HIERARCHICAL FACTOR ANALYSIS AND THE DERIVATION OF PHYLOGENETIC SKULL SHAPE CHARACTERS IN CANIDS

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Character independence is an important assumption in parsimony-based phylogenetic analysis. For taxa with extant representatives, the analysis of within-species covariation of quantitative characters provides a basis for assessing character independence. One promising approach is to use mean species scores on factors of within-species covariation as phylogenetic characters, but the use of common morphometric factor models leads to problems with either the independence or the interpretability of such characters. Principal components and principal factors, whether rotated or not, may be constrained to be orthogonal but may be difficult to interpret since the effects of each factor are spread over all variables. In Wright-style factor analysis the restriction of secondary factors to subsets of variables facilitates their interpretation, but the factors may be highly correlated.

An alternative approach is to adopt a hierarchical factor model in which correlated first-order factors are restricted to subsets of the variables. Size is modelled as a second-order factor inducing correlation of the primary factors, in contrast to the common morphometric procedure of attempting to partial out size in the first stage of analysis. The size-independent components of the primary factors provide shape characters which are interpretable as the deviations of regional growth from their predictions based on size. Hierarchical factor models have been widely used in psychometric studies since their introduction by Thurstone in the 1930's, but have been little used in morphometric analyses.

The hierarchical model is applied to the covariances of interlandmark trusses measured on skulls of extant canids using a video-based stereophotogrammetric system. Preliminary results indicate that the canid skull may be partitioned into discrete regions of relatively independent local growth.

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