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Searching for genetic markers for specific behaviors: A group technique to assess fingerprint patterns

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Dermatoglyphic patterns, such as fingerprints, are potential genetic markers for a number of behavioral syndromes. A method for rapidly assessing fingerprint patterns, which is suitable for group or postal administration, is described. This method appears to have high validity, showing 96.2% concordance with more traditional methods of fingerprint pattern assessment.

Over the past decade, psychologists (e.g., Iacono, 1982) have become increasingly interested in the search for genetic markers of various behavioral traits. Although most genetic markers are quite subtle, involving blood chemistry, physiological arousal patterns, or eye movement patterns, a set of simple physiological manifestations that are predominantly genetic in nature may be useful as potential genetic markers. These phenotypic characteristics are the dermatoglyphic patterns on the fingers, commonly referred to as fingerprints.

There is a good deal of evidence from twin and family studies that dermal ridge patterns are strongly determined by genetic factors (for reviews, see Cummins & Midlo, 1961; Okros, 1965; Roberts, 1979). The usefulness of these dermal patterns as indicators of genetically based syndromes has been shown in relationship to a number of disorders known to be due to chromosomal or genetic sources. For instance, there are specific fingerprint pattern distributions associated with Down's Syndrome, Turner's Syndrome, Klinefelter's Syndrome, de Lange's Syndrome, Rubinstein-Taybi's Syndrome, and several others (see Schaumann & Alter, 1976, for a review). More recently, the association of specific finger ridge patterns with some forms of psychosis has suggested a genetic origin for these behaviors as well (e.g., Naryanan & Mallikarjunaiah, 1980).

There are a number of features that make fingerprint patterns convenient and desirable candidates for studies seeking genetic markers for behavioral patterns. Dermal ridges are usually completely formed within the first trimester of pregnancy. From this time until death, there are no morphological changes in either the detailed structure of the ridges or in the patterns that they form. The only changes are in size (they keep pace with the growth of the hands) and in the depth of the ridges (which may vary due to environmental factors that cause abrasion of the surface of the skin).

There are also some disadvantages associated with use of fingerprints as an index. Normally, fingerprint patterns are measured by rolling the papillary surface on an ink pad and then "printing" the pattern by rolling the finger across a piece of paper. This procedure is somewhat time-consuming, and one can seldom take fingerprints from more than 20 to 30 individuals per hour, even under optimal conditions. In addition, many subjects object to the messiness of the procedure, and others object on philosophical grounds (or perhaps due to mild paranoia) to having their fingerprints permanently recorded.

For some aspects of dermatoglyphic research (such as counting ridges) a permanent copy of the fingerprint is required; however, for many genetic analyses, actual impressions of the fingertip pattern are unnecessary. This is due to the fact that much of the information needed requires only global pattern classification, rather than quantitative measurement. It usually suffices to know whether the fingerprint is an arch, a whorl, a radial loop, or an ulnar loop. Thus it may be possible to develop a rapid and reliable method of fingerprint classification that would take little time, would be suited for group administration, would avoid finger smudging and staining, and would also circumvent the philosophical problems some subjects express when asked to leave a permanent record of their fingerprints. This procedure, based upon self-report, is described and validated below.

METHOD

The subject sample consisted of 127 student volunteers (mean age = 18.4 years). Each subject received an inventory that consisted of a single sheet of paper. On the front of this sheet was a general discussion of the three global classes of fingerprint pattern (arches, loops, and whorls) and some simplified schematic diagrams illustrating their characteristics. On the back of the sheet was a set of eight prototypical fingerprint patterns, such as those shown in Figure 1. Each pattern was labeled with a letter and a descriptive title (such as "oval whorl" for E or "spiral whorl" for F). Beneath these patterns were outline drawings of the two hands. Subjects were asked to select the fingerprint pattern that most closely matched each of their own fingers and to write the

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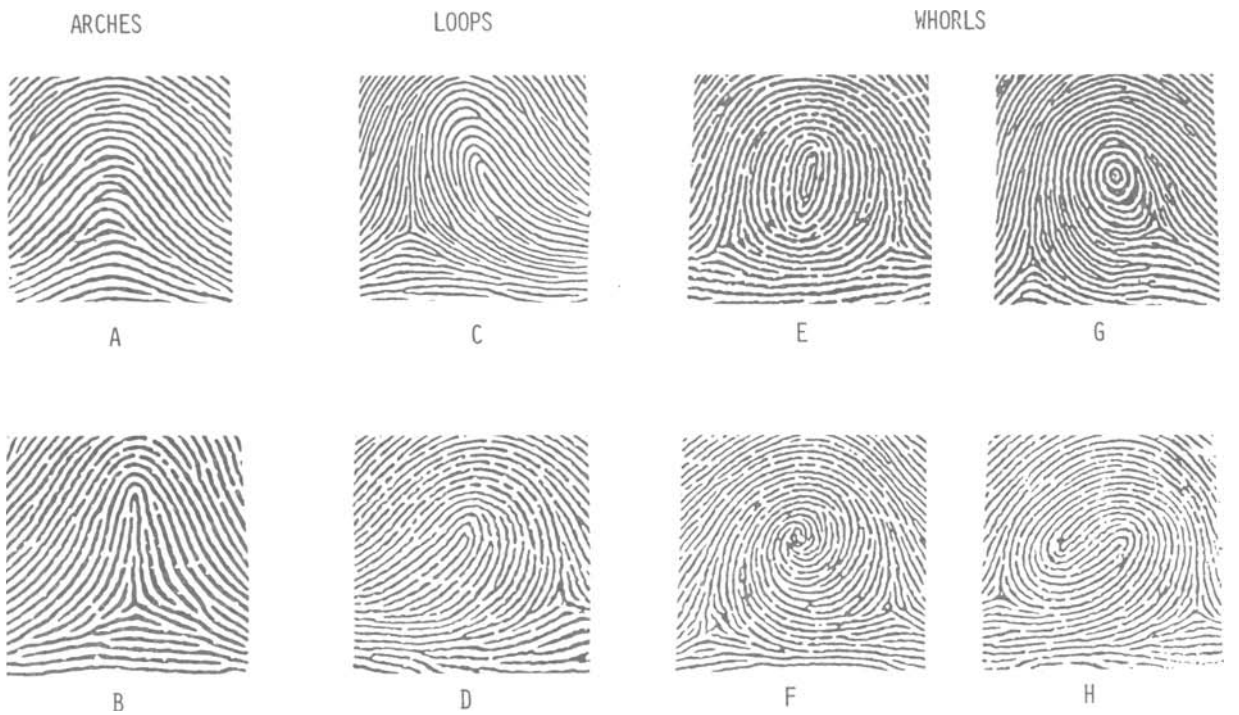

Figure 1. The fingerprint prototypes used in this study. They were labeled on the inventory as follows: (A) simple arch, (B) sharp arch, (C) left loop, (D) right loop, (E) oval whorl, (F) spiral whorl, (G) round whorl, and (H) double loop.

letter associated with each pattern on the corresponding tips of the fingers in the drawings representing their left and right hands. The instructions also indicated that if subjects had any difficulty assessing the patterns on their fingers, they were to indicate this to the experimenter. After each subject reported his/her own judgments of his/her fingerprint patterns, the experimenters assessed fingerprint patterns using more traditional techniques and 500% magnification.

RESULTS AND DISCUSSION

Of the 127 subjects, only 4 (3.1%) reported major difficulties assessing their fingerprint patterns using this technique. In each of these instances, when the fingerprints were examined, it was found that there was either severe abrasion of the dermal ridges or scars or burns that rendered the patterns difficult to interpret under unaided visual inspection. The condition of these fingerprints would have made them somewhat difficult to interpret even using traditional ink-pad impressions.

For the remaining 123 subjects, responses regarding each finger were coded into one of four global categories. Responses of patterns A and B were classified as arches, and responses E, F, G, and H were classified as whorls. For the purposes of scoring concordance between self-assessed patterns and experimenter-assessed patterns, no distinction was made among the items within a global grouping; for example, a subject response of pattern E and an experimenter assessment of pattern G were considered equivalent since both E and G are classified as whorls. Loops were classified on the basis of their direction and the hand upon which they occurred. Thus pattern C on the left hand and D on the right are ulnar loops, whereas C on the right hand and D on the left are radial loops. Since they form separate classes of patterns, confusions between C and D were scored as errors.

Of the 1,230 fingerprint patterns assessed, the subjects' self-reports agreed with experimenter assessments in 1,183 instances, or 96.2% of the cases. Of the 47 (3.8%) errors, two thirds of these (2.5%) were confusions between loops and whorls. Confusions between loops and arches and between arches and whorls each accounted for only 0.3% of the total (or 4 confusions each). Confusions between radial and ulnar loops occurred only 8 times in the entire sample (0.7%), and 5 of these were by the same subject, who seemed to be suffering from some sort of dyslexic reversals.

Overall, these data suggest that subjects are quite accurate in assessing their own fingerprint patterns when they are given a brief introduction to the nature of dermatoglyphic assessment and an adequate sample of prototypes. The 96.2% concordance level should be acceptable for most purposes.

One can verify that the self-reports agree closely with more objective assessments by assessing the fingerprint index called *pattern intensity* (actually the number of triradii per pattern: arches have 0, loops have 1, and whorls have 2). This measure of the complexity of the fingerprint pattern has proven to be particularly sensitive to genetic factors and can be shown to vary across racial and geographic subgroups that are relatively inbred. When we correlate the pattern intensity obtained from self-

reports with those obtained by experimenter assessment, we find that $r = .97$, which is, of course, statistically significant ($p < .001$).

On the basis of these data, it seems that this self-report technique may be quite useful in obtaining assessments of fingerprint patterns to determine whether there are dermatoglyphic patterns that may serve as genetic markers for various behavioral traits. The procedure is rapid (usually requiring less than 5 min), is suitable for group or postal administration, and seems to provide valid and reliable data, especially when the small percentage of individuals with scarred or abraded fingers are eliminated or slated for more traditional assessment.

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