations involving modified crania.

Secular Change and Modularity in Craniofacial Fluctuating Asymmetry as an Indicator of the Demographic Transition in Americans

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Craniofacial fluctuating asymmetry provides a marker of developmental instability and reflects the inability of an individual to buffer against environmental and genetic stressors during growth and development. In this study we examine secular changes in craniofacial fluctuating asymmetry in individuals born between the 17th and 20th centuries using landmark-based three-dimensional geometric morphometric methods. The samples come from the Farringdon Street collection in London and are representative of early colonial Americans and Euro-Americans born during the 19th and 20th centuries. There were several important shifts in demographic parameters at occurred during the time period under study, including significant declines in infant and juvenile mortality. This study examines whether there is a significant change in the level of fluctuating asymmetry associated with the demographic transition. We examine whether the changes in infant and juvenile mortality patterns reflect modifications in growth and development related to developmental instability. Preliminary results show that individuals born later in the 20th century have significantly lower levels of fluctuating asymmetry. Additional results will examine modularity and integration in the pattern of fluctuating asymmetry in three regional craniofacial modules that reflect differing developmental pathways. A determination of the whether the modules are integrated or independent will provide insights into when developmental stability is disrupted resulting in the variable levels of fluctuating asymmetry. Moreover, by determining if the pattern of integration is stable or variable over time, we will more precisely characterize how the timing of developmental disruptions changes during the period under study.

Molecular Identification of Mycobacterium tuberculosis in the Milwaukee County Institution Grounds Cemetery

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The possibility of identifying Mycobacterium tuberculosis in skeletal remains has been a debated topic for many years. This study utilizes the remains from the 1991 and 1992 excavations of the Milwaukee County Institution Grounds Cemetery, a collection of human skeletons ranging from 1882 to 1925, of various ages and sexes, to address that possibility. To test the utility of previously used methods of osteological identification of tuberculosis, the collection has been analyzed for the IS6110 repetitive element marker using molecular biological techniques, such as Polymerase Chain Reaction (PCR). Eighty-six skeletons from the collection have been analyzed, with nine of them showing evidence of skeletal tuberculosis. PCR has also been carried out with the oxyR marker to rule out Mycobacterium bovis contamination on all positive IS6110 samples. The goal of the study was to evaluate whether or not osteological identification of M. tuberculosis is possible and whether it can be confirmed using molecular biological techniques.

Life under early colonial occupation: the encomienda as experienced by the people of El Chorro de Maíta, Cuba

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While the historical literature offers lengthy discussions of the effects of European contact on the indigenous peoples of the Caribbean, little has been written on the effects that these early colonial interactions had on the physical remains of the people themselves. The cemetery within the site of El Chorro de Maíta, Cuba, contains the skeletal remains of 133 individuals who were among the first in the New World to interact with Europeans. By analyzing and pooling individual life histories, the story of a community living under the Spanish colonial *encomienda* system of forced labour can be written. But rather than echoing the "Black Legend" of violence, overwork, and poor nutrition, the remains of the Chorro *encomendados* illustrate a life largely similar to other Pre-Columbian Caribbean populations. The one exception is a mortality profile with a large catastrophic component, which may have been influenced by the introduction of infectious disease to which the Chorro population had no immunity. Though not necessarily representative of the effects of the colonial experience on the indigenous population as a whole, the life histories of the Chorro people illustrate a specific moment in time during the early colonization process.

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A Proposed Model of Postnatal Ontogeny in the Human Craniofacial Complex

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Researchers have proposed two mutually exclusive models of postnatal growth in the human craniofacial complex. One model proposes that shape differences are established prenatally with craniofacial modules growing proportionally throughout postnatal life. The other model argues that modules of the face grow at different rates and at different proportions. To address these two opposing hypotheses, a model of proportionality among five developmentally independent regions of the face is tested to determine if facial proportions are set early in ontogeny and further elaborated through postnatal parallel ontogenetic trajectories. To this end, three-dimensional geometric morphometric cranial data obtained from 299 (155 females and 144 males) CT scans of juvenile heads (ages 7 to 17) were assessed. Thirty eight three-dimensional landmarks were used to define five independent regions of the face: the frontonasal region, the left and right maxillary processes, the ethmoid, and the sphenoid. To test a model of proportionality, scaled Euclidean distances of all landmarks and of each individual facial region were calculated and subjected to a two-factor ANOVA. The results indicate that males and females portray proportional growth in the facial skeleton throughout ontogeny in all regions except for the ethmoid ($p<0.001$). In light of these results, a proposed "hybridized" model of ontogeny is presented to explain postnatal growth patterns in the craniofacial complex of humans.

The human cognitive-motor action interface: integration of central and peripheral nervous systems for tool use

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The capacity for humans to have highly refined, developed and adaptable skillful motor control of the upper limb has been an emerging focus of neuroscience. Evidence has shown a tight coupling of central (brain, spinal cord) and peripheral (limb) nervous elements that provide constant feedforward and feedback interactions. However, the emergence of the utility of peripheral visual information in both feedforward and feedback of motor control has opened a unique window on how upper limb actions can be modeled by the visual system to operate a "cognitive-motor architecture" that is vital for skillful motor performance. Understanding this mechanism can provide insights on how systems co-developed as motor skills developed in mankind. To understand this, we have sought to model eye movement patterns of expert flint-knappers and those naïve to the

task observing stone tool making. We hypothesized that eye movements in experts would be modeled to identify key events in the task and anticipate actions related to the performance of the task while naïve participants would be more prone to view the hand and distractor items (e.g., flakes). Findings confirm the hypothesis, and further suggest that the coupling of eye movements is not driven solely by action, but by modeling predicted action which necessitates a central-peripheral co-integration. Ongoing studies are evaluating how eye movements develop with neurobehavioral patterns in similar tasks.

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Comparing narrow-band to full-spectrum based methods for measuring human skin pigmentation

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Pigmentation, resulting largely from the presence of melanin in the epidermis and hemoglobin in the dermis, is one of our skin's fundamental features. Most research on skin color variation today employ simple single-parameter measures of skin color using narrow-band reflectance spectroscopy. Although full-spectrum instrumentation and methods have been available for a number of years, studies on variation in human pigmentation have utilized older methods. In an effort to investigate to what extent narrow-band methods might differ from full-spectrum methods, we used principal components analysis (PCA) to compare melanin (M) and erythema (E) indices provided by the DermaSpectrometer (Cortex Technology, Hasund, Demark) to spectral trace reflectance values provided by the DataColor 45S (Datacolor International, Lawrenceville, NJ). The DermaSpectrometer calculates M and E using percent reflectance at 568nm and 655nm, respectively, while the DataColor measures percent reflectance at 10nm intervals from 400-700nm. PCA on melanin and erythema index from n=1,844 individuals of varying ancestry showed that PC1 explained 86% of the variance in pigmentation. PCA on the DataColor reflectance values from n=900 individuals of varying ancestry showed that PC1 explained 96% of pigmentation variance. When visualized, biplots of DataColor PCs 1 and 2 show a much higher level of clustering by ancestry than do biplots of DermaSpec PCs 1 and 2. Thus, melanin and erythema indices are not adequate to usefully study intra- or inter-population variation in pigmentation. Future studies are needed to determine the biological components of pigmentation being measured by full-spectrum methods, however, their usefulness in pigmentation studies is promising.

Environment, culture and society as reflected in the dental wear and pathology of the inhabitants of the 4th cataract, Sudan

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Rescue archaeology from the 4th Nile cataract has produced a collection of skeletal assemblages covering the Neolithic to the Medieval eras. Archaeological evidence, from this and surrounding areas, has illustrated the complex changes in environment, culture and social practices during these periods. This study aims to investigate how these changes are reflected in the dental anthropology of the inhabitants of the 4th cataract. Dental caries is recorded by lesion site and periodontal disease through changes in the supporting bone. Digital photogrammetry of the occlusal surface is used to determine a pattern of dental wear, using Java-based image processing software. Preliminary results from a medieval population show that attrition facet caries increase with age, while pit caries decrease. Similarly occlusal caries are found in all age groups with the highest prevalence in children of 3-12 years, suggesting a link with dental wear. Very low variation in caries prevalence was seen between sexes. In addition, dental wear results show increasing wear of the anterior dentition as age increases. High caries prevalence indicates a high carbohydrate intake, possibly reflecting an agriculture based society. This research should provide a unique insight into the impact of socio-cultural practices on the oral health of the inhabitants of the 4th cataract.

Dominance Rank, Male-Female Aggression, and Male Mating Success Among Chimpanzees at Ngogo

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Chimpanzees (*Pan troglodytes*) have a complex mating system in which males use multiple tactics to gain copulations. Research on the effects of male rank and male-female aggression on male mating success in chimpanzee communities with relatively few males has shown that male dominance status positively influences mating success and that males often direct aggression at sexually receptive females, behavior that can constrain mate choice and potentially influence paternity probabilities. Multiple studies have shown that high-ranking males have relatively high paternity success.

We investigated relationships among dominance rank, aggression, and mating success in the unusually large Ngogo community, using data collected over seven years during which the community contained > 25 adult males. We constructed linear mixed models, using the lmer package in R, to test the hypothesis that both rank and male/female aggression influence male mating success. The response variable was the relative share of copulations that individual males gained with a given female; predictor variables included male dominance rank, the rate of male/female aggression, male identity; female identity; female parity (nulliparous vs. parous); whether females were periovulatory; and year of data collection. Results showed that male rank and male/female aggression significantly and independently affected male mating success. These effects were stronger during periovulatory periods (POPs), but also held outside of POPs. They did not vary significantly among years. Ngogo data thus reinforce the arguments that success in male status competition influences mating success in chimpanzees and that males also use aggression to females as a mating tactic.

L.S.B. Leakey Foundation, National Geographic Society, US National Science Foundation BCS-0215622 and IOB-0516644, Yale University

Flipping Anthropology: an assessment of student knowledge and evaluation in a flipped introductory anthropology course

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The National Research Council (1996), in its National Science Education Standards, advocates for teaching students with hands-on and minds-on activities in order to improve their scientific literacy. The flipped classroom strives to make learning more active by providing foundational material to students before class (e.g., narrated lectures and readings on Blackboard) and reserving face-to-face meetings for exercises that address higher-order thinking. ANT 100 Human Origins at SUNY Buffalo State is an introductory course in biological anthropology and archaeology that attracts many non-majors. We traditionally taught it as a lecture class. In Fall 2014, we transformed it to a flipped class. We used a control-treatment study design; 240 students in lecture classes in Spring 2014 served as controls to 150 students in flipped classes in Spring 2015. We hypothesized that students will retain their knowledge more in the flipped class. We measured this with a 12-question true/false test at the beginning and end of each semester; we calculated the mean difference in percentage correct on each question between each semester's post- and pre-tests. We also hypothesized that students will have a more positive evaluation of the flipped class as

measured by Likert-scale statements and open-ended questions. Students in flipped classes had greater mean differences between post- and pre-tests on seven questions. Students had more positive evaluation of the flipped class, including feeling more engaged in, preferring, and believing they learned more anthropology in the flipped classroom. Flipping this anthropology course was a success and we encourage others to flip their courses.

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Seeing RED: A new statistical solution to an old categorical data problem

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Non-metric traits such as dental morphological traits are often used to compare populations through biological distance statistics. These data can be presence/absence, count, categorical, or ordinal, and share the common feature of parsing a continuous or quasicontinuous phenotype into degrees of expression. Nonmetric data can be used to calculate biological distance using statistical techniques such as the Mean Measure of Divergence (MMD) or pseudo-Mahalanobis D^2. However, two significant disadvantages to these techniques are that the researcher must 1) compress the data using a breakpoint into dichotomized presence/absence, for which the frequency of "present" is calculated for use in the statistic, and 2) edit the traits to diminish missing data and inter-trait correlations. We propose an alternative method to analyze dental morphological traits that requires neither dichotomizing nor data reduction. This nonparametric method, Robust Estimator of Grade Differences (RED), avoids data compression and allows for missing data.

We performed two comparative tests of methods on simulated and orthodontic datasets to determine how well RED performs against MMD and pseudo-Mahalanobis D^2 for illuminating patterns of biological distance. Our tests using both the simulated data and the orthodontic data reveal that RED produces expected results under a wide variety of conditions. Furthermore, the analyses show that RED provides results as good or better than MMD and D^2 without introducing bias through dichotomization or trait editing. These findings suggest that RED be added to the statistical toolkit for use on categorical data, as it avoids data compression and is not sensitive to missing data.

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Bones in the village: Indications of the Crow Creek massacre from scattered human remains found in the habitation area

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The fourteenth-century Crow Creek Bone Bed constitutes the largest human osteological assemblage from a prehistoric massacre. Located in central South Dakota, the mutilated, partially disarticulated remains were discovered at the end of the site's fortification ditch in 1978. Largely overlooked in discussions of the massacre, however, are the human remains scattered across the habitation portion of the village, recovered in the 1950s by archaeological crews from the Nebraska State Historical Society. This presentation compares and contrasts the Village elements with those from the Bone Bed to enrich understanding of the Crow Creek massacre.

Some of the scattered Village remains indicate alterations, many in keeping with those among the Bone Bed remains. However, some of the Village specimen alterations suggest more tortuous actions. As an example, an adolescent discovered in a storage pit inside a lodge shows numerous deep cuts on the bones of the thorax, arm and leg. None of the hundreds of Bone Bed specimens showed comparably numerous or severe cuts.

In addition to mutilation comparisons, the spatial distribution of the Village remains also expands what the Bone Bed demonstrates. Violence occurred at many Crow Creek Village locations, spread across the site and not just limited to the area adjacent to the Bone Bed area. This wholesale, village-level involvement indicates the probability of additional remains scattered across unexcavated portions of the village, even the possibility of additional bone beds.

Experimental Coevolution with Bacteria and Phage Provide Insights into Human-Pathogen Coevolutionary Dynamics

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Infectious diseases pose a significant threat to human health, in addition to jeopardizing the economic and social development of affected countries. Traditional experiments examining complexities of coevolution between humans and pathogens pose health risks and bioethical concerns among scientists and the public. Experimental coevolution utilizing bacteria that infect non-human hosts and their phages presents an alternative line of inquiry. Experimental coevolution studies provide a safe and controlled environment that allows for the examination of the selective pressures exerted by hosts and parasites and pleiotropic effects of long-term periods of continuous interaction. From these studies, we can elucidate the molecular basis for resistance, infectivity, and virulence applicable to human-pathogen coevolution.

Pseudomonas bacteriophage φ6 is a widely used model system for research on RNA viral evolution and ecology due to the phylogenetic relatedness and physiological similarities to viruses that can infect humans. In our coevolution experiment, we coevolved φ6 and its host, *Pseudomonas syringae*, and measured the concentration of phage and bacteria in three replicate lines over the course of five days. Preliminary results were consistent with previous studies, which described a consistent concentration of bacteria, a declining population of phage, and the appearance of resistant bacterial phenotypes. The Red Queen dynamics described here are also observed between humans and pathogens. Future work will delve into the genetic mechanisms behind resistance and virulence that contribute to the alternating cycle of dominance and decline associated with long-term coexistence.

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Comorbidity of linear enamel hypoplasia, periosteal lesions, and cribra orbitalia in medieval and post-medieval central European populations

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Extensive research on living and past human populations illuminates interdependent relationships between diet, disease, and physiological stress. Many osteological markers for assessing these variables are multifactorial in etiology. In particular, linear enamel hypoplasia (LEH) have been linked to disease and nutritional deficiency during development. Thus, LEH should co-occur frequently with other skeletal indicators of infectious disease and nutritional deficiency.

To test this, LEH, periosteal lesions, and cribra orbitalia frequencies were assessed in six populations from medieval and post-medieval (AD ~800-1850) Germany and Austria. Adults and subadults were both included; data were collected according to Global History of Health Project Standards and recoded as presence/absence. Both healed and active cribra orbitalia lesions were recorded by individual and grouped. LEH presence was recorded for individuals with at least one affected anterior tooth. Periosteal lesion presence was coded for individuals with at least one affected lower limb bone. Presence/absence for all three conditions could be collected from 107 of 349 individuals.

A dummy variable for the comorbidity of LEH with either cribra orbitalia or lower limb periosteal lesions was created and the proportion

of individuals fitting this model of comorbidity was tested. The proportion of individuals adhering to the expected comorbidity was significantly lower than would be the case if LEH always co-occurred with either indicator (67.3%, t = -7.178, p < .000). These results reveal that inquiries into past quality of life vis-a-vis osteological indicators are complex, and further underlines the need for multiple indicators of stress, disease, and nutritional deficiency.

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Exploring Ecogeography, Drift, and Selection on the Macaque Cranium

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The human cranium is one of the most studied osteological complexes among primates due to its size, good preservation in the paleontological record, and its wide morphological diversity. As *H. sapiens* is the last extant member of its genus, we must turn to related genera to answer questions regarding variation among species and the evolutionary forces that produce it. This pilot study uses morphometric data collected from skeletons of three species of macaques (*M. fascicularis*, *M. nemestrina*, *M. radiata*) housed at UC Davis. Following the work of Lande, Ackerman and Cheverud the data are used to 1) examine the phenotypic variation present in the cranium of each species by module, 2) to test for deviation from a null model of neutral microevolution (i.e. genetic drift), and 3) to quantify the selection gradients for each trait by species. The results from this study indicate that phenotypic variance in the *Macaca* cranium has been driven largely by selection since the divergence of the genus from the last common ancestor (LCA) of Papionini some 9-10 million years ago. Further, in line with observations by Ito et al., selection is related to ecogeographic factors on the splanchnocranium (highest), neurocranium, and basicranium (lowest) in *M. fascicularis* and *M. radiata*. These results warrant further investigation via process modeling in order to rule out other complicating factors such as hybridization and heterochrony.

The axial skeleton and scaling of the trunk in *Homo naledi*

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We describe the axial skeletal material recovered from the Dinaledi chamber of Rising Star cave that, together with some pelvis and shoulder remains, document the complicated nature of trunk evolution. The axial material includes two near-complete lower thoracic vertebrae found in articulation with an 11th rib, the proximal portion of a 12th rib, and 80 other rib and vertebral fragments. Proximal aspects of the two lower ribs are straight (uncurved), suggesting a broad, australopith-like lower ribcage. The thoracic vertebrae are amongst the smallest yet encountered in the hominin fossil record, but are characterized by large neural canals and moderately-proportioned centra, consistent with opposite scaling trends (negative and positive allometry, respectively) of these features in small-bodied *Homo*. Given the derived aspects of cranio-dental, hand, and foot morphologies and limb lengths, we suggest that the primitive appearance of the ribcage and other anatomical features (e.g., pelvic breadth, glenoid orientation) either 1) reflects the evolutionary retention of australopith-like features coupled with more derived (*Homo*-like) aspects of lower rib and thoracic vertebra shape and/or 2) points to the importance of scaling relations among respiratory system elements and other trunk morphologies that may correspond with possible size-related differences recently identified in small- and large-bodied *Australopithecus afarensis*. In combination with some features that are most similar to Middle Pleistocene hominins (to the exclusion of modern humans), such as robust lower rib cross sections and dorsally sweeping transverse processes, we entertain multiple evolutionary scenarios to explain the presence of this unique combination of morphologies in *H. naledi*.

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Predictions for an osteological signature of stone tool behaviors in hard tissue anatomy

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To determine the origins of stone tool behaviors and the degree to which fossil hominins engaged in them, paleoanthropologists have long sought diagnostic skeletal features of stone tool manufacture and/or use. Here we integrate biomechanical and trabecular methods to help generate baseline hypotheses of that signature within hard tissue anatomy.

Dynamic manual pressure data were gathered from the (dominant) palmar phalangeal surfaces of ten experienced knappers replicating Oldowan-style flakes, using state-of-the-art textile pressure sensors on each phalangeal segment. The internal trabecular bone volume (BV/TV), degree of anisotropy (DA), and E-modulus (*E*) was quantified using micro-CT scans of whole human hands (n= 27) from a random (e.g., potentially including knappers and non-knappers) temporographically disparate Holocene group.

Knapping data show a consistent radioulnar and distal-to-proximal pattern in pressure distributions: loads peaked on the pollical distal phalanx and decreased both ulnarly (from digit 2 to 5) and proximally (from the distal to proximal phalanx). In terms of trabecular bone anatomy, the 3rd and 4th digits are more "robust" compared to the 1st and 5th digits. Additionally, we find a palmoulnar concentration of BV/TV and *E* in the 2nd to 5th metacarpal heads, consistent with flexion-based loading. Based on EMG and pressure data, we expect the same palmoulnar pattern in knappers, but variation in inter-digit trabecular robusticity. We predict that in committed knappers trabecular robusticity will be greatest in the three radial digits, increasing in a distal-to-proximal pattern through the wrist to withstand high cumulative external and internal loads concentrated on the radial carpals.

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"By the skin of their teeth": Instrumental striations on Neandertal and early modern human anterior teeth challenge the assertion of differential visuospatial integration and extended cognition

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The ubiquity of instrumental striations, or cutmarks, on the labial surfaces of archaic human anterior teeth (*Homo heidelbergensis* and Neandertals, *sensu lato*) is well-known. These striations have recently been invoked as

evidence supporting differential, or mismatched, visuospatial integration and extended cognition among archaic humans as compared to *Homo sapiens*. However, these comparisons have only considered a small sample of Australian Aboriginal anterior dentitions as a proxy for *Homo sapiens* behavior, rather than comparisons with temporal and behaviorally relevant samples of early modern humans (EMH). Therefore, cutmarks were assessed on the labial surfaces of right and/or left maxillary central incisors from eight Middle Paleolithic modern humans (MPMH) and 14 early modern humans (~40-20 ka BP) using scanning electron microscopy. Results document the presence of labial surface cutmarks on 100% of MPMH and EMH teeth, which is in stark contrast to research proposing less use of the teeth for manipulative behavior among *Homo sapiens*. Thus, there is no support from instrumental striations for deficient visuospatial integration or extended cognition among Neandertals given the ubiquity of cutmarks on the anterior teeth of all Middle to Late Pleistocene human groups. When assessing the role of behavior as an explanation for the eventual demise of the Neandertals it is necessary to look at temporospatially relevant groups (i.e., early modern humans) rather than using one or a few comparative samples from the Holocene as a proxy for the behavioral repertoire of all *Homo sapiens*. This research reinforces the need for appropriate comparisons in Paleoanthropology.

The Leakey Foundation

Experimental Mummification Project for Radiological Detection of Cancer

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Most paleopathological case studies of cancer have been based on the description and analysis of neoplastic disease in skeletal remains, which limits diagnosis to cancers that affect the skeleton. Mummified human remains, however, have the potential to preserve soft tissue tumors, in addition to skeletal evidence of neoplastic disease, thus presenting a broader and more detailed picture of neoplastic disease in the past. Non-invasive imaging analysis is preferred for the study of mummies, with CT analysis representing the most detailed and informative method. Unfortunately, the effects of natural and anthropogenic mummification on soft tissue tumours are unknown and could affect the visibility of tumours in mummies examined through CT analysis. To this end, an experimental archaeology project was undertaken to test the effects of natural and anthropogenic mummification on tumorous tissues and their appearance through CT imaging analysis. Mice from a cancer research center that contained human tumors were mummified in various conditions, including: anthropogenic mummification in the ancient Egyptian style, natural desiccation using a controlled heat source, frozen, and naturally preserved in an anaerobic bog environment. The mice were documented before mummification using a microCT scanner, and then again at intervals after mummification. Tumour size and shape were recorded and changes in the different tissues were observed over time. Preliminary results will be presented as this long-term project is ongoing. This research demonstrates the value of experimental archaeology for paleopathological research, as well as for our understanding of the presentation of cancer in mummified remains.

Influence of acculturation and lifestyle change on metabolic health among the Sakha (Yakut) of Northeastern Siberia

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Many populations worldwide are rapidly shifting to a market-based society, producing changes in energy balance and obesity risks. Indigenous circumpolar populations have traditionally had low rates of obesity, due in part to high basal metabolic rates (BMR). This paper tests whether BMR mediates the relationship between acculturation and obesity risk in a sample of Sakha (Yakut) adults (>18 years, n=66, 28 men) from Northeastern Siberia. Participants were interviewed on lifestyle and socio-demographic information. BMR was measured with indirect calorimetry. Mediation was tested with multiple linear regressions.

The sample had a mean age of 45.6 years (SD=15.7) and 40# were overweight or obese by body mass index (BMI). The mean BMR was 1,322 kcal/day (SD=339). Pariticipants with a mixed SoL tended to have higher BMR in a simple ANOVA (p=0.051). Traditional and mixed SoL significantly predicted lower BMI (B=-2.3, SE=1.05) and higher BMR (B=151.2, SE=76.8) after correcting for age and sex in multiple regressions. However, BMR did not mediate the relationship between SoL and BMI.

Overall, lifestyle was related to obesity risk in this sample of indigenous Siberians yet BMR did not mediate the relationship. Though this population has been found to have elevated BMR compared to more equatorial populations, it does not appear to alter the obesogenic impact of a market-based lifestyle.

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Stressful childhoods, (un)healed lesions, and lifelong impacts: A view of life history and frailty in West-Central Illinois

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Bioarchaeologists routinely tabulate indicators of childhood stress to assess the adaptive success and health of past populations. An increasingly popular extension of this practice has been the examination of the relationship between prior stress, as reflected in healed lesions, and future growth and longevity. In this study, we explore the impact of childhood stress on the life history of Native peoples that inhabited west-central Illinois during the Late Woodland and Mississippian periods (AD 600-1425). Age-at-death, sex and other demographic data were collected for 2,331 individuals. Recorded measures of childhood growth and stress included porous skull lesions, enamel hypoplasias, long bone length, and vertebral neural canal dimensions. Hazard models were utilized to examine how childhood stress may have detrimentally impacted future growth and mortality patterns. Comparison of older children, adolescents and adults with and without healed porous skull lesions revealed significantly different survivorship patterns with the former experiencing 10 fewer years of life on average. When analyzed by sex, adult females with porous skull lesions were found to have significantly lower survivorship, shorter tibiae and femora, and smaller transverse neural canal dimensions. Among adult males, survivorship and neural canal dimensions were not associated with the presence of porous skull lesions, though those that experienced childhood stress were shorter on average. No significant associations between the presence of enamel hypoplasias and porous skull lesions were detected. These findings contribute to an emerging area of scholarship indicating that early life stress can impact later physiological capacity, growth and longevity.

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An assessment of correlation between linear enamel hypoplasias and Wilson bands in a cemetery from the Bronze Age Levant

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Linear enamel hypoplasias (LEHs) result from serious systemic stress events in conjunction with severe nutritional deficiency. Similar physiological processes contribute to the formation of Wilson bands (WBs), however this study examines whether a clear relationship between LEHs and WBs can be observed in one test population. This study used canine teeth (n=115) from tombs dated to the Middle to Late Bronze Age (2,000BC-1,200BC) at the site of Ya'amun in northern Jordan. The climate during this period was cooler and dryer than previous periods. Intensive agriculture was just beginning and the skeletal analysis of this site showed no chronic infectious disease. The teeth were thin-sectioned and examined with a light microscope. Micrographs were made of the thin-sectioned teeth. The number and location of enamel defects were recorded for each tooth. This study does not demonstrate that a clear relationship between LEHs and WB exists in this sample. There was an average of 4.207 WBs for each individual no matter how many LEHs were present. When graphed together, there was no increase or decrease in WBs with increased incidence of LEHs (R^2=0.000). Out of the total 111 LEHs recorded for the entire sample, 56 LEHS were directly associated with at least one WB and 55 were not associated with any WBs. The Bronze Age citizens of Ya'amun had a unique history and context that contributed to childhood stress and at least for this particular population, Wilson bands are not always seen in association with LEHs.

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The relationship between dental topography and dental microwear in *Sapajus apella*

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Dental microwear and topographic analyses offer two approaches to inferring diets and feeding adaptations of fossil mammals. Yet few studies have looked at relationships between these two proxies in individuals within species. For example, what affect does average slope, angularity or relief of an occlusal surface have, if any, on microwear texture attributes, such as fractal complexity, anisotropy, scale of maximum complexity, textural fill volume, or heterogeneity? This study reports on an analysis of variably worn M^2s (n = 23) of wild-caught apelloid capuchin monkeys (*Sapajus apella*) to determine whether standard measures of dental topography and microwear texture are significantly associated. A Spearman rank correlation matrix model was used to test for associations between pairs of variables. Results indicate significant associations between some topographic attributes (e.g., average surface slope and relief) and between some microwear texture variables (e.g., complexity and heterogeneity of complexity). On the other hand, there are no significant associations between any of the topographic attributes and any of the microwear texture variables (whether using an experiment-wise error rate or not). In other words, dental microwear texture appears to be independent of occlusal surface topography for this taxon. This has important implications for reconstructing the diets of fossil species, especially when considering teeth that change shape as they wear.

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The biocultural signature of Afro-Caribbean religious rituals from a multiregional medicolegal perspective

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Biological anthropologists working in medicolegal settings sometimes encounter human remains in ritual contexts. In Florida, New York, and New Jersey, states with large Caribbean populations, these assemblages of human remains and material culture frequently result from Afro-Caribbean religious practices.

Traditionally, anthropologists treat these assemblages as forensic cases, assessing the remains for biological profile and trauma, and simply noting the material contexts in which they were deposited (e.g., within cauldrons, stained with soil and blood, associated with faunal remains, feathers, sticks, and metallic mercury). However, we believe that these extraordinary depositional contexts are essential to the interpretation of the remains.

Sensitive study of the material culture associated with the remains can enable greater specificity in identifying the religious rituals involved in the creation of these assemblages. Ethnographic research can augment an understanding of these practices. Taphonomic data can supplement biological interpretations. Multiple lines of biocultural evidence must be considered when interpreting Afro-Caribbean ritual remains.

To illustrate the importance of this holistic perspective, we present multiregional case studies from medicolegal contexts across Florida (n=42), and New York and New Jersey (combined, n=14). A biocultural signature of Afro-Caribbean ritual emerges, with shared features highlighting similarities in religious practice in these regions (including animal sacrifice, acquisition of buried human remains, and ritual use of metallic mercury and Kongo-inspired iconography).

Biological anthropologists have much to contribute to the study of Afro-Caribbean ritual practice in the U.S., but only if they synthesize biological, material cultural, ethnographic, and taphonomic data, and adopt a comparative, holistic, multiregional perspective.

Topographic complexity of second mandibular molars increases with a wear proxy in five species of cercopithecoid primates

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After entering functional occlusion, primate teeth undergo lifetime destructive wear. Molar teeth may be adapted to maintain chewing efficiency despite wear. Evidence for this has been observed in artiodactyls, but it has proved difficult to quantitatively assess this hypothesis across mammals. Topographic methods that quantitatively describe tooth shape may help achieve that goal. Primate molar topographic relief has been shown to decrease with wear and age. Meanwhile topographic complexity has been shown to not change significantly with age in two species of lemurs. Both metrics have been linked to feeding behavior and are assumed to reflect function. Using relief as a wear analog, we investigate changes in second mandibular molar complexity across wear in cercopithecoid primates. Relief and complexity were quantified using RFI and OPCR metrics respectively for a sample (n = 76) including *Cercopithecus campbelli*, *Macaca fascicularis*, *Papio cynocephalus*, *Theropithecus gelada*, and *Colobus guereza*. Molar complexity increases as relief decreases significantly in four species and with marginal significance in *M. fascicularis*. ANCOVA results show that slopes of OPCR by RFI are not significantly different between species, while OPCR intercepts do differ. If complexity is related to dental function, these results may quantitatively indicate the maintenance of molar function through wear. Molars of species considered may evince a relief-complexity balance through life that helps to ensure teeth are functional even as wear changes tooth shape. This might also help to explain the reduced efficacy of complexity in predicting diet from assemblages of primate teeth with low degrees of molar wear.

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Coalition frequencies in the feet of modern Thai

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Malsegmentation of foot bones during embryogenesis results in fibrocartilaginous or osseous union between elements. Recent research suggests that the coalition location and frequency in the foot varies between populations. Proximal midfoot tarsal coalitions are rarely found in Euroamerican samples, but more frequently occur in Africans and Asians. Conversely, distal midfoot (tarso-metatarsal) frequencies are moderately high in Asian samples, and lower elsewhere. Coalition patterns may indicate shared ancestry due to past migration, since the few Asian samples studied appear to have similar coalition patterns to Native Americans, suggesting these patterns date to the late Pleistocene.

We examined tarsal coalitions in modern Thai skeletons to refine our understanding of Asian sample frequencies since few have been published. The morphology of 4554 tarsal bones from 331 skeletons curated at Forensic Osteology Research Center, Faculty of Medicine, Chiang Mai University were observed for coalitions, alongside examination of 169 individuals for pedal symphalangism. Multiple tarsal coalitions were identified in the proximal midfoot, including naviculo-cuneiform I and intercuneiform II-III coalitions; only a single hindfoot coalition (calcaneo-navicular) was found. Similar to other Asian samples, pedal symphalangism was found in 75% of modern Thais, while the frequency of MT3-C3 coalition was 5.9%. These results generally support the overall pattern emerging in other Asian and Native American samples which display proximal midfoot coalitions, which are infrequent in Euroamerican samples, and high rates of pedal symphalangism. Increasingly, it appears that lower MT3-C3 coalition frequencies (<12%) in Asian samples distinguish them from Native Americans, where higher frequencies are frequently found (12-26%).

A possible case of unilateral cleft lip and palate from the late Neolithic site of Verteba Cave, Ukraine

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Cleft palate is a bony defect that affects the midline of the maxillary palate in which the right and left halves fail to unite during fetal development. As a result, an opening occurs, either unilateral or bilateral, which connects the nasal and oral cavities. This malformation may be found in association with cleft lip, an anomaly of the upper lip and underlying facial bones. Affected individuals would suffer from facial disfigurement, have difficulties producing comprehensible speech, and would likely have respiratory and nutritional difficulties. It is likely that this defect would have been lethal in prehistoric contexts; possibly explaining why few cases from the archaeological record have been reported. Orofacial clefts are among the most common congenital anomalies reported today, with cleft lip/palate reported in 1-2 of every 1,000 live births and isolated cleft plate in 1 in 2,000-2,500 live births. Orofacial clefts, like most common congenital anomalies, have a multifactorial etiology largely influenced by the interaction between environmental and genetic components. We report here on a case of unilateral cleft lip and palate diagnosed in a young male (25-40 years) from Verteba Cave, Ukraine, a late Neolithic site dating to 3500 calBC. Dating to the Tripolye CII period (c.3600-3000 BC), this secondary burial is associated with Tripolye ceramics, figurines, and stone tools. This is one of the oldest cases of cleft lip and palate yet reported in the paleopathological literature.

Hominin Taxic Diversity: Fact or Fantasy?

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To assess the evidence for taxic diversity in the hominin clade we looked at the hominin fossil record in nine time intervals. The first includes the fossil evidence between c.7 and 5 Ma, the next two consider the fossil evidence in one million year intervals (i.e., 5.0-4.0 Ma and 4.0-3.0 Ma) and the next four consider the fossil evidence in half a million-year intervals (i.e., 3.0-2.5 Ma, 2.5-2.0 Ma, 2.0-1.5 Ma and 1.5-1.0 Ma). We then consider evidence for taxic diversity within the hominin clade between 1.0 Ma and 0.25 Ma, and finally in the interval between 0.25 Ma and the present. We used current published evidence about the first and last appearance dates of each taxon to decide whether a species or specimens should be included in one, or more, of the intervals. Within eachtime interval we consider the strength of the evidence that more than one hominin species is sampled and score the probability of each pairwise species comparison as high, moderate or low. With the exception of the oldest time interval (>5 Ma) in our judgment in all of the other time intervals there is at least one well-supported example of hominin taxic diversity, and several time intervals have multiple examples. In summary, not all new hominin taxa are created equally, but while hominin taxic diversity may not be as prevalent as some have claimed, it is a feature of the hominin clade from 4 Ma until c.40 ka years ago.

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Low Mortality Rates among Ngogo Chimpanzees: Ecological Influences and Evolutionary Implications

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Data on chimpanzee (Pan troglodytes) life histories and demography are invaluable for investigating human life history evolution and reconstructing life history parameters in extinct hominins. We add to the chimpanzee comparative sample with the first formal analysis of mortality rates in the unusually large Ngogo chimpanzee community. We also provide a novel method for estimating survivorship under the assumption that age estimations for chimpanzees are imperfect and increasingly error prone for older individuals. We used life table and survivorship analyses of yearly field records to characterize mortality during 1995-2014. We find that the Ngogo chimpanzee community experienced the lowest mortality of any community studied thus far, which partially explains why it is so large. Notably, mortality was significantly lower than at Kanyawara, in the same park only 10 km away. Ecological factors presumably reducing mortality at Ngogo relative to Kanyawara include: historical absence of commercial logging; higher fruit abundance; higher energy intake rates; and less extensive food shortages. Lack of serious epidemics, better habitat protection, and the absence of large felids at Ngogo may also contribute to lower mortality than at other sites. However, the absence of predators cannot explain the Ngogo-Kanyawara contrast. Ngogo mortality rates are similar to or lower than human hunter-gatherer populations until age 45, after which mortality notably increases. Thus even under Ngogo's advantaged ecological conditions, differences between chimpanzee and human mortality rates persist.

The data presented here provide insights into derived features of human life history and factors that influence human life history evolution.

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Loss of MHC immunogenetic diversity in bonobos (*Pan paniscus*)

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Molecules of the major histocompatibility complex (MHC) influence fitness by functioning in both immunity and reproduction. These molecules are encoded by genes located in the most polymorphic and rapidly evolving region of the vertebrate genome. Understanding the comparative immunogenetics of humans' closest ancestors informs upon how selection shaped modern human variation. Despite bonobos and chimpanzees being equivalently related to humans, the immunogenetics of bonobos have been grossly understudied. Therefore, we studied six populations of wild bonobos in the Democratic Republic of the Congo. We extracted DNA from feces and PCR amplified and sequenced the variable segments of the most polymorphic *MHC-B* (*Papa-B*) gene, exons 2 and 3, for over 130 individuals (identified by microsatellite genotyping). We discovered over 20 new *Papa-B* alleles. Bonobo populations possess allele numbers comparable to chimpanzee and indigenous human populations. However bonobo Papa-B molecules have reduced nucleotide and amino acid diversity compared to chimpanzee Patr-B molecules. Bonobos also lack alleles from the uniquely conserved lineage containing human, chimpanzee, and gorilla alleles associated with protective effects against HIV and SIVcpz disease progression. Both bonobos and the western chimpanzee subspecies (*Pan troglodytes verus*) have experienced similarly severe population bottleneck, however western (*P.t.v.*) chimpanzees have retained greater MHC diversity compared to bonobos. Genomic analyses show that bonobos have a stronger signature of inbreeding than western (*P.t.v.*) chimpanzees. Thus there is strong selective pressure to maintain MHC diversity during bottlenecks, but the MHC diversity retained by populations depends not only on how many but also which individuals survive bottleneck.

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Plantar pressure distribution in Pacific Island and Malagasy populations: implications of variation for the interpretation of the fossil record

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The human footfall pattern has long been recognized as one of the hallmarks of our lineage; interpretation of fossil pedal remains and footprints is often focused on the extent to which fossil evidence approximates the modern human condition. A plethora of recent fossil evidence from Africa, Europe and Indonesia emphasizes the need to understand human variation in foot structure and foot function. It is widely recognized that considerable variation exists in human foot structure, but little research has addressed variation in human foot function, especially across habitually unshod populations that are better models for interpretation of the fossil record than consistently shod populations. This study examines plantar pressure distribution in two populations of minimally shod Pacific Islanders (PI) from Fiji (n=17) and Samoa (n=37). These data are compared with data from habitually unshod individuals from Madagascar (n=26) and published data from other populations. There were no significant differences between PI groups, however the PI groups exhibited differences from other unshod groups and from western shod populations. The Samoans exhibited significantly higher lateral midfoot pressures that the Malagasy. All PIs exhibited significantly ($p<0.01$) higher metatarsal peak pressures and pressure-time integrals (mean 332.5-511.3 kPa) than unshod Malagasy (176.3–234.3 kPa). Hallux peak pressures are similar across habitually unshod/minimally-shod groups but significantly higher in PIs than in western shod populations ($p<0.01$). Variation in human foot shape and foot function is substantial; only through examination of human variation in pedal biomechanics can we understand the range of functional morphological features characterizing modern human feet.

Taxonomic affinities of catarrhine capitates from Songhor, early Miocene, Kenya

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Songhor is one of a group of sites located around the lower slopes of the Miocene Volcano at Tinderet in western Kenya and has produced a diverse assemblage of primate fossils dated to ~19-20 Ma. Here we provide qualitative descriptions and comparative computational analysis (PCA and CVA) of several non-cercopithecoid catarrhine capitates recovered from Songhor between 1966 and 1996. These and several other Miocene catarrhine capitates were analyzed in association with a taxonomically diverse sample of extant anthropoids (n=374). Morphometric variables were extracted from 3D models derived from laser surface and micro-CT scans. The results indicate that KNM-SO 31245 and 31246 are morphologically similar to each other and to KNM-CA 409 from nearby Koru, as well as to specimens of *Proconsul* (*sensu lato*) from Rusinga. They cluster together with a range of extant cercopithecoids, consistent with previous analyses of Rusinga material, suggesting the Tinderet specimens likely belong to *Proconsul africanus*. KNM-SO 1002 is similar in size to the above specimens, but is morphologically distinct, clustering with extant great apes and sharing several features with them, including mediolateral expansion of the head and body and a markedly waisted neck. This distinctive morphology suggests it belongs to a different taxon, with *Rangwapithecus gordoni* being the only other similarly-sized catarrhine known from Songhor. KNM-SO 1000 and 1001 resemble hylobatids and arboreal cercopithecoids, and their size is most similar to *Trachypithecus cristatus* of the extant sample. These factors are consistent with previous behavioral and body size reconstructions of postcrania attributed to *Dendropithecus macinnesi*.

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Evolution of *MUC7*: Insights into human salivary adaptation

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Genomic structural variants constitute the majority of variable base pairs in primate genomes and have an impact on human

phenotypic evolution in multiple ways. The salivary *MUC7* gene provides an exceptional opportunity for studying such impact, since it harbors copy number variable subexonic repeat sequences that encode for microbe-interacting protein domains. Here, we showed that *MUC7* has rapidly and recurrently evolved under episodic positive selection in primates after it originated in the placental mammal ancestor. The subexonic repeat copy numbers vary across primates from 4 to 12 copies, and remain variable in most of these species. The level of MUC7 genetic variation in humans is in the upper 0.1% when compared to size-matched windows across the genome. Haplotype structure of MUC7 in humans revealed that the extant subexonic copy number variation (5 and 6 repeats) has recurrently evolved. Analysis of pairwise distances among the majority of human haplotypes of *MUC7* revealed an outgroup of sub-Saharan African haplotypes, suggesting admixture from an archaic African hominin. Functionally, variation in the *MUC7* locus is associated with oropharyngeal microbial composition. We argue that diversifying selection as a response to pathogenic pressures has maintained biomedically relevant ancient and recurrent variants in the *MUC7* gene that would otherwise be lost due to drift or directional selection. Our findings provide a framework for further studies to associate the common genetic variation in this gene with environmental and cultural factors across time and across geographies.

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Dietary chemical and energetic values differ in *Lemur catta* sexes

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Lemur catta, the ring-tailed lemur, lives in highly seasonal environments, and, like some other lemurs, adheres to a schedule of strict seasonal reproduction and female dominance. We studied two troops in Tsimanampesotse National Park, southwestern Madagascar, in order to investigate patterns of diet and energetics with respect to lemur traits. We collected food plants and feces for chemical analyses (e.g., soluble carbohydrates, proteins) and urine samples for determining energy balance (assays for C-peptide and urea standardized with creatinine). Our study periods occurred over three seasons that coincided with different reproductive stages: the transition between wet and dry seasons (end lactation), beginning of the dry (end mating), and toward the end of the dry (end gestation).

C-peptide (proxy for glucose) levels were higher for females earlier in the dry season, while the opposite was the case for males. Urea (protein) levels were much higher for both sexes at the beginning of the dry season compared to the end. These results did not immediately correspond to availability of food resources as soluble carbohydrate and protein values in plant foods did not differ between seasons. However, actual intake (plant chemistry values factored by amount ingested) was much higher earlier in the dry season.

Females appear to incur more stress than males energetically throughout the dry season, while males appear to be in negative energy balance earlier, directly following mating efforts. These energetic patterns align with reproductive efforts, which underscore that sex differences in energetics need to be considered in discussions of lemur traits.

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Hunter-Schreger band configuration in the molars of modern humans and Plio-Pleistocene hominins

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Enamel prism decussation, which manifests as Hunter-Schreger Bands (HSB), is considered to be a mechanism that mitigates crack propagation. We measured the degree and location of maximum HSB curvature in the lateral enamel of physically sectioned human permanent molars to investigate variation between the buccal and lingual sides of the crown, between upper and lower molars, and along the molar row (metameric variation). Nearly equal numbers ($n \approx 10$) of crowns from each maxillary and mandibular position were sectioned through the mesial dentine horn tips and examined by scanning electron microscopy. No significant difference in either parameter was found between sides, between jaws or along the tooth row. Therefore, these data could be pooled, enabling comparison with fossil molars without regard to side or position. We examined sectioned and naturally fractured specimens attributed to *Australopithecus anamensis*, *A. afarensis*, *Homo habilis*, *H. erectus*, *H.* sp., *Paranthropus aethiopicus*, *P. boisei* (East Africa) and *A. africanus*, *Homo* sp. and *P. robustus* (South Africa). The HSB curvature values for most of the fossils fall within the human sample range. However, the majority of the *Paranthropus (P. aethiopicus*, *P. boisei* and *P. robustus*) crowns exhibit noticeably less curvature. The location of maximum HSB curvature (inner, middle, outer enamel) is quite variable in *Paranthropus* in comparison to the range established by the modern human (and other fossil) specimens. These results, which are consistent with earlier observations that *Paranthropus* possesses relatively "straight" HSBs, beg the question of the functional optimization of *Paranthropus* molars to resist stress-induced fracture.

Using ancient DNA from museum specimens for phylogenetic correction to interpret island dwarfing in *Macaca fascicularis*

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Island dwarfing, whereby large-bodied organisms evolve smaller body size on islands because food resources are limited, has been widely studied. But time of colonization and intraspecific relatedness have rarely been taken into account. Relatedness is especially important when studying island dwarfing because evolution occurs within species or between closely related species. Here, we report the successful use of next generation techniques to sequence mitogenomes of 120 Southeast Asian longtailed macaque (*Macaca fascicularis*) specimens ranging between 50 and 100+ years old, housed at natural history museums around the world. These sequences, at an average of 45x coverage, have been used to reconstruct intraspecific phylogenies of *M. fascicularis* throughout the Southeast Asian mainland and islands using both maximum-likelihood and Bayesian analyses, which yielded almost identical results. Calibration of the phylogeny indicates that colonization of the Sunda islands began over 1.5 Ma, as previously found, but that colonization of various oceanic islands, including the Philippines, was much more recent, on the order of thousands of years. Additionally, we used this phylogeny to take relatedness amongst individuals into account when analyzing body size and brain size data from these museum specimens. Without phylogenetic correction, *M. fascicularis* does not display dwarfing in either body size or brain size. When phylogeny is taken into account, we see a trend in body size dwarfing on islands but still not in brain size. These results reveal the importance of taking intraspecific phylogenetics into account when conducting comparative studies, especially when studying island organisms.

Congruence of articular surface curvature and dynamic range of motion in the subtalar joints of lorisids and cheirogaleids

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Based on passive joint mobility, lorisids can achieve higher degrees of pedal inversion and eversion than other strepsirrhines. However, initial assessments of curvature of the talar ectal facet suggest this component of the subtalar joint is noticeably flatter among lorisids than other strepsirrhines. Flatter joint surfaces have been associated with reduced joint mobility.

To examine the discrepancy between passive joint mobility and joint morphology, we measured dynamic range of motion (ROM) of inversion/eversion and modeled subtalar articular surface curvature with quadratic functions. We collected kinematic measures of inversion/eversion from freely moving *Loris tardigradus*, *Cheirogaleus medius*, and *Mirza coquereli* (30 strides per species, 3 individuals per species). To measure joint curvature, we cropped ectal facets from 3D surfaces of 23 cheirogaleid and 21 lorisid tali using Avizo 8.0. The facet was then modeled as a quadratic function, with curvature quantified along the major (anteroposterior) and minor (mediolateral) axes.

ROM results support published passive joint mobility measures. *Loris* exhibits a more dynamic ROM at the subtalar joint, with pronounced eversion near the end of support phase. In contrast, *Cheirogaleus* and *Mirza* have reduced ROM, and maintain slight inversion throughout support phase. The major axis of the ectal facet is significantly less concave in lorisids than cheirogaleids ($p<0.001$), but the minor axis of the facet is significantly more convex ($p=0.006$), generating a strongly sellar subtalar surface in lorisids. These results highlight the importance of combining data of multidirectional articular surface curvature and kinematics for inferring patterns of joint mobility.

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Analysis of Long Bone Osteometrics in a Commingled Skeletal Sample from a High Altitude Site in the Ancient Peruvian Andes

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This study examines long bone osteometric data from commingled skeletons at a high altitude site (2700 masl) in Peru to address two key questions: 1) Was there a bimodal distribution in long bone measurements that might suggest marked sexual dimorphism? 2) On average, did this population exhibit long bone measurements that are associated with high altitude adaptation? The post-Wari skeletons were excavated from the ancient city of Huari, former capital of the Wari Empire, which is located in the Department of Ayacucho, Peru. Radiocarbon dates show that the human remains date to the second half of the Late Intermediate Period (1250 – 1400 AD). Measurements were taken of left femora (N=87), left tibiae (N=99), left humeri (N=65), left radii (N=100), and left ulnae (N=98). Twenty-eight measurements were taken across these five long bones.

Results show that there are four measurements with a bimodal distribution, perhaps reflecting sex-based morphological differences that might be useful for estimating sex in high altitude Andean populations. The four measurements are: 1) medial-lateral diameter at the nutrient foramen of tibia; 2) maximum diameter at the nutrient foramen of tibia; 3) epicondylar breadth of humerus; 4) vertical diameter of humoral head. Comparison to original data collected from a low-altitude precontact Andean population from Nasca reveals a significant difference in femur length ($t=-3.79$; $p<.001$; $df=140$), but not tibia length ($t=-1.19$; $p=.236$; $df=137$). These long bone measurements are also compared to previous studies on skeletal populations from coastal and high altitude regions in the Andes.

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Sex and Famine: Mortality Differentials in Medieval London

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Between the 12th and 16th centuries, the city of London was growing and expanding, and relied heavily on imported foodstuffs. Consequently, the risk of famine mortality in London was relatively high. To better understand how mortality during medieval famines was selective with respect to sex, this study analyzes data from London's St. Mary Spital cemetery (SRP98, *c.* 1120-1540). Multiple burial types (single- and multiple-individual interments) are available from the medieval period, with the larger burials likely representing pits dug to accommodate famine victims. Sex, in adults, was modeled as a covariate affecting the Gompertz hazard of mortality. The results indicate that sex did not have a significant effect on the risk of mortality in the 12th and early 13th centuries, but was significantly associated with mortality risk in the 15th and early 16th centuries. Males interred in attritional burials dated to 1400-1539 CE faced a significantly lower mortality risk compared to females. These results suggest that a cultural or biological transformation took place in the intervening decades (1250-1399 CE), affecting the relative risk of mortality by sex. Potential causes include the selectivity of the Black Death (1348-1351 CE) or the improvements in diet and standard of living that followed the epidemic, which may have been unequally distributed among the city's population.

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Sleeping exposed to the elements: Tsimane sleep conditions reduce sleep efficiency

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Sleep efficiency, defined as total sleep duration divided by total time in bed, is typically considered healthy above 85%. Some argue, however, that highly-condensed (high sleep efficiency) sleep patterns are partially responsible for high sleep pathology rates in the US, and are a product of modern sleep environments. Taking advantage of the heterogeneity in sleep environment and market integration among Tsimane hunter-horticulturalists of lowland Bolivia, we test the hypothesis that sleep conditions typical of small-scale societies (environmental exposure, bedtime hunger, and bed-sharing) decrease sleep efficiency. We used Philips Respironics Actiwatch-2 sleep monitors to measure sleep for an average of 4.7 nights per person with 57 men and 74 women. GY performed daily in-home interviews, for an average of 2.4 subsequent days. Results are from mixed-effect models predicting sleep efficiency, controlling for age and individual variation. Sleeping on the ground and sleeping in houses without walls both decreased sleep efficiency, but walls only affected women's sleep efficiency. Going to bed very hungry reduced sleep efficiency 4.8% relative to going to bed satiated, but only for men. Bed-sharing with an average of 2.14 bedmates increased the number of reported sleep interruptions each night by .92, but had no effect on objective measures of sleep efficiency. These results support the claim that high sleep efficiency in the US is a product of the modern sleep environment, but the specific predictors found to be significant in this analysis may reflect that this increase in sleep efficiency is an improvement in sleep quality.

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An Assessment of Sexual Dimorphism in the Crania from Roonka Flat, South Australia

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The site of Roonka, in the lower Murray River Valley of South Australia, was excavated between 1968 and 1977. During this time a large series of approximately 200 sets of human remains were recovered through a large-scale salvage excavation. These remains span approximately 8,000 years, with the most recent interments occurring around the time of European contact in South Australia.

In this project, CT scans of the crania from Roonka are used to assess patterns of sexual dimorphism. Previous work by Brown on lateral radiographs of Australian Aboriginals suggested that males were consistently larger than females by about 5%-9% in the craniofacial complex. Later work by Ingerslev and Solow, also performed on lateral radiographs, highlighted a series of linear measurements and angles that were useful in distinguishing patterns of sexual dimorphism in a larger sample. The present project uses Howells measurements on the original Roonka crania, coupled with measurements and angles obtained from sectioned CT scans. These data are used to both reassess Brown's, and Ingerslev and Solow's methods and determine the most sexually dimorphic dimensions and angles in the Roonka population.

What does the fox say? Analysis of fox remains from island and mainland California, and implications for hominin evolution in insular environments

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The evolutionary history of late Pleistocene diminutive hominin fossils (LB1) from the island of Flores, Indonesia, is a contentious topic in paleoanthropology. Because these insular individuals have an extremely small body size (outside the normal range of variation for modern humans and early *Homo*), and display unique skeletal proportions and traits, their relationship within hominin phylogeny is debatable. To test published hypotheses on whether these individuals are pathological modern humans or insular hominin dwarfs, additional research should focus on features that characterize skeletons of small bodied, insular populations. While the trend of body size reduction in insular mammals is frequently observed, detailed observations on allometric changes in element length are lacking. By comparing island fox skeletal remains (*Urocyon littoralis)* from the Channel Islands, CA, to ancestral mainland California foxes (*Urocyon cinereoargenteus*), this research explores the skeletal elements and body proportions that characterize small body size in insular populations.

Preliminary results show differences between the island fox (N=40) and mainland fox (N=37) samples in body size and proportions. Island fox forelimbs and hindlimbs are significantly shorter than mainland foxes ($p < 0.001$). The brachial index is 88.9% in island foxes and 85.57% in mainland foxes ($p = 0.003$), indicating to achieve smaller body size in the forelimb, island foxes shortened their proximal humeral elements more than their forearms. From these findings, and published accounts of early Pleistocene hominin and modern human skeletal measurements, conclusions are drawn regarding the body size and shape of Flores hominins to clarify their evolution and taxonomy.

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Standing on the shoulders of apes: evidence for the hominin ancestral morphotype from the limbs and girdles

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Evolutionary shifts in shoulder and limb morphology are associated with some of the most important behavioral changes in human evolution, such as reduced arboreality, bipedalism and running, sophisticated tool use, increased manual dexterity, and accurate throwing. The uniquely derived features of humans, including our unusual limb proportions and shoulder morphology, evolved from an ancestral hominoid pattern presumably found in the last common ancestor (LCA) of humans and chimpanzees, and the starting point from which the hominin lineage evolved. However, recent interpretation of the ape and hominin fossil record casts doubt as to whether the ancestral morphotype was African ape-like, suggesting instead that many features of the human postcranium evolved from a more primitive condition found in early apes. Here I argue that traits of the limbs and shoulders found in early hominins are predictable intermediate states consistent with evolution from an African ape-like ancestral morphotype. Absent a better fossil record of the African Late Miocene, the best available route for resolving alternative models may be identifying the genetic and developmental basis for the morphogenesis of key traits, timing the signatures of selection on associated sequences, and testing these differences experimentally.

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Sex differences in dental caries in medieval Alkmaar, The Netherlands

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Biological studies of living populations demonstrate the aetiological role of saliva, sex hormones and reproductive life histories on sex differences in dental caries prevalence. Women's life history events, including puberty, menses, and pregnancy involve changes in hormone levels that directly impact their predisposition to dental caries. Caries rates reported in archaeological skeletal samples, however, do not always support that women have a higher caries prevalence than males, and these studies indicate that diet, food preparation, and division of labour also contribute to sex differences in caries. The pattern of women having a higher caries prevalence was tested for in a medieval archaeological skeletal sample from Alkmaar, the Netherlands. This was done to understand the importance of physiology in producing sex differences in caries experience in an archaeological skeletal sample. Caries, demineralisation of enamel, dentine, or cement, was recorded macroscopically in dental remains of 40 males and 40 females of equal age distribution. Caries rates were found to be significantly higher in females compared to males (Chi-square: $p<0.05$). A higher carious tooth frequency among women in medieval Alkmaar is attributed to sex hormones and adaptations to childbirth, which influence the biochemical composition of saliva and salivary flow. These finding support the hypothesis that dental caries rates in past populations are consistently sexually dimorphic, with females having a higher caries prevalence than males.

Ratios of humeral to femoral mid-shaft cortical area reflect differences in locomotor behavior in primates, including fossil hominins

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Functional differentiation between the upper and lower limbs of hominins and other primates is commonly reflected in relative limb bone lengths. Additionally, analyses of the cross-sectional properties (CSPs) of limb bone mid-shafts may reflect functional differences in locomotion between species and permit inferences about early hominin locomotor behavior. Because limb bone mid-shaft CSPs are highly correlated with limb bone lengths, we suggest that ratios of humeral to femoral CSPs should provide additional indicators of functional differentiation between limbs both among populations of modern humans and among primates that use their limbs in different ways. Ultimately, these relationships may be useful for inferring locomotor behaviors among fossil hominins.

We test this hypothesis by analyzing variation in humero-femoral indices of mid-shaft cortical area. The nonhuman primate sample consisted of 23 species, representing all major taxonomic and locomotor groups, 6 populations of humans encompassing geographic and activity pattern variation, and fossil specimens AL-288-1, OH 62, and KNM-WT 15000. Interspecific comparisons show that species with either elongated fore- or hindlimbs can be distinguished from generalized quadrupeds in predictable ways. Humans show greater humero-femoral indices than generalized quadrupeds and *Pan* and *Pongo* show lower indices. KNM-WT 15000 clusters within the lower end of observed human variation, likely due to body size. AL-288-1 and OH 62 cluster with *Pan* suggesting increased use of arboreal substrates compared to KNM-WT 15000 and the human samples. Human groups can be differentiated, although the behavioral correlates of these differences remain unclear.

Human nose shape variation can be explained, in part, by local adaptation to temperature

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The shape of the nose, like other regions of the face, varies both within and across human populations. Whether this variation is primarily due to selection is unclear. Functional studies of the inner nasal cavity suggest that the nasal passage is useful in conditioning inspired air, helping to prevent damage to the mucosal lining of the lungs. We have tested the hypothesis that nose shape differences across human populations are climate-related adaptations. We quantified the three dimensional shape of the nose in 415 individuals of West African, Northern European, East Asian, and South Asian ancestry and show, using a quantitative genetic framework, that the differentiation in the shape of the nares and the size of the nostrils is greater than that expected under genetic drift only. Partial Mantel tests show that nostril size is correlated with projected temperatures for the Last Glacial Maximum (Mantel's r: 0.062, P-value = 0.002) after correcting for sex, age, BMI, and spatial autocorrelation. We confirm that this is a signal of adaptation and not due to phenotypic plasticity. We also find nostril size to be highly heritable in a sample of 1,731 unrelated Europeans (h^2 = 0.41, S.E = 0.18). Together, these results suggest that climate has likely played an important role in the evolution of nose shape. However, the nose is sexually dimorphic in all populations, suggesting that sexual selection be considered in models of nose shape evolution.

Subsistence and mobility at Morton Shell Mound (16IB3): Analysis of femoral cross-sectional properties

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This study relies on bone functional adaptation to test subsistence-related behavior of a Coles Creek fisher-hunter-gatherer group from Morton Shell Mound on the Louisiana coast (male n=8; female n=9). Femoral cross-sections obtained through CTs were processed with Avizo and ImageJ (MomentMacro). Using non-parametric methods, Morton cross-sectional properties were compared to those of fisher-hunter-gatherer groups from Plash Island (1BA134), a Middle Woodland site located in the Coastal Lowlands of Alabama (male n=4; female n=3), and Gold Mine (16RI13), a Troyville site located in northern Louisiana (male n=4; female n=6). Given the similar subsistence strategies and coastal environments at Morton and Plash as well as the relatively more terrestrial environment at Gold Mine, this study predicted the following: Morton terrestrial logistic mobility (TLM), or daily distance traveled on land, reflected through femoral midshaft shape, would not differ significantly from Plash TLM but would be significantly less than inland Gold Mine TLM. While no significant differences exist among the samples in terms of midshaft shape, Morton and Plash exhibit lower levels of sexual dimorphism of midshaft shape, suggesting lower TLM compared to Gold Mine. Additionally, Morton exhibits significantly less midshaft percent cortical area than Gold Mine (males: p=0.023; females: p=0.042), associated with an expanded subperiosteum, which may reflect a mechanical compensation for metabolic-influenced bone mass loss. By assessing cross-sectional properties at Morton Shell Mound through comparison of inland and coastal prehistoric fisher-hunter-gatherers, this study contributes to an understanding of bone functional adaptation in Southeastern archaeological samples, specifically in the central Gulf Coast.

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Little Indiana vs. Big Kentucky: Violence in the Middle-Late Archaic

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Bluegrass (n=50), Firehouse (n=5) and Meyer (n=30) are Middle to Late Archaic mortuary sites located in Southern Indiana that date to around 6,200 to 5,000 ybp. Each has examples of trauma that include cranial depressed fractures, inflicted injuries and trophy taking behaviors (decapitation and dismemberment). This study aims to quantify the prevalence of trauma among Middle to Late Archaic people over the age of 15 in order to compare sites north of the Ohio River to those from the Green River area in Kentucky. The Indiana sites are considerably smaller than those from Kentucky, which have hundreds of individuals per cemetery: Indian Knoll (n=459), Ward (n=240) and Carlston Annis (n=218). Analysts documented traumata in the Indiana groups following standard procedures. Cut marks were verified using 3D profilometry. Green River data came from a combination of direct observation and published sources. Bluegrass, Meyer, and Firehouse had overall trauma prevalence of 10%, 6.7% and 40%, respectively. Of those exhibiting trauma, Bluegrass was the only site that had a higher percentage of females (60%) than male. When cranial depressed fractures are excluded, Bluegrass and Meyer have trauma prevalence at 6% and 6.7% comparable to those of Indian Knoll (6.5%), Ward (11.3%), and Carlston Annis (5%). Firehouse site's small sample size likely exaggerated its prevalence, but the Bluegrass and Meyer data indicate the Archaic people north of the Ohio River were engaged in violent behaviors at levels similar to their Kentucky counterparts.

Variation in parietal bone thickness and structural arrangement in Eastern African *erectus*-like *Homo*: comparative evidence from late Early Pleistocene Uadi Aalad and Mulhuli-Amo, Danakil depression of Eritrea

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Cranial vault thickness behaves as a highly variable feature in extant and fossil humans. While traditionally used to define *H. erectus s.l.* because of its relatively thick-walled bones, recent estimates show that, along the mid-sagittal plane and at the frontal and parietal eminences, bone thickness does not markedly differ between *H. erectus s.l.* and anatomically modern humans, nor does it reliably distinguish African and Asian *erectus*-like representatives. However, compared to the parasagittal areas, paleoanthropological information on thickness variation along the lateral parietal wall is scarce.

By using direct, CT- and microCT-based observations, we quantified the tabular and diploic thickness in two circa 1 Ma parietal bones from the 4.7 km apart but stratigraphically correlated sites of Uadi Aalad and Mulhuli-Amo, Eritrean Danakil depression. The first belongs to the nearly complete UA 31 cranium, noted for its blend of *erectus*-like and derived morphoarchitectural features. The second parietal bone is part of an incomplete cranium preliminarily labelled MA 64-88-378, assembled from nine elements collected on the surface in 2011-2014, whose global shape closely resembles UA 31.

While our records do not systematically sample homologous landmarks but rather comparable regions in UA 31 and MA 64-88-378, their relative thickness at various sites is nearly invariably diploë>outer≥inner table, even if proportions vary site-specifically. In all cases, intra-individual thickness variation tends to exceed that commonly observed in extant humans. We found a similar pattern, but expressing even more contrasted values, in the chronologically slightly younger parietal specimen from Gombore, at Melka Kunture, Ethiopia.

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Digitizing "Roger": Creating a Recommended Osteology Guide for eReaders [ROGeR]

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Most undergraduate anthropology majors at the University of West Florida are required to take Human Osteology. Study material for class is available on reserve in the library in the form of a plastic skeleton nicknamed "Roger." However, the vast majority of UWF students live off campus, and studying in the library is not always feasible.

In order to solve the problem of access to skeletal material in an ethical manner, we used 3D scanning technology to create a virtual collection of bones. We scanned a total of 102 bones from one individual, including the skull; left and right long bones; representative bones from the hands, feet, vertebrae, and ribs; sacrum; and pelvis.

Our goal was to create a resource that students could easily use and modify. The digital models were converted to .u3d files and embedded into PowerPoint slides with removable labels depicting various landmarks on the bone. Students can download PDF files, which can be opened more easily and used on smartphones, tablets, and other e-readers.

Our aim was to make a better, digital ROGeR with 3D models of real human bone. By creating these osteological materials, we are encouraging UWF students to study outside of the laboratory at virtually any time and opening up access to anyone worldwide. In this way, instructors and students who do not have access to physical remains due to budget, space, or legal issues can utilize a free resource to aid in learning human skeletal anatomy.

A comparative, ontogenetic approach to trabecular architecture with implications for inferring foot function in fossil hominins

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Fossil hominin foot bones exhibit unique combinations of modern human-like and ape-like features. This variation suggests a range of pedal mechanics beyond that observed in adult extant hominoids. Early locomotor development may offer a way to understand this mechanical and anatomical variation. Heel strike develops gradually during locomotor ontogeny in humans and trabecular structure in human calcanei changes in response to changing ground reaction forces associated with heel strike development. However, developmental form-function relationships in the ape calcaneus are unstudied. This study tests the hypothesis that trabecular architecture in the plantar region of the posterior calcaneal tuber changes ontogenetically in chimpanzees and gorillas. Trabecular fabric properties were calculated using microCT scans of infant and adult chimpanzee (n = 12) and gorilla (n = 11) calcanei and compared to existing data on humans. Primary trabecular orientation changes throughout ontogeny in chimpanzees. However, this orientation differs from that of humans at each developmental stage. Discriminant function analysis of five trabecular properties distinguishes between chimpanzees and humans but not gorillas and humans. These results imply potential ontogenetic differences in foot function within chimpanzees and between chimpanzees and gorillas. Multivariate results suggest that heel strike in infant and adult gorillas may be mechanically similar to that of adult humans. Interspecific and intraspecific developmental differences in hominoid calcaneal trabecular structure, and potentially heel strike mechanics, have significant implications for understanding the evolution of heel strike and provide an expanded suite of extant variation that may help infer foot function in the earliest bipedal hominins.

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An examination of biological distance between Late Woodland and Mississippian individuals using non-metric dental trait analysis

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This paper examines whether the large cultural changes that swept throughout the North American Midwest between the Late Woodland and Mississippian time periods, circa A.D. 1050, are associated with the appearance of a biologically different population or simply a distinctive cultural change amongst *in situ* individuals. Processes associated with these changes have been attributed to trade, religion, and migration of Mississippian peoples from the Mississippian center, Cahokia; near present-day St. Louis, Missouri. Biological distance analysis examining skeletal assemblages from sites in the Cahokia area and adjacent Illinois River Valley region have found biological continuity between the two time periods, with resulting biological distances affected by geographic space rather than temporal and cultural transition. Minimal biological distance research has been conducted on sites located in the northern areas of the Mississippian cultural landscape. This project provides an examination of three, non-neighboring, culturally Mississippian sub-regions: southeast Wisconsin, northern Illinois, and south-central Indian; thereby presenting a unique and broad examination of Late Woodland and Mississippian interaction in the Midwest.

To evaluate biological continuity in the northern Mississippian cultural landscape, this project examined the permanent dentition of 857 individuals using non-metric dental traits. Results show that there was less biological variation among the Mississippian groups than among the previous Late Woodland groups; however, there is no evidence of biologically different people moving into the northern Mississippian cultural landscape at either the regional or sub-regional level, possibly as an effect of the homogenizing influence of Mississippianization on the groups being studied.

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A case of neolithic cranial trepanation in Qinghai, China

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This paper presents an archaeological case study of a trepanation specimen from Minhe, Qinghai Province which can be dated back to 3770±30BP. The trepanation individual was discovered at Yangshan cemetery, the funerary objects indicate the burials belong to the Banshan Type under the Majiayao Culture, a famous prehistory archaeological culture in Western China. This study presented here combines CT scanning and 3D deep field microscopic analysis to observe the intentional trepanation. The macroscopic hole observed on frontal bone is located in front of the bregma precisely. The skull was scanned with a 64-slice CT and the hole was observed directly with a 3D deep field microscope, on the edge of the hole, a new bone formation with an uneven surface and thin bony outgrowth can be observed, demonstrating the high possibility of the earliest healed intentional trepanation in western China known to date. As to the intention and technique applied on this case, considering the location, size and shape, the trepanation was probably performed out of medical treatment after compared with the other cases in the world and the stone chisel unearthed from the cemetery may be the tools used in the trepanation.

Genetic diversity of Sanggan River Valley population provides evidence of Neolithic introgression from people of two farming centers in North China

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To study the Sanggan River Valley population's genetic characteristics and its genetic relationship with the populations of the two farming centers, we analyzed the mitochondrial DNA (mtDNA) and the Y-chromosomes of 47 individuals from Jiangjialiang (>5000 years BP) and Sanguan (~3500 years BP) sites, both of which are located in the Sanggan River Valley. We found similar mtDNA distributions at the two sites, but there was a significant difference in the Y-chromosomes. The individuals of Jiangjiangliang site (JJL) were typed into two haplogroups, N1 (not N1a, not N1c) and N1c while the Sanguan site (SG) individuals were typed into haplogroup O3. Combining ancient DNA results from previous investigations with our results, we found the JJL population was closely related to populations in West Liao River Valley, but the SG population was more closely related to Yellow River Valley populations. Our results demonstrate that introgression in the Sanggan River Valley population was contributed by farmers from both the West Liao River Valley and the Yellow River Valley. People from West Liao River Valley spread towards the south and reached Sanggan River Valley over 5000 years ago, and the expansion from the Yellow River Valley occurred later, between 5000 and 3500 years ago.

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Father's parenting style influences infant development in common marmosets, *Callithrix jacchus*

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Fathers of bi-parental species offer many advantages to their offspring such as higher survivorship during the critical neonatal period, increased growth weights and even more positive psychosocial development. In bi-parental primate species fathers also share the high energetic cost of direct care of their infants. However, even in the cooperative breeding Common Marmoset, *Callithrix jacchus*, not all experienced fathers show the same high responsiveness to their young infants when these infants produce distressed calls. Thirty-nine experienced fathers were categorized by their motivation to respond (responsive n = 25, nonresponsive n = 14) to infant distress calls. We examined the survivorship of their current offspring up to 1 month of age and their offspring's growth curves up to 100 days. We found that there were differences in infant survival: Infants of responsive fathers had a significantly higher survival rate than infants of nonresponsive fathers ($p = 0.0002$). There were no differences in infant's first weight taken at 2 weeks but following weaning; the infants from the responsive fathers had significantly higher weights than the infants from the nonresponsive fathers ($F = 5.21$, $df = 1, 39$, $p = 0.03$). We found evidence that highly interactive fathers provide an advantage to their offspring during the first month when infants need constant contact and during weaning when fathers have a prominent role in providing solid food to their offspring.

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Challenges in ancient microbiome reconstruction using 16S rRNA gene amplification

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Dental calculus, formed by mineralization of dental plaque, is an ideal biomolecular reservoir for the ancient oral microbiome. To date, characterization of ancient microbiomes has primarily been accomplished through a phylotyping approach involving targeted amplification and sequencing of hypervariable regions in the 16S rRNA gene. Specifically, the V3 region (*E coli* 341-534) of this gene has been identified through *in silico* and *in vitro* analyses as an excellent candidate for ancient DNA amplification and community reconstruction. Nevertheless, in practice this phylotyping approach often results in unusual taxonomic frequency data. In this study, we use targeted (amplicon) and non-targeted (shotgun metagenomics) sequencing methods on four archaeological dental calculus samples to better understand these discrepancies. The four samples were chosen from diverse geographic and temporal contexts: Middenbeemster, Netherlands (159 BP); Guadeloupe, Caribbean (700 BP); Samdzong, Nepal (1900 BP); and Camino del Molino, Spain (4000 BP). Through comparisons of microbial taxonomic counts from paired amplicon and shotgun sequencing datasets, we show preferential amplification of archaea and the candidate bacterial phylum TM7 and underamplification of Spirochaetes and many important bacterial genera (e.g., *Streptococcus*) in amplicon datasets. Through informatics analysis, we demonstrate that extensive length polymorphisms in the V3 region are a consistent and major cause of amplification dropout and taxonomic bias in ancient microbiome reconstructions based on amplicon sequencing. We conclude that systematic amplification bias confounds attempts to accurately reconstruct microbiome taxonomic profiles using 16S rRNA V3 amplicon data.

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Hands and Feet: Comparative anatomy of apes and Old World Monkeys

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Hands and feet contribute equally to locomotion and are the segments that come into

direct contact with the environment. Numerous studies emphasize only hands and their role in climbing, knuckle-walking, and manipulation, or conversely only feet and their function in quadrupedal or bipedal locomotion. This gross anatomical study compares hands and feet in the same individual, and then across species. Prior to dissection, we made external linear measurements and collected prints. During dissection of hand and foot segments, we separated bone, skin/fat, and muscle, then determined the percent contribution of each tissue. Our sample includes *Hylobates, Pongo, Gorilla*, and *Pan* (n=25), individuals of known body masses and ages. *Semnopithecus* (n=4) provides the outgroup. Our findings on the prints show that ape hand and foot lengths are similar to each other and contrast with a short hand and long foot of *Semnopithecus*. African apes have pronounced heels compared to Asian apes, and *Pongo* has the longest hands and feet relative to body mass. In tissue composition gibbons have the highest percent of bone in hands and feet (43.8, 44.0%); orangutans and gorillas, the highest skin/fat (46.4, 53.8%); and chimpanzees the highest muscle (28.6, 30.0%). This approach emphasizes 1) the shared locomotor adaptation of apes relative to monkeys; 2) orangutan feet have diverged from those of other apes; 3) both hands and feet of African apes are suited to moving on firm, stable surfaces. Soft tissue in relation to bone provides a perspective for comparison with fossil apes and hominins.

Risky business: Subsistence change and reproductive decision making in an uncertain environment

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A variety of demographers, economists, and evolutionary theorists discuss the influence of harsh environments on fertility. These authors mainly focus on the long-term effects of prolonged exposure to environmental insults on life-history strategies. A theory of fertility response to acute environmental shocks remains a relatively underdeveloped area. In the aftermath of the fall of the Soviet Union, total fertility rates fell significantly in the post-Soviet world. We examine this dramatic fertility transition in the indigenous community of Ust'-Avam in northern Russia, during which the total fertility rate fell from approximately five children per woman before 1993 to just over one per woman a decade later. We explore the behavioral changes that produced this phenomenon by applying hypotheses developed by evolutionary ecology and demography. We compared the age at first birth, interbirth interval, and reproductive cessation prior to and following 1993 by employing a mixed parametric accelerated failure-time model. Results indicate that reproductive delay, as predicted in population biology, cannot solely account for the drop in fertility in Ust'-Avam. Average age at first birth remains relatively constant in the two periods surrounding 1993 counter to expectations about risk from life history theory. The proportion of women not having children increases dramatically. The present results encourage researchers to investigate stopping behavior in confluence with age at first birth and interbirth interval when exploring fertility responses to the environment. The next step in this research is to examine explanatory variables related to embodied, material, and relational wealth.

The hybrid dynamics of baboons

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The evolutionary history of hominins was heavily affected by changes in climate and ecology in the African woodland and savannah biome. Expansion, fragmentation, isolation and merging of populations with impacts on interpopulation gene flow and speciation most likely occurred various times and at various locations during the Plio-Pleistocene. Since today only one hominin species remains, studies of speciation and hybridization within our extant lineage are problematic. However, baboons (genus *Papio*) evolved and radiated in parallel with hominins, probably within the same landscape and timeframe. In contrast to living hominins, they currently comprise at least six species, providing an analogue model for the study of speciation and hybridization in a savannah living primate taxon. Molecular studies indicate incidents of ancient hybridization and provided insight into ongoing gene flow among different species.

We report on findings of phylogeographic and population genetic studies, which suggest that male introgression with nuclear swamping or mitochondrial capture might have played a predominant role in shaping the contemporary phylogeographic pattern of baboons, and that hybridization has also impacted their speciation processes. To what extent the patterns and processes found in baboons can be a useful model for various aspects of the intra-African hominin evolution will be discussed.

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Disability, disease, trauma, and stigma: did chronic infection with syphilis influence experiences of trauma and recidivistic trauma in post-medieval London?

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Syphilis is typically conceptualized in the historical record as a profoundly destructive and stigmatized condition, but not as source of trauma or recidivistic trauma. However, untreated syphilis is well documented as causing life-long physical impairment, impoverishment, and extreme ostracism. Here, we examine whether chronic syphilis infection, particularly destructive lesions on the face and hands, is associated with higher rates of trauma, specifically recidivistic trauma. We take a life course perspective, positing negative synergy between early life health experiences, adult exposure to stressors, chronic disease—syphilis—and associated psychosocial, economic, and immunological stressors, impoverishment, stigma, and increasing vulnerability to recidivistic trauma precipitated by physical impairment and social exclusion-driven interpersonal violence. Our baseline are results indicating that negative early life health experiences, evident in frequencies of linear enamel hypoplasias (LEH) ($p=.03$; $p<.05$), and negative adult health experiences (i.e. periodontitis), are strongly associated with the establishment of tertiary syphilis ($p=.04$; $p<.05$), likely reflecting immune dysregulation. From there, we examine whether trauma, particularly evidence of recidivistic trauma, is associated with syphilitic lesions, particularly their destructiveness and visibility, and skeletal and oral stress indicators over the life course in a sample of individuals with syphilitic lesions (n=55) from five post-Medieval London archaeological sites representing different socioeconomic strata. Taking a comparative approach, we also assess whether syphilitic individuals were more susceptible to trauma and recidivistic trauma than individuals from the same sites (N=1314) with and without evidence of other chronic—but less stigmatized—conditions to explore more complex relationships between chronic disease, stigma and recidivistic trauma.

The third root of Mexico: Genetic structure of Mexicans of African descent

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Between the 16th and 19th centuries, over 12 million people were kidnapped mainly in West and West Central Africa and transported to the Americas as a result of the trans Atlantic slave trade. The way enslaved Africans adapted to their imposed new places of residency impacted how they established their social

networks, formed communities, identity and, ultimately, how the Afro-descendant population forged their way through time and contributed to current diversity and cultural identity of today's Countries in the Americas. This major demographic shift has been studied from a genetics perspective focusing mostly on ancestry of African Americans, and to a lesser extent on Caribbean populations. Despite having received 200,000 Africans during the slave trade, no study has focused on the study of African genetic ancestry and its implications in Mexico. In this study we worked together with Afro-Mexican communities living in the coastal regions of the States of Oaxaca, Guerrero and Veracruz to characterize their genetic ancestry. Using genome-wide genotype data we analyzed the African genetic ancestry that prevails in these groups to complement our knowledge on the population dynamics of the trans Atlantic slave trade to Mexico. Importantly, as the current situation of Afro-Mexicans, is of poverty, marginalization and lack of official recognition as a vulnerable minority, this study contributes to their appreciation as part of Mexico's mosaic of diversity and is a positive step towards their recognition.

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The Degree of Limb Bones Asymmetry in Relation with Health and Environmental Stress in Medieval Lower Socioeconomic Society

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The rate of skeletal asymmetry of different parts of human body can be used as a measure of health and environmental stress of a population. Therefore asymmetry, as a result of non-specific stress affecting the organism, may be connected with the social structure of society and the quality of living conditions. This study is based on measurements of bones of upper and lower limbs of skeletons derived from the scope of the Mikulčice settlement agglomeration (Central Europe), which represents one of the largest cohesive early medieval population sample in Europe, mostly from the 9th century. Skeletons from the civilian necropolis (inhabitants from the area in front of Mikulčice castle) have been included. The aim of this research was to evaluate the asymmetry rate of limb bones in the medieval population of the middle and lower socioeconomic classes; to use these indicators to compare differences between this rural population and recent population skeletal sample of known lower socioeconomic status from previous studies; and to assess the degree of health/environmental stress affecting the medieval population. The objective was to assess directional asymmetry (DA) and fluctuating asymmetry (FA) of the dimensions of the evaluated bones. The results were compared with other studies conducted in Mikulčice settlement population, based on the measurements of both skulls and limb bones. Both DA and FA was confirmed. Yet the results show that the medieval population was subjected to lower non-specific stress than the recent population sample.