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### Canine integration and modularity in a sample of pedigreed *Papio hamadryas*

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Multiple hypotheses address the selective pressures driving primate canine size evolution, as well as the evolution of canine size dimorphism. Historically important ideas posit that canine size should co-evolve with the size of either the incisors or postcanine teeth. However, few studies have considered the covariance of canine size with other dental modules within species and none have assessed the genetic covariance between canine height and incisor and postcanine size. To test the hypothesis that the canine represents a discrete dental module, 17 linear measurements were collected from casted maxillary dentitions of a *Papio hamadryas* sample (females,  $n = 321$ ; males,  $n = 138$ ) for which pedigree information is available. Phenotypic integration was assessed using partial correlations, measuring the degree of association between dental measurements after the effects of sex had been removed. Genetic correlations were estimated using an animal model with sex as a fixed effect. Both phenotypic and genetic correlation matrices show similar patterns and, corroborating previous studies, both reveal an incisor module and a postcanine module, consisting of two submodules. A semi-independent canine module is also apparent, although canine height shows low genetic covariance with other metrics. In addition, this sample shows the highest covariation between homologous dimensions (i.e., length, breadth) among teeth within each module. These results indicate that canine size evolution, particularly canine height, is relatively unconstrained from changes to either the incisor module or the postcanine module.

### Mortality risk and survival in pre- and post-Black Death Denmark

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Previous bioarchaeological research on medieval London populations revealed declines in survivorship before the Black Death (c. 1347-1351), followed by improvements in survivorship following the epidemic, perhaps due to historically documented improvements in standards of living. While these findings have been repeatedly demonstrated among London populations, mortality risks and survival in pre- and post-Black Death populations in other medieval populations are not well understood. This study examines differences in survivorship and mortality risk between

pre- and post-Black Death populations throughout medieval Denmark by applying Kaplan-Meier analysis and Cox proportional hazard analysis to nonadult and adult age estimates and controlling for changes in birth rates. We use skeletal samples from medieval cemeteries from Jutland and Funen dated to one of three periods based on arm burial position: Early Pre-Black Death (c. 1050-1250), Late Pre-Black Death and Epidemic Years (c. 1250-1350), and Post-Black Death (c. 1350-1536). The results indicate that survivorship for all individuals (all ages pooled) decreased prior to the Black Death and increased afterwards ( $p = 0.06$ ) while there were no significant differences in birth rates; similar results were found for a subsample that included only nonadults ( $p = 0.02$ ). Male survivorship appeared to improve more than females after the Black Death. Comparison of the survivorship curves across time periods further suggests that the Black Death may have acted selectively on frail individuals. These results support that there were significant differences in survival and mortality, but not birth rates, between time periods in medieval Denmark similar to populations in medieval England.

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### Temporal variation in Carabelli's trait frequency and lactase persistence

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Dental morphology is frequently utilized in biological anthropology to explore human migration and evolution as a proxy for genetic information. While single nucleotide polymorphisms of the EDAR and WNT10A genes have been shown to influence dental morphological variation, the genetic mechanisms underlying dental phenotype frequency and expression remain unknown. Mizoguchi (1993) identified an association between Carabelli's trait expression and the consumption of milk, suggesting that common underlying genetic factors may be at play. Here, we examine whether temporal changes in Carabelli's trait frequency coincide with the prevalence of the European lactase persistence allele (-13,910\*T). Since the British Isles exhibits the highest frequency of this allele (~85-95%), we focus our analyses here.

Data on Carabelli's trait were collected from the literature spanning nine temporal periods (Late Pleistocene/Early Holocene, Neolithic, Bronze Age, Iron Age, Romano-British period, Early Christian period, Medieval period, Postmedieval period, and Modern period). A Kruskal-Wallis test and a Dunn's

post-hoc test were conducted to test for temporal differences. Due to a lack of region-specific data on temporal lactase persistence allele variation, published data were compiled from Europe.

Genotype data show that the derived lactase persistence allele only becomes prevalent (~70%) in Medieval Europe and thereafter. Similarly, Carabelli's trait frequency increases during the Postmedieval and Modern periods ( $p < 0.05$ ). These results tentatively confirm the apparent covariation previously highlighted by Mizoguchi (1993), and suggest a complex evolutionary past for dental morphological traits. Future studies will explore the exact genetic mechanism underlying lactase persistence and Carabelli's trait expression through a genome-wide association study.

### Taxonomic Efficacy of the Macaque Skeleton

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Taxonomic classification is fundamental for understanding the natural world, yet current methods for unknown species assessment are based on qualitative methods and focused on craniodental morphology. It is currently unknown how much variation could, or should, exist within a particular genus. Here, we tested whether taxonomy can be accurately predicted from patterns of morphological variation in a geographically widespread taxa, the macaques ( $H_1$ ) and whether postcranial bones reflect subgeneric taxonomy similarly, or better, than the cranium ( $H_2$ ).

Data included 3D scans from nine species (*M. arctoides*, *M. fascicularis*, *M. fuscata*, *M. mulatta*, *M. nemestrina*, *M. nigra*, *M. radiata*, *M. sylvanus*, and outgroup *Trachypithecus cristatus*), for a sample of 297 individuals. Macaque species were chosen for their phylogenetic diversity and their geographic representation. 293 fixed and semi-landmarks were applied to eight skeletal elements for each individual (crania=45; mandible=31; scapula=66; humerus=38; radius=33; os coxa=28; femur=40; tibia=40). A regression analysis was performed to minimize the effects of sexual dimorphism, making the primary input variables regression residuals.

Patterns of variation were analyzed between- and within-species via Canonical Variates Analysis and 2D Multidimensional Scaling. Classificatory ability was tested using Discriminant Function Analysis. Results suggest that different species of macaque monkeys are taxonomically distinct and that the crania and postcrania possess a taxonomic signal. Some bones, like the limb bones, were more useful taxonomically than

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previously realized. Results suggest that taxonomic assessment should be updated to reflect newer methodologies and we argue that these results should inform future studies.

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### Exploring the use of portable X-ray fluorescence (pXRF) for the identification of pathological archaeological bone

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The accurate identification of pathological conditions in human skeletal remains is crucial for building an understanding of the past—contributing information about living environment, health, and societal structure. This study assesses the utility of using portable X-ray fluorescence (pXRF), a rapid and non-destructive method of trace element analysis, in the investigation of pathological conditions in archaeological human skeletal remains. The elemental distribution in the femora of 99 individuals (34 adult; 63 non-adult) from the Post-Medieval Coach Lane skeletal collection (Durham University, UK) was determined, and the results examined in relation to rickets, scurvy, cribra orbitalia, and pathological new bone formation. Scatterplots revealed no observable patterns correlated with rickets, scurvy, or cribra orbitalia. Femora with pathological new bone formation had increased levels of geologically abundant elements (silicon, potassium, titanium, aluminum), and decreased phosphorus and calcium values, relative to bones without. There was a strong linear correlation between these elements ( $\text{Si/P: } r = -0.84, p < 0.05$ ), suggesting the post-depositional exchange of elements. Single cases of “phossy jaw” and neoplastic disease, as well as suspected occurrences of tuberculosis, smallpox, and syphilis, were noted in the sample, with potential alterations in bone chemistry observed for syphilis and neoplastic disease. The complexity of interconnected factors contributing to the elemental content of bone prevents definitive conclusions about the sources of elemental variation. Although the results of this study do not support adding pXRF to the current repertoire of palaeopathological diagnostic techniques, further research could provide greater clarity about its potential use.

### The influence of lunar phase on circadian rhythms in a mobile, non-industrial population: Sleep analysis from a community of BaYaka foragers from the Congo

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**Background:** Accounts in Western contexts have linked many human behaviours to the phases of the moon, including restlessness and increased nighttime activity. However, little research on whether moon phase affects sleep patterns has been conducted in foraging populations, whose subsistence practices lead to high levels of environmental exposure. Thus, their sleep may be more influenced by nighttime light exposure. We investigated sleep in the BaYaka, a forager population in Republic of the Congo.

**Methods:** Participants' sleep was measured when they lived in a higher density village setting, as well as a forest camp setting. Objective actigraphy devices were worn for ~7 days each setting ( $n=362$  nights total). Lunar phase data was obtained from the Astronomical Applications Department of the US Navy. We conducted a linear mixed-effects model to determine if sleep variables were influenced by lunar phase. Additionally, we investigated sex differences in central phase measure (CPM), the midpoint of main sleep periods, to assess the potential influence of gender roles in nighttime subsistence activities.

**Results:** A greater lunar phase predicted a later CPM ( $\beta$  estimate = 0.119,  $p < 0.05$ , CI: 0.0012, 0.236). Additionally, CPM was phase delayed in men ( $\beta = 0.112$ ,  $p = 0.05$ ), indicating a later chronotype that could suggest gendered patterns of nighttime hunting or social activities

**Significance:** These findings suggest a link between lunar phase and circadian sleep patterns in subsistence foragers, perhaps reflecting increased activities during greater lunar phases. These results provide insight into the moon's potential influence on human social behaviour.

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### Post-impressionistic Age Estimation? Quantitative analysis of pubic symphysis complexity, curvature, and relief for age-at-death estimation

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Age-at-death estimation of skeletal remains is a foundational procedure for reconstructing individual identity and mortality in past and modern populations, and to diagnose age-specific diseases. Recent efforts to mitigate the inherent subjectivity involved with macroscopic age estimation have improved the accuracy and reliability of these estimates using Geometric Morphometric (GM) algorithms and digitized surfaces generated by widely accessible optical scanners. Prior GM aging methods based on (semi)landmark shape analyses on digitized symphyses have reduced within-/between-observer error and increased repeatability in age estimation. Nevertheless, these methods suffer from decreasing age-informative power past mid-life.

This project quantifies three homology-free topographic variables on the symphyseal surface of the pubis and evaluates their usefulness as bony correlates of age-at-death. We analyzed 3D digitized surfaces of the ( $n=56$ ) Suchey-Brooks standard and instructional pubic symphyseal cast sets, and recorded three surface topography metrics that characterize the complexity, curvature, and relief of the symphyseal face; Dirichlet Normal Energy (DNE), Relief Index (RFI), and rotated Orientation Patch Count (OPCr), respectively. Preliminary analysis using linear regression models suggests that statistically significant relationships exist between age-at-death and the three metrics ( $r \approx 0.7$  to  $0.7$ ;  $p < 0.05$ ). R-squared values indicate that 20-50% of this topographic variation can be explained by age. However, DNE requires a drastic truncation of the young or old age groups (i.e., below 30 years or over 50 years). These results demonstrate the three metrics' utility as non-traditional, objective, and quantitative proxies of age-related change of the symphysis when used in combination with other measures/age indicators.

### Critical Pedagogy in the Online Environment

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Current research into pedagogy has shown that teaching is not just the dissemination of information. Furthermore, we know that learning happens best in interactions with others. At the same time, it seems that connection with others is more challenging in a totally remote digitally mediated environment. The work of critical digital pedagogy, an extension of Paulo Freire's observations that “There is no such thing as a neutral educational process”, can help to connect students and professors. Scholars spend countless hours critiquing our science and scholarship, but we rarely examine our work in the classroom in the same manner. Because of this, and in light of the so-called ‘pivot’ to online learning necessitated