H101 Three-Dimensional Variation in Face Shape in a Large Study Sample

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After attending this presentation, attendees will gain basic understanding of the nature of face shape variation in 3D as measured empirically in a large study sample and its implications for forensic facial comparison from videotape, photographic, and other facial images.

This presentation will impact the forensic community and/or humanity through this first large empirical study of face shape variation in 3D undertaken using contemporary stereophotographic measuring techniques.

This paper will provide a summary of a study of face shape variation measured in three dimensions in a sample of over 3000 individuals collected in an eighteen month period from December 2003 to May 2005. A feasibility study will be briefly reviewed, which indicated that an anthropometric approach to face shape comparison in two- or three- dimensions using traditional craniofacial landmarks was plausible on the empirical grounds of density and visibility of the landmarks, particularly in areas of the face that it is commonly believed are variable between individuals—the shapes of the major facial features and the positional relationships between them. A student project examining face shape variation in two dimensions conducted in collaboration with Dr Nick Fieller of the Department of Probability and Statistics at the University of Sheffield, offered further confirmation of differences in positional relationships between landmark datasets in different individuals. A substantial proof-of-concept project was initiated involving a much larger sample of three-dimensional landmark data, which will form the core of this presentation.

The structure the collaborative research, between three University research groups—Sheffield, Nottingham and Kent at Canterbury, will be described. The process of ethical review and informed consent for the collection of 3D photographs of volunteer's faces for research in crime prevention and detection will be reviewed. Promotion of the project, with the support of the Magna Science Adventure Centre, near Rotherham, United Kingdom, will be described. In general, the museum visiting public were overwhelmingly well disposed to volunteer to be photographed in support of research in crime prevention detection. Methods used for collecting data from three-dimensional landmarks using a Geometrix® stereophotographic scanner and FaceVision® software will be presented. A pilot study involving a sub-sample of thirty five faces landmarked at sixty sites in triplicate by two different observers offered measures of inter- and intra-observer error, and indications of landmarks that were relatively distinct in position between individuals, more or less subject to intra- or inter-observer error, and technically problematic with regard to establishing consistency in placement via a standard operating procedure. As a result of the pilot study, an optimal landmark set—based on accuracy and discriminating power—of thirty landmarks was chosen. This set of thirty three-dimensional landmarks was placed on a total sample of over 3000 individuals, in duplicate. A small comparative control dataset was collected manually using calipers and also using a Cyberware® 3030 RGB Head and Face scanner. Age, biological sex and ancestry distributions—all of which can affect face shape—will be discussed, especially in relation to the representativeness in an investigative context.

Our key findings with regard to the nature of face shape variation in 3D as assessed by the measurement of 30 landmark positions in duplicate in the sample of over 3000 individuals will be discussed. The distribution conformed to that of a multivariate normal model and normal distributions were indicated in pair-wise distance distributions assessed between paired landmarks. Landmark distributions between the most and least discriminating landmark pairs in the set of thirty will be described. The overall potential for the utility of three-dimensional landmarking in forensic face shape comparison will be discussed in relation to possible further research.

Facial, Variation, Comparison

 ** Presenting Author*