



Physical Anthropology Section – 2006

H6 Selection of Variables for Discriminant Analysis of Human Crania for Determining Ancestry

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The goal of this presentation is to present to the forensic anthropological community the value of using non-standard instruments in the analysis of unidentified human crania.

This presentation will impact the forensic community and/or humanity by suggesting that biological anthropology laboratories purchase radiometers and coordinate calipers to record data that would be missed with spreading and sliding calipers. Standard measurements can be combined with nonstandard measurements to produce more powerful discriminant function formulae for the prediction of ancestry.

Forensic anthropologists use the computer program FORDISC 2.0 (FD2) as an analytical tool for the determination of ancestry of unknown individuals. There are an almost endless number of measurements that can be taken on the human skeleton, yet FORDISC includes only 78 measurements for its analysis. In particular, the program will only utilize up to 24 measurements of the cranium. These 24 cranial variables are used because they require simple, relatively inexpensive instruments that most biological anthropology laboratories have (spreading and sliding calipers). Also, individuals with a basic knowledge of the anatomical landmarks can take the measurements with relative ease. Unconventional measurements of the cranium require unusual, costly instruments (such as the radiometer and coordinate caliper) and are more difficult to take. This poster will examine which measurements of the human cranium provide the greatest classificatory power when constructing discriminant function formulae for the determination of ancestry and will answer the question of whether the use of variables that require more time, training, and equipment are worth the effort.

Sixty seven cranial measurements were taken on 155 adult human crania from three different ancestral groups: (1) African American (n=50), (2) European American (n=50), and (3) Coyotero Apache (n=55). The 67 measurements were broken up into four subsets for statistical analysis: (1) FD2 (1996), (2) Howells (1973), (3) Gill (1984), and (4) All Measurements. A predictive discriminant analysis with a forward stepwise methodology of $p = 0.05$ to enter and $p = 0.15$ to remove was run using the computer software package SPSS 13.0. The analysis produced four sets of discriminant function formulae. The classificatory power of each set of formulae was determined by comparing the hit-rate estimation (the percent correctly classified) of each of the subsets. First, the resubstitution rate was compared to the leave-one-out (LOO) rate for each subset and then both rates were compared across all subsets. The FD2 subset had a resubstitution rate of 91% and LOO rate of 85.8%. The Howells subset had a resubstitution rate of 96.8% and a LOO rate of 94.2%. The Gill subset had a resubstitution rate of 64.5% and a LOO rate of 62.6%. Finally, the All Measurements subset had a resubstitution rate of 94.8% and a LOO rate of 93.5%. The non-standard measurements of the Howells subset performed the best and the standard FD2 measurements performed third best. Nonstandard measurements incorporated in the Howells formulae included frontal subtense, zygoorbitale radius, biasterionic breadth, occipital fraction, and prosthion radius.

The formulae provided the best separation of the Apache group from the other two groups. Stepwise analysis showed that the use of more variables is not necessarily better. Not all of the variables were included in the final formulae. Only 12 of the 24 FD2 measurements, 18 of the 61 Howells measurements, 4 of the 6 Gill measurements, and 14 of the 67 All Measurements were used. Results show that the non-standard measurements can be useful for determining the ancestry of unknown human crania. These measurements could be especially useful for incomplete crania. It is suggested that biological anthropology laboratories purchase radiometers and coordinate calipers to record data that would be missed with spreading and sliding calipers. Standard measurements can be combined with non-standard measurements to produce more powerful discriminant function formulae for the prediction of ancestry.

Ancestry Determination, Discriminant Analysis, Radiometer and Coordinate Calipers