



### D12 Genetic Influences on Count and Distribution of Forks and Ridge Endings in Fingerprints

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The goal of this presentation is to investigate whether fingerprint minutia, a type of detail used in fingerprint identification, is influenced by heredity.

This presentation will impact the forensic science community by contributing to the understanding of fingerprint uniqueness.

This research is accomplished by comparing the number and distribution of forks and ridge endings (the two most fundamental types of minutia) in the fingerprints of 151 biologically related British adults from eight different families to those of 304 unrelated British adults.

Several prior studies have suggested a strong genetic component to the number of minutiae in fingerprints, as evidenced by strong correlation coefficients between family members and monozygotic twins. The relationship between heredity and minutiae distribution has been largely unexplored.

In this study, fingerprints were collected either by rolling, inking, and printing on high quality white printer paper, or by using black powder and white adhesive labels affixed to a plastic transparent sheet. The prints were then scanned into digital format at 12,000 dots per inch resolution.

The portion of the fingerprint examined consisted of a square grid positioned over the center, or core, of the fingerprint pattern, which was further subdivided into four quadrants. First, the core of the print was marked. Next, a gridline distanced 10 transecting ridges from the core was placed. That distance was then used as the basis for a square grid placed over the fingerprint to define the sample area. The number of ridge endings and of forks occurring in each quadrant of the grid was recorded for each fingerprint.

Chi-square tests comparing the variation in total minutiae for the 8 family groups were statistically significant ( $p < 0.001$ ) (expected values were calculated from the control sample). Analysis of variance tests comparing the number of minutia occurring in each of the four quadrants in the eight families to the quadrant data for subsets of the control sample was not statistically significant, either when the minutiae counts were considered as a whole, or when forks and ridge endings were considered separately. No individual in the study presented less than one fork, less than one ridge ending or fewer than four total minutiae in the central portion of their fingerprints.

The results of this study indicate a genetic influence on the number of forks and ridge endings in fingerprints, though not necessarily on their distribution. There is more similarity in the number of minutiae occurring in the fingerprints of individuals from the same family than would be expected if compared to an unrelated individual. This study found no familial correlation in the distribution of minutiae, though distribution was examined only narrowly in this study, in terms of quadrants of the fingerprint, but not in terms of proximity to the core or to other minutiae for example. Also of note, is the finding that the fingerprints of adult individuals display a minimum number of forks and ridge endings.

The validity and reliability of fingerprint identification in the United States, when carried out by a qualified latent print examiner is largely unquestioned, though it has occasionally been challenged under the *Daubert* standard. Despite the wide acceptance of identification from fingerprints, the ability to quantify fingerprint uniqueness would still be useful, for example in calculating a minimum number of corresponding points necessary for identification from fingerprints by matching minutiae, from both a legal and scientific standpoint. **Fingerprints, Minutiae, Heredity**