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Collaborative Research: Integrative Analysis of Ingestive Biomechanics and Dental Microwear in Evolutionary and Ecological Context

This proposal integrates behavioral, ecological, experimental and engineering methods to test hypotheses about the biomechanics of ingestion and the causes of microwear in primates, with implications for hominin evolution. Although masticatory biomechanics is often invoked as an important selective pressure in primate (including human) evolution, less attention has been paid to ingestive biomechanics, defined here as the mechanics of a broad class of behaviors usually involving the incisors, canines and premolars that are often associated with preparing large food items for processing by the postcanine teeth. We propose to undertake an integrative analysis of ingestive biomechanics in four closely-related primate species that vary in diet and ingestive behavior, and that can be examined both in the laboratory and in the wild.

In doing so, we test several hypotheses relating ingestive behaviors to cranial and mandibular functional morphology in primates. Moreover, we develop an explicit framework for assessing the relative importance of different feeding behaviors by calculating the cumulative strain value associated with each behavior. The use of this metric is transformative in that it allows us to formulate and test hypotheses with greater precision than previously possible.

We also test competing hypotheses about the causes of microwear. One hypothesis is that microwear pattern formation is influenced primarily by the material properties of the foods being consumed. An alternative hypothesis is that microwear feature formation depends critically on the geometry and hardness of abrasive particles that are consumed along with foods. Evaluation of these hypotheses has the potential to transform our understanding of early hominin diets, insofar as microwear is considered one of the pillars of paleodietary reconstruction. We will test these hypotheses experimentally under laboratory conditions, and also by gathering and testing the mechanical properties of foods and adherent abrasives in habitats similar to those inhabited by primate specimens from which we will collect microwear data.