

FUNCTIONAL VS. PHYLOGENETIC CONTROL IN THE EVOLUTION OF THE VERTEBRAL COLUMN

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In the evolution of morphology, the importance of both historical constraints and selection for adaptive design has been widely acknowledged, but the relative efficacy of these internal (historical or phylogenetic) and external (selective or functional) factors has been much debated. Innumerable examples can be selected to make a case either way, but disinterested evaluation requires study of instances in which the relative degrees of functional and phylogenetic control are not already known. The vertebral column is an appropriate case: as the central structure for vertebrate locomotion and support, it ought to be subject to strong selection for functional design, yet it is also deeply generatively entrenched in vertebrate development, and therefore, arguably, ought to be less plastic than other structures.

For this analysis, I applied three shape metrics to the vertebral column. The metrics are univariate and measure shape as functions of degree of differentiation within a column. (The metrics were developed in another context as measures of morphological complexity.) Then, a series of tests was conducted: in each, mean shape values for a group of functionally similar mammals (e.g. aquatics) and values for a group of phylogenetically related mammals (e.g. carnivorans) were compared independently with values for a test case, a mammal which belongs to both groups (e.g. aquatic carnivoran, otter). In almost all instances in which differences in resemblance were significant, the test cases more closely resembled their functional kin than their phylogenetic kin, suggesting a predominance of functional control. Results of standard cluster analyses (unweighted-pair-group method) supported this conclusion.