H113 Forensic Characteristics of Hand Shape: Analysis of Individuation Potential and Sexual Dimorphism Using Geometric Morphometrics

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After attending this presentation attendees will learn of the issues surrounding the biometric use of hand geometry and its forensic anthropological basis, and methods which may be applied using advanced shape analysis statistical techniques in order to standardize the individuation of hand shape.

This presentation will impact the forensic science community by presenting a novel standardization method for the quantitative analysis of hand morphology as an aid in individuation and sex assessment.

The human hand is often used for verification of identity only (using one-to-one comparison), as the dimensions of hands have been considered to be too alike to individuate based on a one-to-many comparison. Past research has often focused solely on lengths and widths of the fingers and palm to compare variation in the hand, and this has led to the belief that hand dimensions are insufficiently individuating for human identification. The research here presented utilizes geometric morphometric techniques to investigate and quantify shape and size variation in the human hand, and consequently the potential for forensic human identification and recognition. The results are presented of a novel hand biometry study, the goal of which was to develop a methodologically and statistically robust means of investigating the individuating potential of the human hand by studying the extent of morphological variation within a sample population. It was imperative the developed technique was simple and highly repeatable, as currently there is no universally accepted method for hand comparison capable of facilitating a systematic assessment of individuation.

Simultaneous digital images were acquired of the dorsal and palmar surfaces of the left & right hands of male and female participants. Ten repeat runs were acquired with varying time-lapses between image capture in order to assess variation due to hand placement. Nine 2D landmarks were selected on both surfaces of both hands, and were subsequently digitized using [TPS Digit.] The resulting landmark configurations (n=720) were subjected to Generalized Procrustes Analysis (GPA) with Full Tangent Space Projection in [Morphologika 2.5.] Principal Components Analysis (PCA) was applied in order to assess individual and populational variation. Factor loadings were subject to Canonical Variates Analysis with stepwise and leave-one-out classification in order to assess individuation potential and the effects of sexual dimorphism on hand shape. The results showed individuals to be correctly classified in 95.3% of cases, with 87.5% being correctly classified by sex (males were correctly classified in 91.9% of cases, and females in 83.1%). These results are strongly significant and suggest the human hand offers significant individuating power for forensic identification purposes. They also indicate male and female hands to have sufficient shape variation for sex-based discrimination with the effects of allometry being strongly implicated. These and other implications of the shape analysis will be discussed.

Hand Biometrics, Geometric Morphometrics, Sex Assessment

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