

Here we present new data describing ontogenetic changes in relative muscle mass (MM) distribution and relative physiological cross section area (PCSA) of the forelimb and hindlimb musculature of *Lagothrix lagotricha* (n=8 adults, n=2 infants). Although there is a general increase in both relative muscle mass and PCSA across both limbs, infants are characterized by higher than expected MM and PCSA values in muscle groups associated with the functional demands of infant riding (shoulder, elbow and hip flexion, forearm supination, hip adduction and digital grasping). For many of these muscle groups infant MM and PCSA values are comparable to or exceed those reported for adults. Digital grasping muscles, however, are characterized by increased PCSA values in the absence of increased MM values. This suggests that functional changes in *Lagothrix* appendicular musculature related to ontogenetic changes in biomechanical loading are not restricted to the simple redistribution of muscle mass but may also include increasing PCSA in the absences of any significant MM increase.

Dominance rank and rank disparity predict female rhesus macaque social relationships even in the absence of kin networks

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Strong social relationships can confer important benefits in primate societies, from increased reproductive success to longer lifespans. However, individuals do not form bonds indiscriminately. In female cercopithecin primates, two non-mutually exclusive hypotheses have been proposed to explain social partner preference. First, individuals should preferentially form bonds with their close kin, if available, to maximize the indirect genetic benefits of affiliative relationships. Second, individuals should preferentially form bonds with higher-ranking individuals in exchange for social tolerance. Teasing apart the relative importance of kinship and rank has been challenging, as they are often highly correlated. Here, we isolated the specific effects of rank in female rhesus macaques by analyzing grooming patterns in experimentally formed social groups (n = 26 groups) that did not contain close relatives, and in which dominance ranks were randomized. We found that grooming was inversely related to social tolerance: the amount a female groomed another female was negatively correlated with the amount of aggression she received from that female. Further, higher-ranking females were groomed more often than lower-ranking females, suggesting that higher-

ranking females were more attractive social partners. Lastly, females formed the strongest grooming relationships with females adjacent to them in rank, and this pattern was most marked for the highest-ranking females. Our findings indicate that rank position and rank disparity between partners influence social bond formation even in the absence of kin. Hence, although indirect genetic benefits are likely important to social bond formation in primate societies, similar patterns may arise even when kin are absent.

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Leporids, landscapes, and the paleoenvironment: Stable isotope ratios of rabbit and hare bones reflect local environmental conditions at modern and archaeological sites

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Environmental conditions have enabled and constrained the evolution and social development of humans since the origins of our species. This study investigates the utility of stable isotope analysis ($\delta^{13}\text{C}_{\text{apatite}}$, $\delta^{18}\text{O}_{\text{apatite}}$, $\delta^{13}\text{C}_{\text{collagen}}$ and $\delta^{15}\text{N}_{\text{collagen}}$) of leporid (rabbit and hare) bones to reconstruct past environmental landscapes. Leporids are among the most frequently found mammals in North American archaeological contexts and at many early hominin sites, including Laetoli and several Neanderthal sites. The relatively small home ranges and short lifespans of leporids, moreover, make them an ideal species to track temporal changes in local environments. Here we present the preliminary results of stable isotope analysis of 145 modern specimens representing multiple environmental zones from across the United States and Mexico. Strong correlations between environmental parameters (i.e., mean annual precipitation, grass coverage, and ecosystem type) and bone isotope values indicate the utility of using leporid bones in environmental research. These baseline data are compared with archaeological leporid isotope values (N=320) from four New World archaeological sites (Teotihuacan, La Quemada, La Ferrería, and Pueblo Grande) in different ecological regions. Our results demonstrate that isotope ratios of leporid bones faithfully predict environmental types and indicate their usefulness for studies seeking to reconstruct environmental conditions of ancient human settlements and early hominin sites.

Questioning Disability: Physical Impairment, Disabled Identities and Deviant Burial in Late Roman Britain

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Human skeletal remains provide a unique opportunity for assessing the social status of the disabled in past contexts, through both evidence for any osteologically-recognisable impairment that they may have possessed and through what their burial can tell us about their social status. This poster examines the relationship between physical impairment and disability (as a form of social status relating to impairment) through the burial record of Late Roman Britain (3rd-5th C. AD.). Physically-impaired individuals have been associated with a variety of types of 'deviant' burial, both in Romano-British contexts and elsewhere in the archaeological literature, as a sign of presumed social ostracisation from their communities that correlates with a concept of disability. Such assertions however have typically relied on individual case-studies. This poster demonstrates that when viewed comparatively through a burial sample of 3000 individuals (both impaired and non-impaired), it is difficult to recognise consistent practices of deviant burial for individuals with the same or similar types of impairments that would constitute a consistent recognition of disability as a cause for this treatment. It will be shown that rather than using impairment/disability as the sole factor through which to view deviant burials when they occur, we must carefully consider social factors in relation to the age and gender of the individual, and how their impairment may have been perceived by others in relation to life-course based expectations. This approach demonstrates a more nuanced way of examining impairment in the past that can inform current debates on disability.

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New data on Late Upper Paleolithic upper limb cross-sectional geometry from Arene Candide: implications for Tardiglacial hunting practices

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European Late Upper Paleolithic people display levels of bilateral asymmetry in humeral mechanical strength comparable to professional tennis players. This highly-characteristic trait has been associated with the use of throwing weapons to "kill at a distance", an activity that likely required extensive training that began at a young age. Previous studies have pooled European samples to increase sample size. This pooling may have masked regional behavioral

variation associated with the fragmentation of populations during the Tardiglacial period (ca. 16-10,000 BP). We collected new data on upper limb (humerus and ulna) bilateral asymmetry for torsional robusticity (via cross-sectional geometry) on four adult males (AC 2, 3, 4, 12) and one adolescent (13 y.o., AC 16) from Arene Candide (northwestern Italy). Results indicate that all adult individuals show high levels of mid-distal humeral bilateral asymmetry (40% to 110%). Ulnar asymmetry was less pronounced (50% in two individuals, 5% in the remaining two). Despite the expectations of an early onset of throwing behavior, the adolescent individual displayed low humeral (12%) and ulnar (16.5%) asymmetry. Conversely, an adult with congenital x-linked hypophosphatemic rickets displayed high humeral asymmetry (40%). The genetic disorder affecting this individual resulted in low stature, diffused enthesopathies, and bowing deformities, which likely affected his ability to perform high-mobility tasks. Yet, results are suggestive of highly-asymmetrical upper limb torsional loadings, which may indicate participation in throwing behavior. The study of functional adaptations of physically-impaired prehistoric individuals may contribute to the understanding of how they integrated into the subsistence practices of their group.

Do longer limbs translate into a reduced cost of transport? A study of locomotor performance and gait in the Longshanks mouse

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Primates must travel in order to acquire the resources necessary to support life. Traits that improve locomotor performance, for example by reducing the energetic cost of ranging, may lead to a larger net energy intake, and thus may be favored by natural selection. One such trait is limb length: Previous functional studies, mostly among species, have shown a negative relationship between limb length and the energetic cost of transport (COT). However, the potential confounding effects of intra- and interspecific variation in other anatomical and behavioral factors in these studies make this relationship less straightforward. We investigated this relationship in the Longshanks mouse, a unique line selectively bred for increased relative tibial length. The Longshanks mouse has on average 13% longer tibia relative to body mass compared to a random-bred control cohort. We tested the hypothesis that the Longshank mouse would have a lower COT, mediated in part by increased stride length. Longshanks (N=22) and control mice (N=23) ran on a metabolic treadmill at three different speeds while oxygen consumption was monitored. The same mice also ran on a treadmill for gait analysis, which provided gait parameters

including stride frequency and stride length. Results show that COT is reduced by ~8-10% in Longshanks vs control mice. In addition, Longshank mice had increased stride length (+7-9%) and lower stride frequency (-6-8%). These data confirm the relationship between limb length and locomotor performance within quadrupedal species, with implications for the evolution of limb length diversity in primates.

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Are terrestrial siamangs left or right handed?

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Recent studies have demonstrated strong hand preferences for complex bimanual tasks in a wide variety of non-human primates. When extracting peanut butter from a tube terrestrial primates show a consistent preference for the right hand whereas arboreal primates are consistently left-handed. It has been hypothesized that when terrestrial primates are released from having to use their right hands for balance or hanging, they shifted to right-handedness. To determine whether handedness is learned by arboreal animals as they forage and move in the trees during their developmental years, or whether it is an innate hard-wired instinct that has been selected for in arboreal species, we studied handedness in a family of captive and predominantly terrestrial siamangs (adult couple and their two offspring) at the El Paso zoo. The family of four were all born and raised in captivity. In the wild siamangs are exclusively arboreal and left-handed for a complex bimanual water dipping activity (Morino, 2011). If handedness is innate, then left-handedness should be expressed in the El Paso siamangs in spite of their terrestriality. Handedness data for five complex bimanual activities was recorded from videos and photographs of the El Paso siamangs taken from 2006-2014. We found that, like their wild relatives, the El Paso siamangs are left handed and their handedness was consistent through time. Handedness was not consistent in the juveniles, shifting from a slight right to slight left preference from year to year. We concluded that handedness is innate rather than learned.

Environmental Variables Affecting Primate Species Richness in the Neotropics

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We examined the effects of altitude and climatic variables on platyrrhine primate species richness

for 248 localities in Central and South America with species richness ranging from zero to fifteen sympatric primate species. Altitude and climate variables (mean annual precipitation [MAP], precipitation of the wettest and driest months, mean annual temperature [MAT], temperature of coldest quarter, and seasonality in rainfall and temperature) were compiled using georeferencing software QGIS, on a 1 km-square grid from WorldClim- Global Climate Data. Species richness data was compiled from recent literature surveys supplemented by our own data. Within the tropical zone, primate richness increases with increased rainfall up to approximately 2500 mm of rainfall, beyond which it is asymptotic, or even slightly declines. Considering all variables in a Principal Components Analysis of tropical localities, factor-loadings show that richness is most strongly and positively associated with MAP and MAT whereas seasonality in temperature and rainfall and altitude are negatively associated with richness. Outside the tropics, species richness declines with increased latitude, following the same factors but with the added factor of temperature seasonality as a negative effect. Temperature seasonality appears to be the most significant factor limiting southerly primate distribution.

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Biodistance analysis of US/Mexico migrants

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Studies utilizing skeletal data with known population histories have the ability to elucidate patterns of population structure and inform studies of migration. Migration across the US/Mexico border results in many apprehensions and deaths that suggest several interesting patterns, namely that the two largest migrant corridors, Arizona and Texas, have migrant groups with different countries of origin. Most migrant apprehensions in Arizona are from Mexico as compared to Texas where most apprehensions are from Honduras, El Salvador, and Guatemala, followed by Mexico. The purpose of this presentation is to utilize biodistance analyses of Arizona and Texas migrant deaths to further inform studies of migration.

Thirty cranial landmarks were collected from Arizona migrants (n=145), Texas migrants (n=13), and Guatemalans (n=75) and subjected to a General Procrustes Analysis, followed by a canonical variates analysis to generate Mahalanobis distances. Guatemalans are included to represent another known migrant group. Results indicate that all groups are significantly different from one another and that the Texas migrants are the most differentiated