C2   Observer Agreement in the Identification and Quantification of Dorsal Hand Traits From Digital Images

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After attending this presentation, attendees will understand the limitations of relying on dorsal hand traits (e.g., scars, moles, freckles, skin creases) to identify individuals from digital images.

This presentation will impact the forensic science community in terms of competency and performance by calling attention to the underlying reliability of dorsal hand traits in order to minimize the likelihood of false identifications.

Improvements in web-based technologies, in addition to increased human trafficking in the sex tourism industry, have increased the frequency of child pornography cases. Recent studies have demonstrated the potential utility of dorsal hand traits in the identification of perpetrators and victims of these criminal activities through photographic comparison. The qualitative nature of this method prevents it from meeting *Daubert* standards, as there are no known error rates associated with rates of identification of these traits from visual media. Recent studies have attempted to develop likelihood ratios for dorsal hand traits, but there have been few studies of the specific underlying reliability of visual identification and quantification of these traits. The objective of this pilot study was to explore this gap in the literature by conducting an analysis of observer agreement associated with scars, moles, freckles, and knuckle skin-creases, with the hypothesis that all traits would exhibit remarkable levels of intra- and inter-observer error. The study also asked observers to define regions of the hands independently, rather than note all features of the hand holistically.

For this study, digital images of the left dorsal hand of one individual were macroscopically analyzed by three trained examiners and three novice analysts from the Forensic Audio/Video and Image Analysis Unit of the Federal Bureau of Investigation. All images were examined at two time intervals separated by a minimum of 24 hours. One image presented the dorsal aspect of the hand encompassing the second through fifth digits (i.e., fingers). The other image captured only the dorsal aspect of the hand that included the first digit (i.e., thumb). A second set of images was taken of these same portions of the hand, but at different levels of exposure. To maximize the visibility of traits, all images were converted to CYMK in Adobe® Photoshop® CC. The full-color image was then compared with the isolated yellow channel. To examine the amount of variation observed in the data, coefficients of variance were computed for each trait. Afterward, a paired-samples *t*-test was performed for all traits with time set as the grouping variable in order to evaluate intra-observer error. To evaluate inter-observer error, an Analysis Of Covariance (ANCOVA) was performed for the same traits with experience and exposure as the covariates. The threshold for statistical significance for both analyses, which were performed in R (v. 3.4.1), was set at $\alpha=0.05$.

Overall, the results of this study provided variable support for the expectation that all traits would exhibit remarkable levels of intra- and inter-observer error. Calculated coefficients of variance indicated high levels of data dispersion among scars ($cv=1.206$), moles ($cv=1.546$), and freckles ($cv=1.270$). Coefficients of variance calculated for counts of knuckle skin-creases on each digit suggested comparatively lower levels of dispersion ($cv_1=0.419$; $cv_2=0.404$; $cv_3=0.450$; $cv_4=0.530$; $cv_5=0.354$). Tests of intra-observer error indicated a statistically significant difference in mean counts between first and second observations of freckles ($t=-2.43$, $df=11$, $p=0.034$) and knuckle skin-creases on the second digit ($t=-2.80$, $df=11$, $p=0.017$), but not for any other traits observed. All computed ANCOVAs yielded statistically insignificant results for exposure; however, trained examiners and novice analysts significantly differed in their observations of scars ($F=17.173$, $df=1$, $p=<0.001$) and knuckle skin-creases on all five digits of the hand ($F_1=4.366$, $df=1$, $p=0.049$; $F_2=9.854$, $df=1$, $p=0.005$; $F_3=24.670$, $df=1$, $p<0.001$; $F_4=25.266$, $df=1$, $p<0.001$; $F_5=14.371$, $df=1$, $p=0.001$).

This exploratory study found that most traits exhibited statistically minimal intra- and inter-observe disagreement. There is considerable intra- and inter-individual variation in the specific observations made by participants, which calls into question the reliability of dorsal hand traits as suitable points of interest for photographic hand comparison. These findings are consistent with recent studies that show support for qualitative methods of identification and have implications for current efforts to develop quantitative methods based off the traits investigated here.

Identification, Photographic Comparison, Dorsal Hand

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