A30 Decision Trees and Non-Metric Traits: A More Accurate Approach for Sex Estimation of the Skull

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After attending this presentation, attendees will gain an appreciation for the use of different combinations of non-metric traits of the skull and the utility of predictive decision trees. Combined, these approaches provide a more accurate and simpler method than has traditionally been used by anthropologists.

This presentation will impact the forensic science community by providing a modified scoring system and data manipulation approach that performs variable selection to achieve maximum accuracy with sex estimation. Decision trees are an attractive statistical approach as they can handle numeric and categorical data and do not require normal distributions. As the non-metric scoring systems so often implemented by anthropologists often encompass these parameters, this approach can be incredibly useful.

The use of non-metric categorical scoring methods to estimate sex in skeletal remains is frequently implemented by forensic anthropologists. Traits of the skull have long been a staple in building the biological profile and associated methods are almost always cited in official reports. The most commonly used method of determining sex from the skull is an ordinal scoring system developed by Walker.[1] Despite its widespread use by practitioners, validation studies have indicated that all traits are not equally useful in sex estimation.[2-4]

Low accuracy rates have been attributed to high variability, inadequate categories, and/or definitions for specific traits. Despite obvious flaws with the Walker traits, few proposals have offered a solution to improve the system. Using the decision tree approach allows for quantification of the predictive power of included variables and provides insight into which traditional non-metric traits may not be of value.

Six cranial traits were scored on 220 American skulls of European descent (n=110 males and 110 females) from the UT William M. Bass Donated Skeletal Collection. The traditional variables of the nuchal crest, mastoid process, supra-orbital margin, glabella, and mental eminence were implemented. Additionally, the zygomatic extension was also included, which is often absent in previous studies. Ordinal scores for each variable were partitioned into training and validation samples and decision trees were created using the Rattle graphical user interface available in R.[5,6]

Preliminary results indicate that high correct classification percentages can be reached with smaller subsets of variables. Glabella was one of the most important discriminatory variables, while the mental eminence showed little significance. This supports the results of recent, related publications. Correct classification percentages were reported at 89%-90% for the validation sample, even when using only one or two traits. Further analyses with larger sample sizes and the possible inclusion of newly defined traits will indicate ultimately what combination of variables can simultaneously maximize prediction and reduce user error. As it has been shown by many studies (including the current work) that the mental eminence shows high levels of variability and low predictive power for sex estimation, it is argued that the trait and scoring method should be redefined in such a way that accounts for the range of morphologies often seen between and among the sexes. Additionally, further expansion on the results reported in this study will include more samples that are representative of other ancestries and thus have more relevance for forensic contexts.

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