H108 Biological Sex and Ancestry Uniqueness of Fingerprint Minutiae: An Anthropological Approach

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After attending this presentation, attendees will see the potential of focusing on the biological basis of the permanence and uniqueness of fingerprints for maintaining the objectivity inherent to fingerprint comparison.

This presentation will impact the forensic science community by demonstrating that fingerprint development is rooted in biology and, therefore, so is the use of fingerprints as a method of identification.

Dermatoglyphics have been studied extensively in physical anthropology to examine the heritability of friction skin traits and inter-population variation. Within the field of forensic science, dermatoglyphics of the fingers and palms have been used in comparisons to match unknown latent prints to complete prints of known individuals for over 100 years. Though studying the same patterns of friction skin, anthropology and forensic science have considered different variables and research questions. The majority of the previous anthropological studies have tested these population relationships on Level 1 Detail (e.g., pattern type, total ridge count), while forensic scientists focus on individual uniqueness of Level 2 and 3 Detail (e.g., minutiae and pores, respectively). Therefore, the results of anthropological studies are largely irrelevant to latent fingerprint analysis, where identifications are made based on comparisons of Level 2 and 3 Detail. Given the questions raised by the National Academy of Sciences Report of 2009 about the subjectivity of latent print examination, research efforts need to be made to focus on the objective aspect of fingerprints, namely their unique biological development. Using a physical anthropological perspective is one way to do this. The present study applies methodologies developed in physical anthropology for quantifying Level 1 fingerprint traits to Level 2 Detail, and tests whether population, sex, and/or pattern type has a significant effect on the number and type of minutiae. Five types of minutiae were analyzed, which include bifurcations, ending ridges, short ridges, dots, and enclosures, as well as a variable for the sum total of all minutiae. Each type of minutia was visually counted on the right index finger of a total 115 individuals (n = 29 African American ♀; n = 29 African American ♂; n = 29 European American ♀; n = 28 European American ♂). A Multivariate Analysis of Variance (MANOVA) was used to analyze the overall effect of sex, pattern type, and population on the minutiae variables. Results of the MANOVA show that only population significantly affects minutiae (p-value=0.019). In addition, contrast statements in the MANOVA model, as well as canonical correlation, were performed in order to identify which of the minutiae variables are being influenced by the main effect of population and showed that ending ridges and dots are significantly influenced. Logistic regression was used to explore whether ending ridges and dots can be used to classify individuals into ancestry groups. Results show that neither of these minutiae can be used to predict population. The results of this study suggest that fingerprint development is driven by a complex biological system that is influenced by a wide variety of factors, both genetic and environmental. This finding partially explains fingerprint uniqueness and emphasizes the importance of including biology in the process and explanation of fingerprint comparisons.

Minutiae, Sex Variation, Ancestry Variation

 ** Presenting Author*