An interspecific comparison of variance in sex-based developmental markers

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INTRODUCTION

Sexual dimorphism varies with the degree of male-male competition among anthropoid primates (Dixson, 2009). Changes in relative body size of both sexes are well known during ontogeny, but less is known about how osteological developmental markers vary under differing levels of sexual selection. The intensity of male-male competition is reflected in a species' body size sex ratio: humans (*Homo sapiens*) have been reported to have a 1.2 ratio, while rhesus macaques (*Macaca mulatta*) have a ratio of 1.6 (Dixson, 2009). We predict greater directional selection for larger bodies and canine size in macaque males compared to macaque females and humans. We also predict this selection results in greater growth marker variation among macaque males than in these other groups.

METHODS AND MATERIALS

- We documented dental eruption and epiphyseal fusion in 292 *M. mulatta* skeletal specimens. See **Figure 1** for protocols (based on Cheverud, 1989; Harvati, 2000)
- We compared our macaque data to more than 25,000 human individuals using published human population data.
- We compared raw variance, between markers of developmental markers
- We then analyzed the level of variation between sexes within each species.

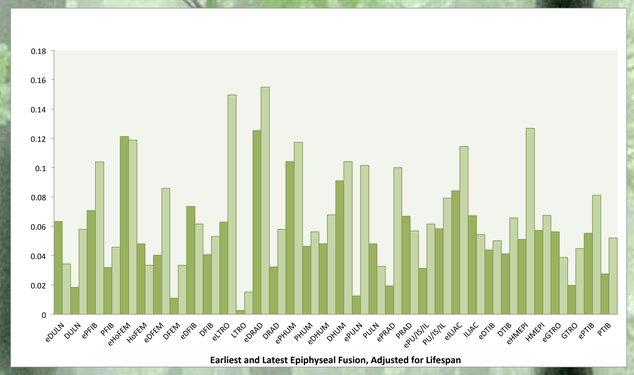
Eruption and Fusion Scoring Methods, Figure 1

Fig. 1: (Left) Degree of eruption (1-4) as illustrated by the third molar. (Right) Degree of fusion (0-2) as illustrated by the first metacarpal.

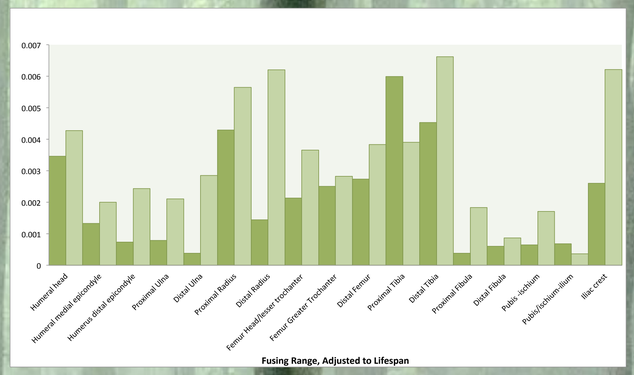
RESULTS

The variances among samples are compared. Our data shows that humans are more variable than macaques, in every case. The data are not comparable by F-tests. Data constraints from published literature reveal a lack of reported variance in populations. However, it is possible to compare raw variance, as shown. In all permanent teeth, the degree to which humans are more variable than macaques is different by two orders of magnitude. However, within species, between sexes are not significantly different to one another ($p > .05$, for all comparisons between sexes). While the actual age of eruption and fusion varies between the sexes, in both species, the variation in our samples is the same per sex on equivalent measures. Our initial hypothesis was not supported. Males were not significantly different to females on any measure, even the canine teeth.

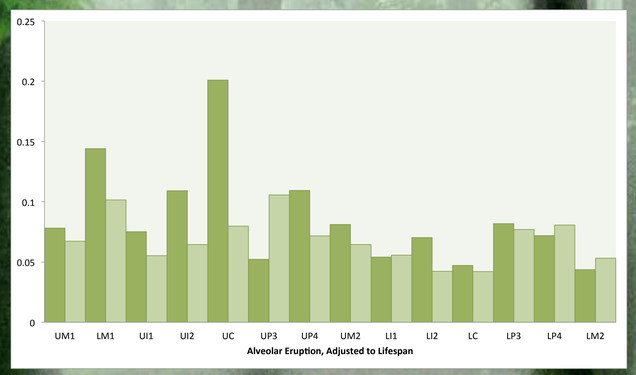
Variance in *H. sapiens* Epiphyseal Fusion, Figure 2



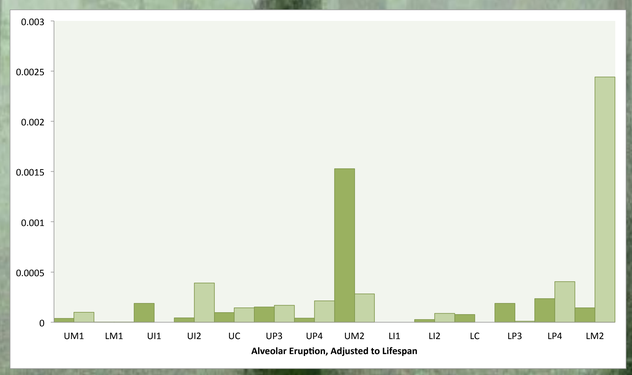
Variance in *M. mulatta* Epiphyseal Fusion, Figure 3



Variance in *H. Sapiens* Permanent Dental Eruption, Figure 4



Variance in *M. mulatta* Permanent Dental Eruption, Figure 5



Graphs Key

Male: Dark Green

Female: Light Green

CONCLUSION

The results do not support our initial prediction that macaque males would show the greatest variation in these growth trajectory markers. Males are bigger in both species, but that difference is not necessarily being caused by differences in growth variance. For future studies, more data is necessary for making robust comparisons between species, especially in common developmental markers like dental eruption and epiphyseal fusion. Interspecies comparisons of developmental plasticity such as this study allow for valuable inferences on how growth variance is affected by sexual selection.

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