

COMMITTEE ON DIVERSITY



UNDERGRADUATE RESEARCH SYMPOSIUM

AAPA 83RD ANNUAL MEETING

6-8 PM WEDNESDAY APRIL 9TH, 2014

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Food insecurity, folate intake, and the moderating effect of coping strategy among Ariaal mothers in Kenya.

ALLISON APLAND and MASAKO FUJITA. Department of Anthropology, Michigan State University.

Food insecurity is a situation in which individuals are unable to access sufficient nutrition for a healthy life. Food-based coping strategies such as stretching or rationing foods are negative mechanisms of managing this problem as they compromise dietary quantity and quality; few studies have elucidated the specific dietary consequences of these coping strategies. The current study investigates the relationships between food insecurity, a coping strategy, and dietary quality, focusing on folate because of its importance in human health. It is hypothesized that the impact of food insecurity on folate intake would be moderated by coping strategy. The study used data from breastfeeding women (n=222) in an Ariaal agropastoral community in rural Kenya. A food insecurity index was constructed from interview data regarding access to key food items. Using 24-hour dietary recall data, women who were stretching food by having the same meal for lunch and dinner were categorized as using a coping strategy. Regression models for folate intake with food insecurity,

and their interaction as predictors were used. Both food insecurity and coping were negative predictors ($p=0.01$ and $p=0.084$ respectively), and the interaction term was also significant ($p=0.001$), after adjusting for covariates. The negative effect of food insecurity on folate intake was exaggerated for coping women, especially for the most food insecure. This research demonstrates that food insecurity can diminish dietary quality, but coping strategies aimed at stretching food can exacerbate this problem by taking a toll on the intake of essential micronutrients such as folate.

Funding was provided by NSF DDIG #0622358, The Wenner-Gren Foundation, The Micronutrient Initiative, Michigan State University Provost Undergraduate Research Initiative Award, and Michigan State University Honors College Professorial Assistantship.

***Mycobacterium tuberculosis* in prehistoric California: A review of evidence and paleoepidemiological comparisons of impacted and related populations.**

JESSICA C. AXELROD¹, RESHMA E. VARGHESE², ELAINE M. BURKE³, JULIE DING⁴, REBECCA S. JABBOUR¹ and GARY D. RICHARDS⁵.
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Health, University of California, Berkeley, ³Department of Molecular and Cell Biology, University of California, Berkeley, ⁴Department of Integrative Biology, University of California, Berkeley, ⁵Department of Biomedical Sciences, A.A. Dugoni School of Dentistry, University of the Pacific.

Most prehistoric evidence for *Mycobacterium tuberculosis* infection has derived from the Eastern United States and a few southwestern localities. Recently, we documented tuberculosis in a prehistoric West Coast population. Besides this geographic difference, the population inhabiting this locality (CA-CCO-138) differs by having a hunter-gatherer economy. Five new cases of tuberculosis from CA-CCO-138 have now been identified. We describe these affected individuals and present results of a paleoepidemiological analysis of this and associated localities.

We evaluated disease processes in 793 individuals from CA-CCO-138, a Late Horizon site (≈700-1500 AD). For diagnostic purposes we also medical CT-scanned and reconstructed a nearly complete juvenile skeleton using Amira®. Data on the incidence of tuberculosis and related diseases in prehistoric California were compiled from a database of 2,570 pathological skeletons (PHMA, UC Berkeley), and 175 potential tuberculosis cases were

examined. In addition to the statewide assessment of tuberculosis, we established paleoepidemiological profiles for CA-CCO-138 and geographically and culturally similar prehistoric mound populations.

We determined that only the CA-CCO-138 locality preserves evidence of tuberculosis in prehistoric California. Further, the disease profile for CA-CCO-138 is otherwise unremarkable, being essentially identical to the other large mound populations examined. A probable autoimmune-induced joint disease (rheumatoid-like) is associated in high frequency with tuberculosis cases, and morphological overlap in expression is described. We discuss a physiological link between these two pathological conditions that may account for the unusually extreme expression of joint disease and the presence in this hunter-gatherer population of tuberculosis.

Funding provided by an Undergraduate Opportunity Fund Grants (UCB) to EMB and JD and an Undergraduate Student Research and Professional Development Grant (SMC) to JCA.

Amputation and subsequent change in bone tissue.

ERIN BACCARI. Department of Anthropology, SUNY Buffalo State.

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Wolff's Law states that bone tissue will adapt to loads under which it is placed. In cases where one limb is amputated, changes in the bone structure of the paired, unaltered limb may occur due to compensation of muscles. This research investigates changes in non-amputated limbs based on Wolff's Law. Due to the way bone remodels with increased force, I hypothesize that increased demands on the unaltered limb will result in morphologic changes to skeletal tissue, causing growth. This research was conducted using the Hamann-Todd Osteological Collection at the Cleveland Museum of Natural History. Specimens with a documented history of ante-mortem amputation were used (23 lower, 4 upper). Measurements were taken of the limb on both the amputated side and the non-amputated side, and upper limb measurements included the shoulder girdle. Standard measurements were taken. Limb measurement data was collected for 27 individuals matched in sex and age to all amputee specimens as a control. Scapular measurements (anatomical breadth/length) in amputated limbs were significantly smaller ($z=2.3805$, $p=0.01729$), as were clavicular measurements (maximum length/anterior diameter at mid-shaft) ($z=2.0396$, $p=0.041389$). The medial-lateral diameter of the femur in those with a lower leg amputation (measured

one inch above amputation or at mid-shaft) were significantly smaller ($z=1.8827$, $p=0.059739$), but not in those with a femoral amputation ($z=0.35564$, $p=0.72211$). There were no differences in anterior-posterior diameter in either sample. There were no differences in the control sample overall. Little literature exists pertaining to Wolff's Law after amputation; this research suggests greater demands on non-amputated limbs.

Sex assessment on a modern Thai sample using carpal measurements.

ELISE BARNES¹, SCOTT E. BURNETT¹ and TROY CASE². ¹Department of Anthropology, Eckerd College, ²Department of Sociology and Anthropology, North Carolina State University.

Assessing sex is one of the first and most important steps for the analysis of human remains in both forensic and archaeological contexts. Usually the pelvis and skull are used to assess sex, although these elements are often too fragmented. Sex assessment using osteometric techniques on post-cranial elements has become increasingly popular. Several previous studies have accurately assessed sex using carpal osteometric data. In this study, previously successful measurements were tested to determine if they are as effective on a modern Thai sample, as

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well as if they could be applied by less experienced individuals if properly trained. The 15 carpal measurements chosen for this study have low measurement error and successfully discriminated between males and females with over 80% accuracy in at least two of the three prior studies. All carpals are represented except the pisiform. A sample of 50 males and 50 females, ranging in age from 22 to 63 years old (mean= 49), was analyzed from the modern documented skeletal sample at Chiang Mai University in Thailand. Carpals from both hands were measured, resulting in a maximum of 30 measurements per individual. Bones that were too damaged for accurate measurement were excluded. Using a univariate logistic regression analysis, individual carpal measurements correctly determined sex in 69.9%-93.0% of individuals. Higher accuracy levels (84.0%-94.0%) were achieved using multivariate logistic regression analysis. These results indicate that carpal measurements can be useful for assessing sex on a Thai sample, even when used by someone with limited prior carpal experience with carpals.

A review on the complex phenotypes of aging: molecular and nutrigenomic mechanisms.

CHRISTOPHER E. BARRETT and KYLE J. HALL. Department of Anthropology, Western Washington University.

Life expectancy for humans has more than doubled in the last two centuries. It is estimated by 2050 that in some European countries that persons older than 60 will increase from 20% to 40%. Calorie restriction (CR), a thirty percent cut in net-caloric intake without nutritional insult, shows evidence of maintaining long term health, a primary concern in contemporary medicine. Calorie restriction has been extensively researched in model organisms, including primates. Within the past decade, polyphenols have received increasing attention in age studies. However, their lifespan benefit in humans is largely unknown. The polyphenol resveratrol has been a topic of growing interest in these studies as a potential nutrigenomic molecule that may alter gene expression in the aging phenotype. Here we examine the current literature on the specific polyphenol resveratrol and compare its effects with that of CR. We predict that resveratrol achieves the same anti-aging properties as CR through histone deacetylase (HDAC) pathways. Through a literary research of over 50 articles, we investigated the roles of CR in extended lifespan and resveratrol in healthier extended aging. Resveratrol

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has been shown to activate HDAC pathways, like Silent Information Regulator 2 (Sir2) and Sirtuin 1 (SIRT1). These HDACs are known to be involved in the extension of lifespan, activated in both CR and resveratrol mechanisms. We find that resveratrol mimics the effects of CR, implicating it as a likely pharmacological supplement for extending lifespan. The finding that polyphenolic compounds could potentially treat various diseases has wide biomedical and chronic health implications.

Effects of selection on the relationship between limb bone length and cross sectional geometry.

MIRANDA COSMAN¹, ALEXANDRA DOWHANIK², CARSTEN KRUEGER², LEAH SPARROW³ and CAMPBELL ROLIAN³. ¹Department of Anthropology, University of Calgary, ²Faculty of Medicine, University of Calgary, ³Department of Comparative Biology and Experimental Medicine, Faculty of Veterinary Medicine, University of Calgary.

Bone scaling in mammals, including primates, follows a predictable relationship (Christiansen, 1999) This type of scaling relationship is thought to preserve the function and strength of bone, but it is unclear whether such a relationship is maintained through a correlated response to selection. We

addressed this question by examining the cross-sectional geometry of tibiae in a CD-1 mouse population selectively bred for increases in tibial length relative to body mass. In 10 generations, this mouse population has experienced an increase in tibial length of ~10% relative to a control cohort. If cross-sectional geometry evolves as a correlated response to selection, we predicted that the selected and control mice will show the same allometric scaling relationships. There should be a proportionate increase in midshaft dimensions due to selection on length. Mice tibiae (n=293) were scanned using a high-resolution μ CT scanner, landmarked with 20 homologous points characterizing tibial shape, and analyzed using 3D geometric morphometrics using Amira 5.3.3. Comparisons were conducted using principal components and allometric analyses. Results demonstrate that while the proximal tibial epiphysis and diaphysis in selected mice scale as expected in terms of anteroposterior length, mediolateral width did not scale proportionally with length. These results suggest that in cases of strong selection, length and cross sectional geometry are unlinked during bone growth. These results further indicate that the presumptive relationship between bone shape, bone strength and locomotor function is more complex than previously thought, with

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implications for interpretations of locomotor behavior in extinct primate taxa.

A quantitative analysis of intramethod and intraobserver variation in postcranial measurement methodologies.

REED COWDEN, NOELLE PETROWSKI, FRANCES J. WHITE, STEPHEN R. FROST and ANDREA R. ELLER. Department of Anthropology, University of Oregon.

In this study we examine the efficacy and precision of three common quantitative methodologies for measuring postcranial elements: digital calipers, Microscribe 3D point digitizer, and laser surface scanning (LSS). This research project was designed to investigate variance when measuring postcrania among methods, observers, and elements. We hypothesized that LSS would be the method with the most precision, despite its larger time investment. Two of the authors measured the humerus, ulna, radius, femur, and tibia from one side of three male, adult Old World monkeys: *Chlorocebus aethiops*, *Macaca nemestrina*, and *Colobus sp.* All specimens are from the University of Oregon's Grand Collection. For each element, five repeated measures of a standard set of linear distances and, for the Microscribe and LSS, landmarks were

collected by both observers. The data were assessed for intraobserver and intramethod precision by calculating the average standard deviation of the five repetitions for each element within each method. These values were analyzed in SAS using a two-way ANOVA to determine if there were significant differences between methods among species, between observers, or an observer-method interaction. The only significant difference between methods was seen within the *Colobus* specimen ('method' p-value of 0.0078). However, the interaction p-value for 'method-observer' was 0.0108, indicating that there was a significant interaction contributing to differences in variance. Given the comparable levels of precision, researchers may want to choose their methods according to different criteria. For example, calipers offer backward compatibility with older data, while Microscribe is useful for large-sample coordinate data. If documenting exact landmark positions is a priority and the sample-size is low, LSS may be the best method.

Do rock climbers have strong hands?

SHALEIGH DIAZ-RYDER and PATRICIA KRAMER. Department of Anthropology, University of Washington.

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Although our pre-hominin ancestors were climbers, most species of hominins infrequently used this ability for survival. Recently, however, people have begun to climb for recreation. With the growing popularity of rock climbing, we were interested in learning how the human body changes under these new forces. This study was designed to understand the relationship between hand proportion and hand strength in rock climbers and non-climbers. We hypothesized that rock climbers have stronger hands for their size than non-climbers.

Both hands of men and women were measured with a total of 59 participants. A hand dynamometer was used to test hand strength with participants squeezing the device three times for an average measurement. We measured the distance from the radial and ulnar styloid processes to the distal end of each ray to determine the combined carpal and metacarpal lengths. The lengths of each digit and each phalanx were measured. In addition, the width and circumference of each hand was taken from the proximal phalanges, with fingers resting against each other, and the circumference of each digit was measured around the proximal interphalangeal joint. We also measured stature, body mass, age and asked climbers how long they had

climbed, typical climbing difficulty, and how often participants climbed.

Student's t-tests revealed that the hands of men are bigger and stronger than those of women ($p \leq 0.004$) and climbers are stronger than non-climbers ($p \leq 0.01$). Digit circumference predicts 67% of hand strength when sex, side, and climbing status are controlled ($p \leq 0.03$, $r^2 = 0.67$).

The morphological relationship between the premaxillary region and nasal septum in european- and african-derived adult populations.

LILY J. DOERSHUK¹, NATHAN E. HOLTON^{1,2}, CHRISTINA L. NICHOLAS¹, TODD R. YOKLEY³ and ROBERT G. FRANCISCUS¹.

¹Department of Anthropology, The University of Iowa, ²Department of Orthodontics, The University of Iowa. ³Department of Sociology and Anthropology, Metropolitan State University of Denver.

The nasal septum, as a key facial growth center, is thought to have a significant influence on population variation in the premaxillary region during early ontogeny. Specifically, the nasal septum is argued to drive anterior-inferior growth of the premaxilla thus contributing to variation in midfacial prognathism. While previous research has

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emphasized the importance of the early developmental relationship between these elements, the relationship between the nasal septum and the morphology of the adult premaxillary region is not well understood. In this study we assess the morphological relationship between the nasal septum and premaxillary region using CT scans of adult individuals from European- (n=41) and African- (n=14) derived populations which have been shown to exhibit early developmental differences in the nasal septal-premaxillary complex. We tested the hypothesis that there is a correlation between the nasal septum (size and deviation) and the shape of the premaxillary region. We measured nasal septal size as a volume and nasal septal deviation as a ratio between nasal septal size and a reconstructed non-deviated nasal septum. The shape of the premaxillary region was quantified using Procrustes scaled coordinate landmarks. We assessed the correlation between our septal variables and premaxillary shape using multivariate regression. Our results indicate a complex relationship between the nasal septum and the premaxillary region. Septal variation was associated with anterior nasal spine prominence; however, there was no association between the septum and variation in subnasal prognathism. This suggests that septal variation may

have a limited influence on population variation in adult subnasal morphology.

This study was supported by grants from the National Science Foundation (BCS-0550036) to N.E.H., the L.S.B. Leakey Foundation to T.R.Y., and The Iowa Center for Undergraduate Research.

Allostatic load varies by apolipoprotein E and ACE genotypes in American Samoans.

GWENDOLYN DONLEY and DOUGLAS E. CREWS. Department of Anthropology, The Ohio State University.

Allostatic load (AL) manifests from both failed and successful morphological and biological stress responses across physiological systems. Genes, culture, and environment affect responses to stressors. Associations of AL with age and sex are found in all populations; AL is enhanced by senescent processes, predisposes individuals to chronic non-communicable diseases, and predicts future morbidity and mortality. AL represents physical decline from "optimal" physiological function to a more dysfunctional phenotype. Reported research has yet to explore associations of genetic markers with AL. We examined such associations in a sample of 284 American Samoans.

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Based on seven secondary mediators of allostasis, we examined associations between AL and variants in apolipoprotein E and H, ACE, and ANP. AL did not differ significantly among genotypes for apolipoprotein H or ANP loci. However, variants in apolipoprotein E and ACE were found to be significantly associated with AL ($p < .05$). Persons with the apolipoprotein E (3,2) genotype showed significantly lower AL than the (3,3) or (2,2) genotypes. Within the sexes, men showed significantly higher overall AL and stronger associations with genotypes than women. Genetic predictors of physiological dysfunction may be important modulators of risks for morbidity, senescent biology, and mortality across populations. Examination of associations between AL and apolipoprotein E and ACE genotypes helps us understand effects of genes on chronic stress.

Establishing sexual dimorphism in *Oreopithecus bambolii*.

ALYSSA M DOWNS¹ and TERRY HARRISON^{1,2}. ¹Center for the Study of Human Origins, Department of Anthropology, New York University, ²New York Consortium of Evolutionary Primatology (NYCEP).

Oreopithecus bambolii, a seven million year old fossil ape, is one of the best-preserved fossil primates. Previous

dental studies indicate that *Oreopithecus* exhibits sexual dimorphism with the male slightly larger than the female. The degree of postcranial body size dimorphism remains unknown. Understanding size relationships between the sexes allows us to make inferences regarding social structures. This study established a linear relationship between sexual dimorphism and body size range among extant primates, and addressed sexual dimorphism in *Oreopithecus* given the length of bones from the preserved postcranial skeleton. We proposed the postcranial data would indicate that *Oreopithecus* would have slight levels of sexual dimorphism.

To test the relationship between sexual dimorphism and size range, the linear distance (total length) of ten postcranial markers associated with body size dimorphism across non-human taxa were measured (3085 measurements). We found a positive correlation between total range and dimorphism for each marker. Using seven taxa, a significant positive correlation between size range and sexual dimorphism was observed ($R^2=0.89$). Based on this relationship, *Oreopithecus* exhibits slight body size dimorphism (Males 39% > females).

In extant primate species, sexual dimorphism informs aspects of social organization that can be used to make

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conclusions regarding social organization in extinct primate species. We compared *Oreopithecus* to other non-human primates with varying degrees of sexual dimorphism and found it to be closest to chimpanzees. More measurements across primate taxa are needed in order to adequately relate *Oreopithecus* and other fossil apes to extant non-human primate social organizations.

Funding provided by the New York University Dean's Undergraduate Research Fellowship grant.

Baby bones and disappearing bodies: The differential preservation of human remains according to age in a 17th to 19th century Dutch cemetery.

CHRISTINE ERKELENS, MENNO HOOGLAND, and ANDREA WATERS-RIST. Human Osteo-archaeology, Faculty of Archaeology, Leiden University.

An ongoing discussion in bioarchaeology is the extent to which differential preservation of subadult versus adult bones affects the composition of the excavated collection. Subadult bones may be more susceptible to taphonomic processes causing degradation, or may be affected by excavation damage. Thinner bones, such as in older adults, may be similarly preserved. To add to

this discussion, 49 skeletons from a post-Medieval Dutch cemetery, ranging in age from fetal to old adult (50+ years), were examined for preservation and completeness. Preservation was assessed using fragmentation and Behrensmeier's bone weathering stages to determine the condition of the skeleton. Results show that subadults under the age of three years were significantly less complete and more poorly preserved than older subadults and adults. Old adults were not significantly different in terms of completeness or preservation. Long bone diaphyses were significantly better preserved than the metaphyses and epiphyses, and this is much more pronounced in subadults under three years of age. It is proposed that these differences are caused by the intrinsic properties of the bone in young subadults, and not by excavation damage. Intrinsic bone properties causing the remains of young subadults to be less complete and well preserved include larger surface-to-volume ratio, higher porosity, lower percentage of hydroxyapatite, and lack of fusion. This research supports the view that subadults are not as well preserved as adults because degradation effects are more pronounced, but that the difference is only significant in fetuses, perinates, and infants.

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Climatic events and hair cortisol in two wild ring-tailed lemur (*Lemur catta*) troops from the Beza Mahafaly Special Reserve, Southwestern Madagascar.

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and MICHELLE SAUTHER.
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Unexpected environmental events including droughts and cyclones can have devastating effects on lemur survival. Hair cortisol can be used to compare long-term patterns in cortisol secretion, a generalized stress marker. We compared cortisol profiles of wild troops of ring-tailed lemurs relative to stochastic environmental perturbations that reduce food resources. Tail hair samples (N=65) were collected from two troops across four collection years with varied precipitation: normal, drought, cyclone, and the following post-cyclone year. Orange Troop (8 males, 11 females) ranged within a gallery forest but obtained additional resources at the research camp on a near daily basis; in contrast the Yellow Troop (8 male, 9 females) rarely used the camp. We predicted higher cortisol in Orange Troop animals, even in drought and cyclone years due to potential buffering effects from accessing camp resources. Further, we predicted lower hair cortisol in males than females in all years as this is a

female dominant species, and higher hair cortisol in juveniles compared to older age groups. We measured hair cortisol using previously validated enzyme immunoassay protocols, determining significant differences among troops, sexes, and age groups using ANOVA with Tukey's post hoc test. Hair cortisol levels differ across troops (Yellow > Orange), years (cyclone year > other years), and age classes (subadults > other age groups). Overall, our findings are as expected, with elevated hair cortisol measurements reflecting periods of high nutritional stress. Results also indicate behavior, e.g. accessing provisioned resources, can mitigate negative environmental effects among some groups, measured via hair cortisol.

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Locomotion of the Northern tree shrew *Tupaia belangeri* and the evolution of primate locomotor capabilities.

DILEK GENÇ¹ and HERMAN PONTZER^{1,2}. ¹Department of Anthropology, Hunter College, City University of New York, ²New York Consortium for Evolutionary Primatology, New York.

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Studying non-human primates and other mammals' locomotion may help us to understand and trace down the evolutionary history of different gaits. Lateral sequence gaits are characterized by same-side foot touchdowns, whereas diagonal sequence gaits follow opposite-side, criss-cross touchdowns. Most primates use diagonal sequence gaits in addition to having greater limb excursion angles. This is thought to be a key adaptation for surviving and balancing on fine branches, and the presence of a highly arboreal forest environment during a long evolutionary history may help to explain the wide distribution of diagonal sequence (DS) gaits in non-human primates and some mammals like squirrels. In this study, I used high-speed digital video to record the gait mechanics of the Northern tree shrew to test whether locomotion on branches was associated with differences in gait. High speed videos were taken at the Philadelphia Zoo and compared to those of non-human primates and other mammals observed at the Bronx Zoo. Gait sequences and limb excursion angles were recorded using the angle and clock tools in Kinovea. *Tupaia belangeri* showed a high rate of arboreality, DS gaits and large limb protraction and retraction angles. This, along with many other primate studies suggests that diagonal sequence gaits evolved out of an arboreal

environment; further comparative study may help us to understand differences in gait in primates and trace the evolutionary history of different kinds of locomotion.

The humor gender gap: How gender and humor interact to influence social behavior.

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Humor is an essential aspect of human behavior and sociality, involving higher cognitive functioning that seems unique among extant primates. Social aspects of behavior involve both the person being funny, as well as the person receiving and/or acknowledging the humor; such reactions further appear to relate to dominance relationships.

Previous studies have suggested gender differences in both humor behavior (telling jokes) and humor responses (laughing at jokes). Here we test whether or not men and women are perceived as equally humorous in a culture in which humor behavior (joke telling) is used to denote social dominance, whereas humor responses (smiling and laughter) are linked with

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submissive behavior. Since men have increased dominance, we hypothesized that they would be considered funnier, thus eliciting increased smiling and laughter responses. To test this, male and female participants (N=19) listened to an audio recording of the same funny anecdote read by either a male or female reader. Both innate responses (spontaneous smiling and laughter) and reported responses (questionnaire ratings of humor) were collected. Though no significant differences between the male and female recordings were found, males found the male recording more humorous than the female recording, both in innate and reported responses (71% more smiles; 11% higher survey responses).

By determining whether there is a fundamental difference in how funny men and women are viewed, one can better understand how humor has been used in the acquisition and maintenance of social relationships, and thus humor's relevance to group cohesion, social dominance and mixed-gender interactions.

How travel time influences sexual dimorphism.

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The function of sexual dimorphism in humans remains elusive and is likely the result of interacting pressures. While a smaller female size has ramifications for energy requirements during reproduction, the thermoregulatory benefits of being small when faced with heat loads are extensive. A growing body of evidence shows that fitness is heavily influenced by heat load, independently of energy availability. One way women may decrease their heat load is by performing their daily mobility in a series of bouts, broken up with resting periods for cooling—as evidenced by multiple hunter-gatherer groups. Here we tested how bout-travel influences thermoregulation by having men and women (N=8) row a canoe in a series of bouts while their core temperatures and rowing speed were monitored continuously. The bouts were two short (6-minute) and one long (12-minute), interspersed with equivalent length rests. Men were bigger than women ($p < 0.001$) and women had higher Surface-Area:Volume ratios ($p = 0.013$). Men rowed faster than women ($p = 0.001$) and their temperatures regularly rose above the heat shock protein threshold of 37.7°C; female temperatures never rose above 37.7°C.

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There were no significant differences between speeds during any of the bouts for either sex; however, female core temperatures were dramatically higher during their second short bout than either the first short bout or the long bout, whereas male core temperatures remained within the same range during all three rowing bouts. This suggests that if women use bouts to reduce their heat load, the rest between the bouts must be extensive.

Midfoot pressure distribution during bipedal and quadrupedal walking in *Pan Troglodytes*.

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Recent evidence suggests that australopithecines as well as *Homo floresiensis* may have possessed a derived, rigid lateral midfoot along with a mobile medial midfoot characterized by a distinctly primitive, possibly weight-bearing, navicular. Few analyses have quantitatively examined the function of the midfoot in apes and humans. We examined midfoot plantar pressure using an EMED-SF pressure mat during bipedal (BW) and quadrupedal walking (QW) in two adult male chimpanzees and during BW in 21 habitually barefoot

humans. A dorsoplantar x-ray (semi weight-bearing) was used to assist identification of foot regions on the plantar pressure data. Peak pressures, contact time, and timing of contact were compared in the medial and lateral midfoot in chimpanzees during BW and QW and humans BW. Following a distinct heel strike, medial and lateral midfoot contact start times did not differ significantly, suggesting these regions are touching down simultaneously following heel strike. Medial and lateral peak pressures were similar during BW and QW ($p=0.47$), although medial midfoot pressures were significantly higher during BW than QW ($p=0.018$). This differs markedly from the human condition in which medial midfoot pressures are negligible or significantly lower than lateral midfoot pressures. Our data supports the suggestion that the navicular tuberosity likely bears weight during midstance of QW and especially BW in chimpanzees (but not humans), and this supports a weight-bearing function in early hominins with a thin, elongate navicular tuberosity. Further functional understanding of navicular tuberosity morphology will require integration of tibialis posterior function into kinetic models.

The interface between biology and culture: Description of a culturally deformed microcephalic cranium.

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Culturally deformed crania are plentiful archaeologically and have been employed in studies of functional cranial matrices and geometric morphometric assessments of shape change. Archaeologically-derived microcephalics have had a similar focus, although their rarity has limited our understanding. We provide the first description and analysis of a microcephalic skull that was modified culturally.

The individual derives from the Silver Creek region of Arizona and is housed at the PHMA, UC Berkeley. This unprovenienced individual is believed to date to the Pueblo period (AD 1000-1400). Normal ($n=32$) and microcephalic ($n=2$) comparative skulls are housed at the Institute for Craniofacial Study, UOP. The deformed individual is aged at 11.0 years, while the normal sample ranges

from 10.0-13.0 years. Individuals were CT-scanned, and isosurfaces/volumes were reconstructed with Amira. Morphological change in osseous units was examined metrically and via comparisons of triangular meshes. Shape and anatomical deviations from normal brains were assessed by comparisons with reconstructed endocranial volumes.

The skull is anteroposteriorly short, broad, and tall as a result of cradleboarding. The endocranial volume is ≈ 750 cc, indicating a primary microcephaly. The typically flat microcephalic frontal is now vertical due to an anterior rotation of the vault relative to the face. The basal frontal lobes were compressed into the orbital plates and olfactory pocket while portions of the temporal lobes posterior to the sphenoidal border were forced laterally. The facial mask is broad for a microcephalic. Compensatory changes in the nasal cavity and palate (long, narrow) are intermediate between the two conditions.

ABCA1 R230C gene variant absent in First Nation communities of British Columbia.

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Developmental plasticity and adaptation have provided a means by which feedback among culture, environment, and genetics has greatly shaped the course of human evolution. The models argued for most strongly have been triggered by the advent of agriculture and of animal domestication. This work presents new information on one of the first examples of gene-culture coevolution found in the Americas, that of the link between domestication of *Zea mays* (maize) and frequency of ABCA1 gene variant R230C. This mutation in the ABCA1 gene allows for greater cholesterol storage in the cells, thus increasing the potential for fat storage in the body, which could be evolutionary advantageous during periods of famine. Alternatively, it is also possible that this variant may have increased in frequency in Indigenous communities by genetic drift rather than natural selection. The relationship between subsistence mode and allelic frequency was assessed in four First Nations communities in British Columbia. The ABCA1 gene has not previously been investigated in this geographic region. These communities are not known to have domesticated maize and were therefore not expected to carry the R230C variant. DNA extracted from saliva samples was analyzed using real-time PCR and Sanger sequencing. Our results provide

no evidence for the R230C variant in these communities, which supports the hypothesis that genetic changes in ABCA1 occurred within the context of *Zea mays* domestication. This is consistent with the current model of gene-culture coevolution in the constructed niche of subsistence mode within the Americas.

Sex and size in relation to fluctuating asymmetry in a captive population of *Macaca mulatta*.

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Previous studies show that facial symmetry is deemed attractive in a wide range of human populations, and has therefore been linked to the probability of higher fitness. One possible explanation for this is that facial asymmetry has been linked to developmental instability, but the relationship between facial asymmetry, developmental instability, and sex or age has not been as extensively studied. Here we examine differences in facial symmetry in a sample of 45 captive *Macaca mulatta* of known age from the Oregon National Primate Center housed in the University of Oregon Grand Collection. We use a Microscribe digitizer to collect 3D data for 45 predetermined landmarks according to

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protocol in Frost et al 2003, and asymmetry is then measured as a calculation of Procrustes' Distance between each specimen and its mirror image. We examine the influence of age, centroid size, and sex on facial symmetry. Results: A significant correlation between centroid size and degree of asymmetry was found, but larger sample sizes are needed to determine actual causes of asymmetrical development, whether sex-linked or ontogenetic. Future aims of this study are to interpret how fluctuating asymmetry in individuals interacts with status in dominance hierarchies, which themselves are an indicator of genetic fitness. This current research will provide valuable insight into the phenomena of fitness as it relates to symmetry non-human primate populations, and future research will help explicate the phenomenon as it relates to humans.

Skull and brain anatomy of a trigonocephalic juvenile: Description of the first known prehistoric case.

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Instances of premature fusion(s) of cranial sutures are well-represented in prehistory. The frequency of sutural fusions generally mimics those in recent populations. Premature fusion of the *sutura frontalis* resulting in trigonocephaly occurs at a very low frequency today (1 in 25-70,000 live births), but it is undocumented in prehistoric contexts. Here we describe the first prehistoric case of trigonocephaly and discuss previously unavailable details of skull and brain morphology and pathology associated with this condition.

This individual is housed in the PHMA, UC Berkeley, and was recovered from Santa Rosa Island, CA (CA-SRI-24). Radiocarbon dating and artifact seriation provide a date of 1500-1650 AD. The age at death was assessed from the dentition to be 8.0 years \pm 24 months. For descriptive and analytical purposes we CT-scanned crania ($n=43$) developmentally aged at 6.0-8.5 years. Isosurfaces and volumes were reconstructed with Amira®. Examination of morphological change in osseous units was examined via comparisons of triangular meshes.

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Shape and anatomical deviations from normal brains were assessed by comparisons with reconstructed endocranial volumes.

Skull morphology indicates a complex, possibly syndromic, form of trigonocephaly. A series of typical features including hypotelorism, superoinferiorly tall orbits, thickening and ridging of the midfrontal region, flattened frontal eminences, short anterior cranial fossa, and a heart-shaped transverse cranial outline contribute to this diagnosis. The endocranial volume was determined to be ≈ 700 cc. Microencephaly resulted from maldevelopment of the frontal lobe and inferolateral portions of the temporal lobes. This individual possesses features consistent with a diagnosis of complex trigonocephaly.

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Cross-cultural reproductive life histories of males.

CAROLYN MCGUIRE¹ and FRANK L. WILLIAMS¹. ¹Department of Anthropology, Georgia State University.

When do men have children? The age at first birth of an infant for males may vary cross-culturally. It has been noted previously that forager women have different reproductive careers than

agricultural women. Comparatively less detail is available for male reproductive life histories. If forager males need to acquire subsistence skills to support a family, then their age at first birth may be later compared to men in agricultural societies. If men in agricultural societies pursue a higher education, then their age at first birth will be later in life. To examine these questions further, data were collected from the literature on male reproductive life histories. Among foraging cultures such as the Ache, Tsimane, and Hazda, male age at first birth is typically in the early twenties. Comparatively, the literature suggests that European males have a later age at first birth ranging from 28-33 years, while U.S. males exhibit a range of values dependent on education from 22.8 years to 29.4 years. Age at last birth also varies, with Ache males showing a mean of 45 years, and Hadza males exhibit a later age at last birth at 55 years. U.S. males show a mean of 44 years. Generally, males in agricultural societies exhibit shorter reproductive careers than forager males, with a later age at first birth and an earlier age at last birth.

How semi is the capuchin prehensile tail?

ALLISON MCNAMARA, NATASHA MAZUMDAR, KRISTINE KURTZ and

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MICHELLE BEZANSON. Department of Anthropology, Santa Clara University.

The capuchin prehensile tail often is described as 'semi' prehensile despite the fact that anatomical and behavioral data suggest the tail is capable of sustaining the entire body mass of adults. The goal of this research was to document details of tail use changes in growing capuchins (*Cebus capucinus*) inhabiting a tropical rainforest in Costa Rica. We collected 164 hours of behavioral data during 2013 at Estación Biológica La Suerte in Northeastern Costa Rica. At each one-minute instantaneous sample, we recorded age, activity, positional context, tail position/ angle, proportion of tail wrapped, diet, crown location, and substrate information. All age groups engaged in mass-bearing tail positional modes (tail-only suspend, tail hindlimb suspend, vertical tripod). The youngest infant (birth-2 mos.) tails were primarily observed in a non-grasping position (89.9%). Juveniles and preadults were observed to use their prehensile tails significantly more often than adults during feeding/foraging and social behavior ($p < 0.05$ in all comparisons). Juveniles and preadults were observed to wrap their tail using relatively distal tail segments significantly more often while older adults were observed to engage the

proximal segments. Our behavioral results support recent morphological and behavioral studies that suggest that juvenile capuchins experience an early peak in tail use and complex positional modes. However, the tail is rarely used in the first few months following birth. Finally, we conclude that despite documented anatomical and behavioral differences in *Cebus* and ateline prehensile tails, the term 'semi' prehensile does not reflect the ecological role of the capuchin tail.

Fauna and identity at Goat Springs Pueblo, Rio Abajo Region, New Mexico.

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I report the results of a zooarchaeological study consisting of the mammalian remains recovered from architectural features of recent excavations at Goat Springs Pueblo. Goat Springs Pueblo (LA 285), located near Magdalena, New Mexico, and overlooking the southern Rio Grande valley, was a residential site dating to the late Pueblo period (A.D. 1300-1680). The pueblo was located on a trail connecting the Zuni and Rio Abajo villages and was occupied at least twice during the late Pueblo period. At present, little is known about the economy, identity, and ritual practices

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of the pueblos' inhabitants - including the response to Spanish contact. This study investigates how animals were incorporated into ritualistic behavior and daily life in the Pueblo at the time of occupation. By conducting zooarchaeological and taphonomic analyses, I identify and quantify the faunal remains and document butchery and preparation practices such as cut marks and burning. Ultimately, my research will contribute to the current dearth of information concerning social dynamics at Goat Springs Pueblo by providing critical information regarding human/animal interactions during this period.

Egyptian mummy autopsy: A history of the practice and preserving the autopsy context.

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During the 20th century, practitioners of paleopathology conducted autopsies on mummified individuals to obtain ancient tissue samples for their research. Unfortunately, autopsies are destructive, irreversible one-time

events, which destroy contextual information as data are generated. This research addresses the issues surrounding preservation of the context of autopsied mummies, including physical remains (e.g. soft tissue, bone, etc.), associated documentation (e.g. notes, photographs, x-rays, etc.), and oral histories (e.g. interviews and memories of those involved).

To better understand how the field has developed and what the goals were at various time periods, I first completed a literature review on the history of the autopsy technique in the field of paleopathology and then conducted interviews with the practitioners. Using this information, the types of materials generated at different times within the field's development were identified. Then, a mummy known as PUM (Philadelphia University Museum) 1, an artificial, non-pharaonic Egyptian mummy from approximately 800 BCE, was used as a case study, to demonstrate not only how to identify, but preserve the elements of the autopsy context.

While the focus of this research is on autopsied, Egyptian mummified individuals, the ultimate goal is to develop a method that is applicable to all 20th century mummy autopsies. It is my hope that by regaining intellectual control over these materials, museum

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professionals can better preserve these mummified individuals and their personal histories, while simultaneously making them more accessible for future researchers and museum-going audiences.

A comparative analysis of the tibia of *Paralouatta varonai*, an extinct Cuban primate.

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The Caribbean islands were home to primates for millions of years, potentially from the Miocene through the early Holocene. *Paralouatta varonai* was a species endemic to the island of Cuba whose fossil remains have been well described. While all known platyrrhines are arboreal, it has been proposed that *Paralouatta* may have been semiterrestrial. This work provides comparative analyses of the fossilized tibia of *P. varonai*, specifically looking at the distal articular surfaces to determine the locomotion of this extinct platyrrhine, as well as its relation to the extant platyrrhine families. Our sample consisted of 154 extant platyrrhines (from 14 primate families) and 6 extinct platyrrhines (representing 4 different species). We used three-dimensional geometric

morphometric shape data in two different principal components analyses, one utilizing all individuals, and one utilizing taxon means. We found that *Paralouatta* possesses a flattened trochlear surface, a characteristic associated with suspensory primates. *Paralouatta* also resembles arboreal primates in having an oval-shaped trochlear surface, as opposed to the trapezoidal shape seen in terrestrial primates. However, the medial malleolus is short and blunt, a trait that typically provides stability but restricts mobility and is often found in terrestrial primates. Thus, the distal tibia of *Paralouatta* exhibits a mix of morphological characteristics that are typically associated with terrestrial and suspensory primates. It occupies a unique position in the platyrrhine morphospace; however, this position is most similar to extant atelids, lending support to earlier assertions that *Paralouatta* is most closely related to this taxon.

Premolar odontomes: A study of their frequency and familial occurrence in a Native American sample from Arizona.

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Odontomes, also known as dens evaginatus, is a morphological dental

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trait characterized by protrusion of an occlusal tubercle consisting of enamel, dentin and variable amounts of pulp tissue. The trait is found most commonly on human premolars. Population variation is well documented, with Asian and Asian-derived samples exhibiting the highest odontome frequencies, which rarely exceed 20%. Analyses indicate varying levels of genetic control for morphological dental traits, but it appears that odontomes have yet to be analyzed. The intent of this study is to investigate the frequency and possible familial distribution of odontomes by studying 19 pedigrees of Pima Indians from the A.A. Dahlberg Collection of dental casts at Arizona State University.

Our analysis included 714 maxillary and mandibular premolars in which 78 (10.9%) exhibited an odontome. Employing the individual count method, our total sample reveals that odontomes occur more frequently on the first maxillary premolar (15.8%) relative to the second maxillary premolar (11.1%). Interestingly, there is contrasting directionality in odontome frequency in the mandible, where the trait occurs more often on second premolars (LP1=7.5%; LP2=20.9%). At least one first-degree relative of an affected individual also exhibited an odontome in 9 out of 19

(47.4%) pedigrees. Overall, premolar odontomes occurred in 16.5% (13/79) of first-degree relatives of affected individuals. The familial odontome frequencies found here are higher than in prior studies of the Pima, thus supporting a genetic causation for premolar odontomes.

Paleohistopathological and taphonomic studies of naturally mummified spleens.

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Spleens rapidly undergo post-mortem autolytic changes making preservation in mummified specimens rare. To date, there have been no previous studies of mummified splenic tissue. The current study addresses this gap through analysis of 19 naturally mummified individuals excavated from five separate valleys within the desert regions of southern Peru and northern Chile dated between 1700 B.C. and A.D. 600. This study seeks to identify normal and abnormal structures in mummified spleen tissue as well as to

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examine the differential preservation of splenic tissue between individuals.

Twenty samples of spleen tissues were rehydrated in Ruffer's solution and placed in a 95% ethanol solution. Each sample was then stained with hematoxylin and eosin, as well as Masson's trichrome in order to visualize the architecture of the organ tissue. After microscopic examination, the most well preserved slides were stained for the presence of iron and calcium. Microscopic examination in conjunction with staining techniques verified the presence of splenic tissue containing blood remnants interposed with fibrous tissue.

Our results suggest that while fibrous tissues were well preserved, the parenchyma was markedly shrunken. Blood elements and calcium were identified in the spleen tissue with no evidence of disease. We hypothesize that the natural mummification process that preserved these individuals prevented normal splenic post-mortem autolytic changes. The identified blood remnants will allow molecular techniques, such as miRNA, to facilitate a more comprehensive understanding of the mummified individual's genetic makeup and life history.

Sex determination of dental remains: Discriminant function analysis of the Dunning Poorhouse Cemetery.

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Determining sex is one of the most basic steps of bioarcheological methodology, and this information can be pivotal at the individual and population level. While there are methods in place involving the pelvis and skull that are widely used and straightforward, skeletal preservation does not always allot for such analysis. Teeth, however, are some of the most durable human remains. Using these remains for sexing is still contentious due to the low rates of sexual dimorphism in human dentition. This project uses discriminant function analysis (DFA) in order to find an effective means of utilizing dental remains in sex determination. The Dunning Poorhouse Cemetery collection was used to create a series of discriminant functions in SPSS in order to find the minimum number of dental measurements to create an efficient function. This collection consists of individuals who died at the Dunning poorhouse of Chicago, IL in the late 19th century. Buccolingual and

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mesiodistal measurements were taken for the available teeth of 60 adult individuals with known sex. After initial analysis, upper canines and lower third molars were shown to have the highest loading values for DFA and therefore higher instances of sexual dimorphism. A series of five discriminate functions used combinations of these measurements, which were compared for significance and classification accuracy when reapplied to the sample. The functions performed at a level comparable to widely accepted pelvic and cranial sexing methods, although the sensitivity DFA shows towards small sample sizes warrants discussion.

Investigating senescence in ancient Nubia.

KATELYN REAVIS and MICHELE BUZON. Department of Anthropology, Purdue University.

The understanding of older adult life experiences is deficient when compared to younger adults and children in the archaeological record. Research has been devoted towards aging techniques and studies of osteoarthritis, but there are few discussions describing senescence in the past. Most research includes the oldest cohort (45 years and above) within the broad category of adults, but it is useful to look at this demographic

separately. Skeletal remains were analyzed from the site of Tombos (ancient Nubia) dated to the New Kingdom and the Napatan Periods (~1400-650 BC). The focus of the analysis was on the pathological conditions present and how this cohort's nutritional and pathological experiences differed between periods. It was hypothesized that individuals who reached extreme old age (45+) would exhibit low signs of pathological and nutritional stress due to their abilities to escape chronic disease and disability. Results show that there was a mix of disease survivors and disease escapers from the population at Tombos and this pattern reflects modern studies on those who reach extreme old age.

The individuals were aged using transition analysis. Most individuals were in their seventies (39.1%), but age distributions were relatively equal among the forties, fifties, sixties, and eighties. Many individuals were robust and displayed low frequencies of nutritional or infectious lesions (less than 14%). All individuals had some form of arthritis, but there was a wide range in severity. One osteobiography is presented to detail a unique condition found.

Too much compost in the trash: Understanding waste allocation.

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The history of *Homo* is characterized by increasing technological complexity, sufficient today to allow people to live in almost any environment. Recently, this penchant for complex technology has become focused on products that are disposable. These throwaway items have created an environmental challenge for human society. Although global efforts to reduce the amount of waste that people produce are ongoing, a significant amount could be recycled or composted, but is not. The purpose of this initial study is to understand how waste is allocated when individuals are offered options.

We compared the composition of items in trash, recycling, and compost bins, six bins total, on the University of Washington campus. The waste in each bin was sorted by type (trash, recycling, and compost) and the mass of improperly allocated waste (contamination) in each bin was determined. We found that the average trash bin contained 12% trash, the rest was contamination which could have been recycled or composted. Recycling bins contained 61% recyclable material and waste in compost bins was 93% compostable.

Our results indicate that individuals who compost know what to compost; yet compost is still the single largest contaminant in trash (72%) and recycling (36%) bins. Food and liquid were most often displaced, followed by compostable food and drink containers. We are left with many questions that require future exploration: Are individuals cognizant of how incorrectly they dispose of waste? Do individuals recognize that their incorrect allocation of waste causes environmental deterioration that threatens our species' ability to thrive?

Biocultural and genetic factors used in osteoporosis risk assessment.

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Previous studies suggest that patterns of bone loss and incidence of fragility fractures observed in age-related and post-menopausal osteoporosis today were not evident in ancient human populations. It is hypothesized that this change is related to less demanding physical labor in modern, more technologically advanced societies, resulting in less robust skeletons. Additional studies emphasize the importance of acquiring maximal bone mineral density through modifiable behavioral practices during childhood and adolescence in order to help

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prevent geriatric onset of osteoporosis. The purpose of this study is to examine the biocultural and genetic risk factors medical professionals consider when assessing osteoporosis risk and to evaluate if the appropriate age demographic is targeted for osteoporosis education. Thirty-three medical professionals participated in a structured survey consisting of 20 questions regarding critical factors for determining osteoporosis risk. Survey results indicate that diet, vitamin D intake, physical activity level, history of low BMI, and cigarette smoking status are among the most important developmental factors considered when evaluating patient risk. Professionals emphasize that the interplay between these modifiable factors significantly influences individual risk. A patient's age, sex, and past medical history are also important, albeit non-modifiable, factors. Results further suggest that medical professionals adequately educate young female patients about osteoporosis risk and bone health. Examining the factors that contribute to the incidence of osteoporosis in modern human populations is crucial for understanding and preventing this debilitating disease.

Trauma and pathology in Western European Pleistocene hominins: Implications for relative adaptability.

SAMANTHA STREULI and MARK HUBBE. Department of Anthropology, The Ohio State University.

Multiple hominin species coexisted in Western Europe during the Pleistocene. Recent studies indicate that archaic *Homo sapiens* (i.e., *H. heidelbergensis* and *H. antecessor*) and *Homo neanderthalensis* possessed advanced cognitive abilities and adaptive strategies which were previously believed to be limited to anatomically modern *Homo sapiens* (AMHS). This information opens the possibility that the disappearance of archaic *H. sapiens* and Neanderthals was unrelated to an inability to compete with AMHS. If AMHS exhibited superior immune and behavioral adaptations that allowed them to better adjust to the environment already occupied by other hominins, then it is to be expected that their remains would exhibit fewer incidences of trauma and dental-skeletal pathological conditions than the remains of archaic hominins. To test this hypothesis, we present a comprehensive literature review of trauma and pathology observed among the Pleistocene fossils of archaic *H. sapiens*, Neanderthals, and AMHS at 32 Western European sites. Fisher's exact test was used to analyze the differences among species. Considering skeletal trauma, no statistically significant difference among species has been

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shown. In terms of dental pathologies, Neanderthals exhibited higher frequencies than both archaic *H. sapiens* and AMHS. Archaic *H. sapiens* exhibited higher frequencies of infectious and congenital disease than Neanderthals, but not higher than AMHS. Despite inter-species differences, all Pleistocene hominins exhibited patterns of trauma and pathology that are within the range observed among later hunter-gatherers. This evidence supports the idea that archaic hominins were well adapted to their environment, and suggests that maladaptation was not a factor in their disappearance.

Variation of proximal femoral angular orientation in human and non-human primates.

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Humans display a wide range of variation in the orientation of the femoral head, which can range from -18° of retroversion (facing posteriorly) and to 26° of anteversion (facing anteriorly), posing a challenge to anthropologists attempting to infer function from femoral morphology and clinicians presented with the task of

accurate reconstruction of the area. The high amount of variation has been suggested to be unique to humans.

To test this hypothesis that humans are more variable than other taxa, femoral version angles were compared within a sample of 149 femora of 8 species of modern human and non-human primate femora. Laser scan data were collected and reconstructed to create 3D digital polygonal models of each bone. First, clinical studies of human were replicated by quantifying orientation relative to a tabletop plane. Second, true functional angle were established using Polyworks software (Innovmetric, Inc) using centers of joint movement at the hip and knee and muscle attachments. All data were collected three times and the average used for analysis. Observed ranges were analyzed statistically using Pearson's product-moment correlation coefficient, Bartlett's F-test and coefficients of variation within and among sample groups.

Contrary to our predictions, human were not significantly more variable than other species regardless of body size, locomotion style, or degree of sexual dimorphism. This study serves as a launch pad for further research into the study of how environmental conditions affect the growth and morphology of the femur, and of the

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relationship between femoral and acetabular version.

This research was supported by funding from the National Science Foundation (BCS 0647557), the Leakey Foundation, and the Wenner-Gren Foundation.

Validation of a model for estimating sarcomere length operating range of the superficial masseter muscle in primates.

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Sarcomere lengths vary with muscle stretch and influence a muscle's physiological output. For the jaw muscles, variation in sarcomere length (L_s) across jaw gapes affects jaw-muscle forces, bite forces and jaw movements. Obtaining *in vivo* estimates of sarcomere-length operating range (L_sOR) for the jaw muscles has proven difficult for most primate species. In lieu of measuring L_sOR *in vivo*, investigators have modeled L_sOR using jaw-muscle architectural parameters collected from cadavers with jaws fixed

in occlusion to estimate L_s at maximum jaw gape.

To model superficial masseter L_sOR , we collected three-dimensional landmark data to estimate muscle excursion as a function of joint angle from occlusion to maximum gape in an adult female *M. fascicularis* skull. We incorporated estimates of jaw-muscle architectural variables from female *M. fascicularis* and our muscle excursion estimates from the dry skull into a model to estimate L_s as a function of jaw angle, fitting the excursion data with a quadratic polynomial using Matlab. At maximum jaw gape, our modeled estimate of L_s exceeded an *in vitro* estimate of $L_s=4.39 \mu m$ measured from four adult female *M. fascicularis* cadavers with jaws fixed at maximum gape. While we consider this initial result sufficient to support the approach, additional species comparisons with *in vitro* L_s data at maximum gape are needed to further refine and validate the model.

Genetic ancestry reports in a community-based participatory research study on the impact of genetic and socio-cultural risk factors for hypertension in African-Americans living in Tallahassee.

NUBIANA L. TODD¹, LAUREL N. PEARSON^{1,2}, AIDA T. MIRÓ-HERRANS¹, CLARENCE C.

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In the United States, studies have consistently reported a higher prevalence of hypertension in African-Americans than in Caucasians. African-Americans also are at higher risk of developing related complications such as stroke and heart disease than are Caucasians, a distinction that contributes to racial disparities. In this study we investigated the impact of genetic and socio-cultural predispositions to hypertension in African-Americans living in Tallahassee, FL by using a community-based participatory research program to engage the community. This approach ensures that the ethnographic data were as accurate as possible, participation was as high as possible, and it returns some benefits to the community. One benefit requested by 30% of the study participants, as indicated by a specific query in the informed consent form, was a report of their genetic ancestry. This information is valuable to study participants so that they can better understand their ancestry and are able to connect with their heritage. Meetings with the local

steering committee were conducted to develop a relevant and accessible document to report individuals' genetic ancestry estimates. The range of estimates for West African ancestry in this study was 27.7%-99.5%, for European ancestry it was <1%-70%, and for Indigenous American ancestry it was 0%-14%. A genetic glossary was developed to include with the reports along with contact information for obtaining feedback information from report recipients. Genetic ancestry reports will likely help interested study participants in both learning about their genetic origins and informing them about genetic diseases for which they may be at risk.

Changing trends of *Papio ursinus* subadult males' consortship patterns in Tokai Forest.

MARIE VERGAMINI¹ and LARISSA SWEDELL². ¹Department of Anthropology, Virginia Commonwealth University, ²Department of Anthropology, Queens College-CUNY.

There is consensus that chacma baboons (*Papio ursinus*) establish male hierarchies that affect which male has priority access to the troop's reproductive females. But what happens when male competition is gradually eliminated? Human encroachment, human urbanization, and the human-baboon conflicts

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present in the Cape Peninsula of South Africa have caused drastic shifts in how male hierarchies are structured in baboon troops inhabiting the area. Over eighteen months, focal samples were collected from a wild troop of chacma baboons in the Tokai Forest of Cape Town that is densely populated with humans. During this time, adult males identified by local wildlife services as “problematic” due to their aggressive interactions with humans and raiding habits were removed from the troop. Data pertaining to these males’ behaviors, locations, and intergroup relationships were collected before and after removal of certain individuals. Our results show that subadult males expressed more dominant behaviors and aggressive courting patterns after the number of adult males in the troop decreased, and specifically after the removal of more aggressive individuals. Over time, clear hierarchical shifts allowed subadult males to monopolize reproductive females in less competitive situations. Studies examining how the elimination of adult males further affects male raiding behaviors and female mating choices are ongoing with the Tokai troop. Implications from these findings are of interest to primate and conservation specialists who are developing methods to diminish raiding habits in a densely human-inhabited region, while also providing

unique data on how dynamics of group membership affect social hierarchy and structure.

Comparison of two-dimensional and three-dimensional measures for capturing palatal shape in *Homo sapiens*.

ANTONIO VILLASEÑOR. Department of Anthropology, Northeastern Illinois University.

This research compares the efficacy of three-dimensional (3D) and two-dimensional (2D) measures for capturing palatal shape in a broad sample of *Homo sapiens*. The sample included individuals from Europe, Africa, and North America that practiced a variety of feeding regimes from a post-industrial diet to pre-industrial agriculture to hunting and gathering. Accurately capturing palatal shape differences is important because it can help address the interaction between the evolution of the human masticatory apparatus and feeding behaviors. While 3D data has become standard in many areas of anthropological research, 2D data does remain an important tool. In this study, eight linear measures of palatal shape and sixty-seven x,y,z coordinate points of cranial and palatal shape were collected on laser-scan generated models of human crania. Of the 3D points, twelve were placed in the

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palatal region. Measures were collected using Landmark Editor for 3D measurements and Geomagic Studio for 2D. On the whole, 3D data were better at capturing aspects of palatal depth and width and at distinguishing groups dietarily. Assessing the efficacy of 3D vs. 2D data is an important step in determining the best methodology to use when assessing palate form. This project has the potential to inform multiple areas of research including our understanding of craniofacial, and more specifically palatomaxillary, development in human evolution, as well as its effects on modern human health.

How do the phases of the menstrual cycle influence core temperature changes during activity?

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In human females, core temperature differs in each phase of the menstrual cycle such that core temperature is cooler in follicular phase than in luteal phase. It has been assumed that these phase-specific differences are limited to basal temperatures and that, during or after periods of activity, these differences disappear as overall core temperature increases. In this study,

seven females were continuously monitored by a core temperature pill as they walked at 4 different self-selected speeds (1.0 - 4.5ms⁻¹) at both the level and a 12% incline. After each condition, subjects rested for a minimum of 4 minutes. The protocol was repeated twice so that data were collected in either a follicular-luteal-follicular or luteal-follicular-luteal pattern. Average temperatures during each walking condition and subsequent resting period were calculated and compared across each phase of the menstrual cycle. Basal core temperature was higher in luteal phase (0.01%). During walking periods, luteal temperatures remained warmer on the level (0.7%) and incline (0.2%). Luteal temperatures were warmer after level trials (0.2%) but significantly hotter after inclined trials (1.0%; $p < 0.05$). Thus luteal temperatures were higher in all cases but only to a significant degree following activity (incline-walking) that produced a substantial heat load. These results indicate that thermoregulatory responses differ in each cycle phase so that core temperature is kept cooler in follicular phase despite strenuous activity. Since it is key for the developing follicle to be protected from increased heat loads, there is a strong selection pressure on effective thermoregulation in women.

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A deadly exchange: Disease transmission between the Old and New World.

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Throughout the history of anthropological and paleopathological research, there has been debate surrounding the origin and transmission of infectious diseases between Europe and the New World. The question whether tuberculosis and syphilis origins, for example, were transmitted across the Atlantic after the European colonization of the New World continues, even though recent research supports that both pathologies were already present in both continents during pre-Columbian times. Here we evaluate the reliability of this conjecture based on a comprehensive literature review of the occurrence of these pathologies in pre-historic populations. This review entailed the recompilation of information on over 100 samples worldwide. With skeletal evidence of syphilis in Europe dating to at least 300 AD, post-contact transmission must be re-examined. However, Pre-Columbian European syphilis was a low threat, with only 0.5-2% of individuals showing evidence of the pathology. In the century after contact, a steady increase occurs, with infection rates increasing to around 5%

or more, with localized spurts of prevalence in Italy and central Europe. Tuberculosis was also spread worldwide, with New World evidence dating back to potentially 2000 BC. Contrasting pre- and post-contact, New World tuberculosis (average <10% pre-contact) increases at least 20% after contact, with Southeastern tribes showing highest prevalence. In conclusion, although evidence shows that post-Columbian contact was not responsible for the origins of these pathologies in the New and Old World, the contact period and demographic growth that followed is clearly associated with the wide spread of these pathologies in later centuries.

Arm swing length: which is most predictive—step length or walking velocity?

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Arm swing length has been observed to vary with walking velocity. The mechanical function of arm swing as a counterbalance to leg movement has been suggested as an explanation for these observations. If this explanation is valid, then step length should be a better predictor of arm swing length

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than velocity, even though velocity and step length are correlated. We hypothesize that the variation in arm swing length can be explained more by step length than by walking velocity in shod and unshod walking conditions.

Thirteen women completed 30 shod and 30 unshod trials at self-selected slow, medium, and fast velocities. An eight-camera system collected kinematic data by tracking infrared reflective markers placed on participants. For each trial, we calculated average walking velocity and step length from the calcaneal tuberosity and measured two distances that the distal arm travelled in a step: arm swing length measured from the travel of the radial styloid process (RSAL) and the ulnar styloid process (USAL).

Arm swing length does not differ between shod and unshod conditions (RSAL: $p < 0.69$; USAL: $p < 0.74$). Using linear regression, arm swing length is significantly associated with both step length (RSAL: $p < 0.001$, $r^2 = 0.46$; USAL: $p < 0.001$, $r^2 = 0.53$) and walking velocity (RSAL: $p < 0.001$, $r^2 = 0.37$; USAL: $p < 0.001$, $r^2 = 0.43$). In stepwise regression, walking velocity and the interaction of walking velocity with step length were removed in favor of step length.

Our hypothesis is not rejected: arm swing length is more closely associated with step length than walking velocity in both shod and unshod walking conditions.

Simulating the social network and population demography of an endemic Sri Lankan macaque.

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Complex social relationships are a key feature of the primate order. Computer modelling and analysis have been invaluable in expanding our understanding of animal, including primate, social networks. Similarly, computer models of population demographics are able to test conservation strategies and suggest more effective means of conservation for a variety of species. Since maintaining social structure is imperative for the survival of most primate groups, we integrated these two types of models into one simulation. This model was constructed using the species *Macaca sinica*, toque macaques or “rillowe” in Sinhalese. Each individual within the model has the attributes of sex, age, and troop membership, which change the rates of mortality, fertility,

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formation of non-familial affiliations, and dispersal between troops which the model includes. The relationships included in the analysis were mother-daughter, mother-male non-adult, sisters, male-male aggressive, and non-familial affiliation. When run, the simulation creates a dynamic but stable population representative of the current state of knowledge about toque macaques, measured by group size, relationships per individual, age and sex ratios, and birth and death rates over time. In an effort to conserve species, researchers will be able to assess the robustness of a population and predict long-term effects of complex variables. To that end, models such as this can be used for simulating the effects of human cultural behaviors, like translocation, human hunting and poaching, or food supplementation, on demographics and social interactions in a variety of species of non-human primate.

Amassing evidence: A study of body mass variation in the Robert J. Terry Skeletal Collection.

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The ability to properly assess body size from skeletal material is instrumental in the study of populations, but there is still much that is not understood about

body composition and its effects. Body size can be tied to social and environmental conditions, such as climate, nutrition, activity, and stress. In order to facilitate a more accurate understanding of how to reconstruct body size, I evaluated the body mass estimators of Ruff et al. (1991), McHenry (1992), Grine et al. (1995), and Ruff et al. (1997). My sample included 49 adult males and 34 adult females from the Robert J. Terry Skeletal Collection housed at the Smithsonian Institution, which offers the opportunity to compare estimated body mass to actual weight recorded shortly after death. Male weight estimates were strongly correlated to near living weights using estimators from Grine et al. (1995) ($r(47)=.445$, $p=.001$), Ruff et al. (1991) ($r(47)=.445$, $p=.001$), McHenry (1992) ($r(47)=.445$, $p=.001$), and Ruff et al. (1997) ($r(47)=.440$, $p=.002$). For females, I found no correlations between Grine et al. (1995) ($r(32)=-.008$, $p=.963$), Ruff et al. (1991) ($r(32)=-.008$, $p=.963$), and McHenry (1992) ($r(32)=-.008$, $p=.963$) to near living weight. There was a correlation for Ruff et al. (1997) ($r(32)=.458$, $p=.008$). These results indicate that the male body mass estimators are close to accurate, whereas only one female equation was significantly correlated. This is possibly due to differences in either the specific portion of the skeleton used for the

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equations or in a sampling bias in their creation.

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Revisiting the case of tuberculosis and leprosy cross-immunity.

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Leprosy declined as an infectious disease in Western Europe after the 13th century. One hypothesis suggests cross immunity exists between tuberculosis (*Mycobacterium tuberculosis*) and leprosy (*Mycobacterium leprae*), i.e. leprosy could have declined due to the rise of tuberculosis. Recent observations show co-infection between these diseases is rare in contemporary populations; with few cases documenting exposure to one *Mycobacterium* species (*M. tuberculosis* or *M. leprae*) provides humans some degree of immunity to other *Mycobacterium* species. We developed experimental *in vitro* protocols to improve our understanding of how exposure to one *Mycobacterium* species can generate a shift in the immune response that could affect the immune response to another species. During our two-day experiment, we exposed human macrophages (THP1) to either

M. tuberculosis or *M. leprae* on day one; sequentially on day two, we exposed the same culture to the other species. The expression of key proteins (TNF- α and IL-12) involved in the immune response against both pathogens was measured by ELISA. Interestingly, when we inverted the exposure of the bacterial lysates we observed a differential expression of the cytokine TNF- α . This suggests that exposure to one *Mycobacterium* species can shift the immune response. We propose: a) to generate alternative experimental protocols targeting other immunological markers for potential cross-immunity, and b) to generate a holistic model including socio-ecological factors that could have mimicked or enhanced cross-immunity between these diseases.

Differences in shod versus unshod walking: Implications for kinematic studies applied to extinct hominins.

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Most kinematic studies using modern human gait to provide insights into the movement of extinct hominins collect data from shod participants. Given that

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our hominin ancestors were habitually unshod, this methodology is potentially problematic if the kinematics of shod and unshod gait differ. We investigate whether or not differences are present by comparing the movement profiles of the lower limbs in shod and unshod walking.

Kinematic data was collected on 10 women using an eight-camera motion capture system. Participants walked at self-selected slow, medium, and fast velocities, performing 30 shod and 30 unshod trials. Average velocities were calculated for each trial, as well as the maximum and minimum angles made by the foot, calf, and thigh during the stride cycle relative to the horizontal (foot) and vertical (calf, thigh) axes in the sagittal plane. Paired t-tests indicated that for all individuals, velocities differed between shod and unshod trials ($p < 0.01$). Linear regression comparing shod and unshod lower limb angles was thus performed including velocity as a variable.

Foot ($p < 0.001$) and calf ($p < 0.01$) angles differ between shod and unshod trials at all velocities. Shod and unshod angles differed as much as 14 degrees at the foot and 8 degrees at the calf. Additionally, the magnitude of the differences is positively correlated with velocity in all individuals (foot: $p < 0.001$, calf: $p = 0.03$). These observed differences warrant a second look at

previous kinematic studies. Future studies should consider using unshod participants to obtain data that is applicable to extinct bipeds.

Stable nitrogen isotopes in modern and archaeological human tooth enamel.

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Stable isotope analysis is a widely accepted source of information on ancient diet, subsistence strategies, migration, and ecological interaction. $\delta^{15}\text{N}$ provides analysis of protein source trophic level and marine content in diet by proxy. Because of the relatively short taphonomic lifespan of traditional sources of nitrogen isotopes (bone collagen, tooth dentine), a consistent source of analyzable nitrogen with a longer archaeological lifespan would substantially improve understandings of past diet in samples previously inaccessible for such analysis. Enamel from modern human third molars from Harvard Dental School ($n=8$), and human second molars from the sixteenth century site of Teposcolula Yucundaa in Oaxaca ($n=27$), Mexico were used to investigate the feasibility of measuring $\delta^{15}\text{N}$ in enamel, and to compare to dentine and bone collagen $\delta^{15}\text{N}$. Fine sampling with

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a hand drill yielded 30-60 mg of enamel per tooth, collected as separate outer and inner layers. A series of corrective factors based on acetanilide, keratin, and faunal tooth enamel $\delta^{15}\text{N}$ ratios were developed. The relationship between enamel and dentine-sourced $\delta^{15}\text{N}$ ratios was examined for isotopic differences and interpretive potential, and we report on the future outlook for this technique.

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