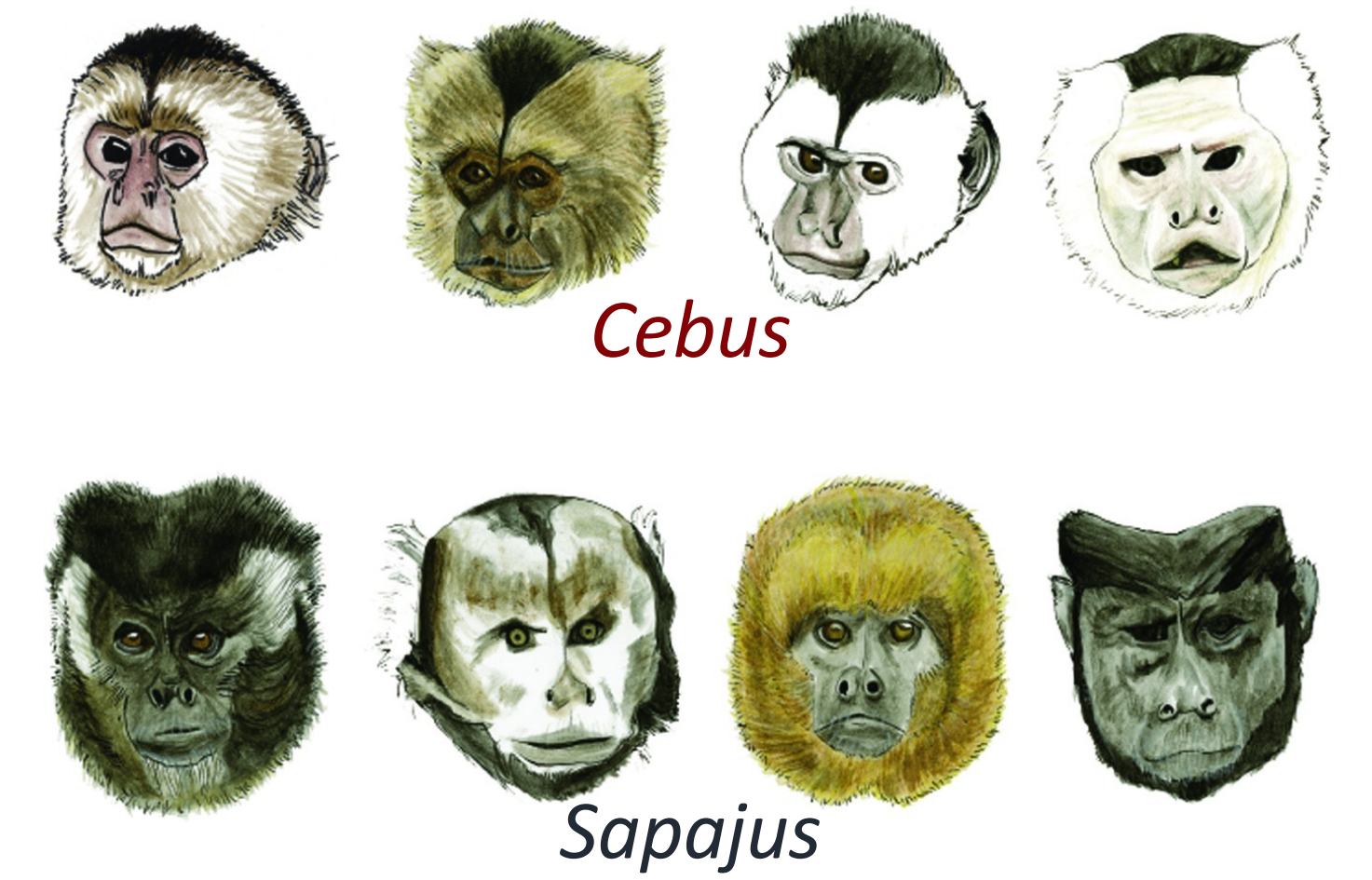


# Interspecific and ontogenetic differences of hyoid body shape in tufted vs. untufted capuchins



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**INTRODUCTION:** The hyoid is central to critical functions such as breathing, mastication, swallowing, and vocalization. However, the relationships between these functions and the shape of the hyoid remain unclear. A previous study in macaques posits that hyoid body shape is tied to ontogenetic changes in vocalizations (1). Others have highlighted the role of the hyoid in mastication and swallowing, suggesting that vocal behavior alone may not fully explain hyoid morphology (2, 3). These studies have either looked at broad variation of the hyoid across primates or focused on a single taxa. None have examined differences in hyoid shape between closely related taxa with documented dietary differences. **Here we quantify shape differences of the hyoid body between tufted (*Sapajus* spp.) and untufted (*Cebus* spp.) capuchins in an ontogenetic sample.**

## MATERIALS AND METHODS

- Hyoid bodies were segmented from soft-tissue microCT scans of 31 *Sapajus* and 20 *Cebus* specimens in Avizo.
- Sex was assigned to specimens where adult canines were visible
- Specimen ages were seriated by dental eruption and wear, with the second deciduous premolar in occlusion in the youngest specimens.
- 200 3D sliding semilandmarks placed across the surfaces of the hyoid bodies using Auto3DGM (4)
- Geometric morphometric methods (PCA, ANOVA, regression) were used to compare shape differences

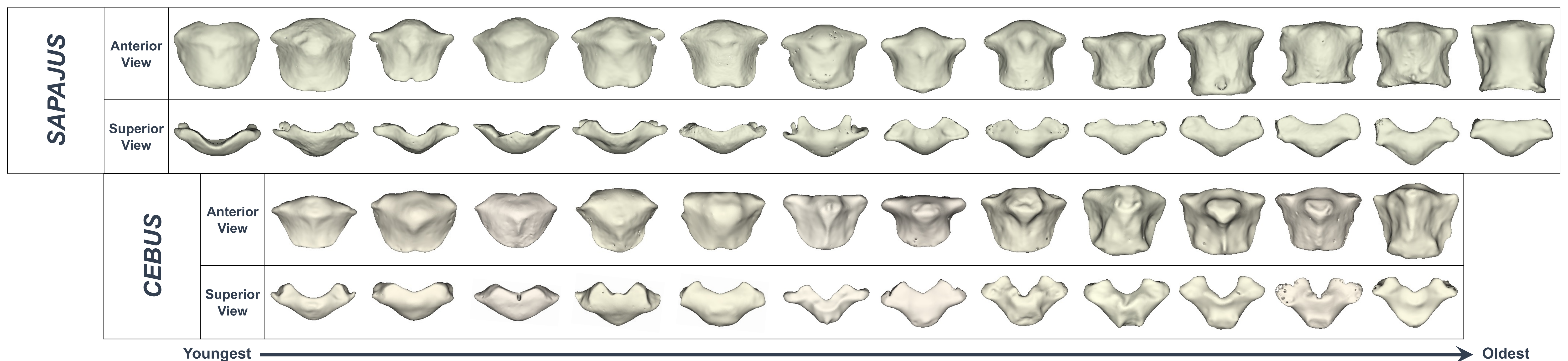


Fig 1. Anterior and superior views of hyoid bodies for *Sapajus* (31) and *Cebus* (20) specimens at similar dental ages with the oldest and youngest for each genus included.

## RESULTS

- Significant interspecific differences in hyoid shape ( $p=0.001$ )
  - Adult *Sapajus* hyoid bodies are larger and wider with smooth, less projecting anterior surfaces
  - Adult *Cebus* hyoid bodies are smaller, taller and dorsoventrally deeper, resulting in a more concave shape
- No evidence of hyoid sexual dimorphism in either genus ( $p=0.202$ )
- Significant differences in the relationship of size and shape between *Cebus* and *Sapajus* ( $p=0.016$ )
  - Cebus* deepens while *Sapajus* widens

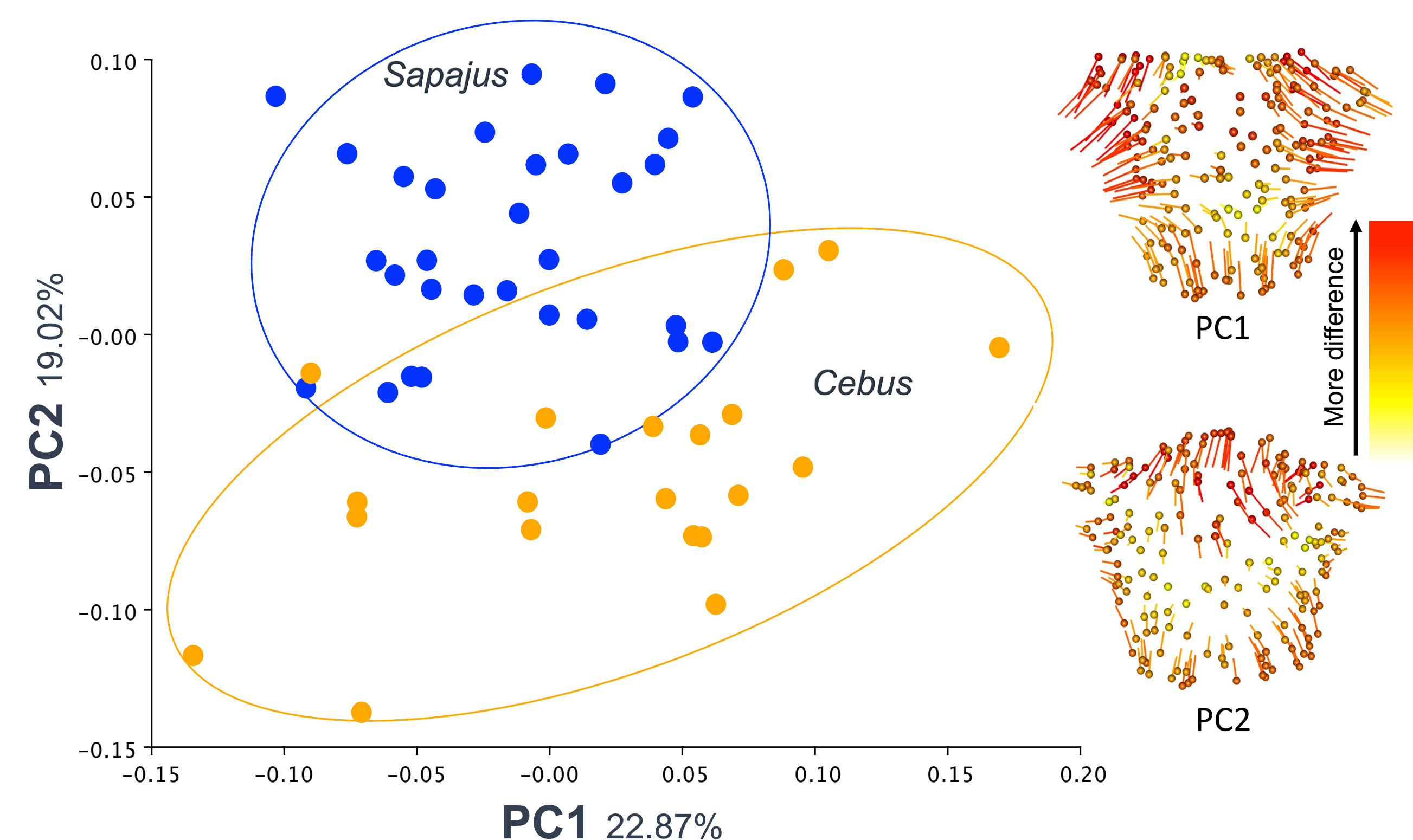


Fig 2. Bivariate plot of PC1 and PC2 showing distributions for *Cebus* and *Sapajus*. Heat-maps showing positive to negative landmark changes for both PC1 and PC2 are also included, where greater changes between landmarks are redder and fewer changes are more yellow.

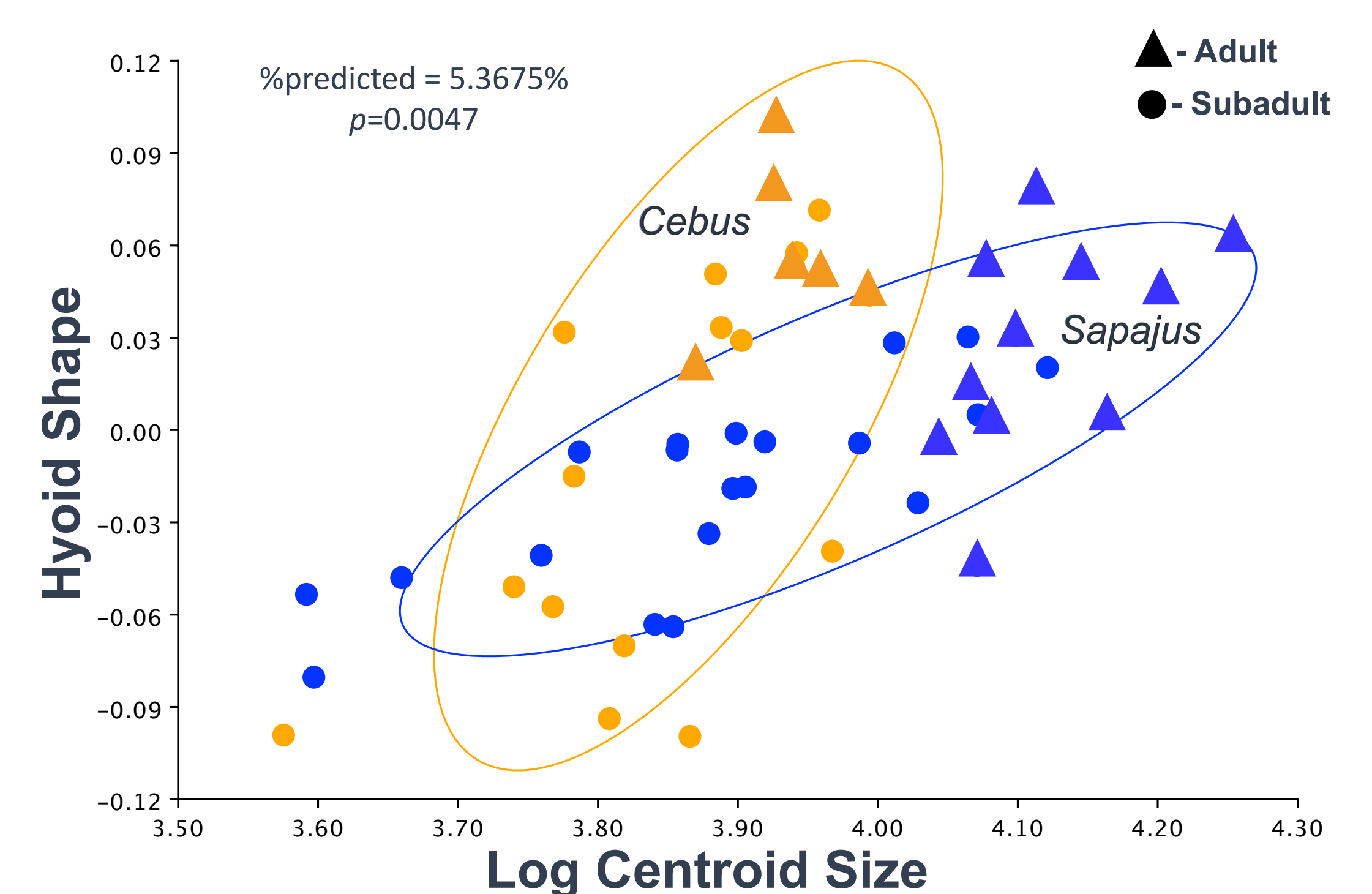


Fig 3. Regression of log transformed centroid size and hyoid body shape showing a difference of shape changes related to growth.

**DISCUSSION:** We observe notable differences in hyoid shape in *Sapajus* vs. *Cebus*. Some of these may be related to differences in size and attachment of the suprahyoid musculature, which attach the hyoid to the masticatory apparatus. We also found that the relationship between hyoid shape and size differ between *Cebus* and *Sapajus*, suggesting ontogenetic differences between the genera, where *Sapajus* becomes wider as size increases, while *Cebus* becomes dorsoventrally deeper. Such morphological differences in hyoid shape may reflect age-related behavioral and ecological differences in dietary niche exploitation and/or vocalization. Therefore, future analyses will focus on using dietary and vocal behavioral data to explain hyoid body shape differences between these two taxa.



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