Finger patterns in families, a preliminary report

by

André G. DE WILDE (*)

Groningen, the Netherlands

Introduction

The existence of common factors for the development of the patterns on all 5 fingers of one hand is highly probable. Arguments in favor of this common factor idea, are found in the concordances of heterologous fingers in monozygotic and dizygotic twins (DE WILDE et al. 1979), and in cases with syndactylism (DE WILDE 1979). Such common factors do not exclude the contemporary presence of finger factors. The spreading of the points in the graphs may indicate that not all factors causing the patterns are common for all fingers.

During embryology the ridge systems of fingers and palm seem to develop as one system of fibroblast streams in the handplate. Later on from this plate the fingers are split off. If common factors do exist, it must be possible to demonstrate them by statistical methods.

Factor analysis

Finger patterns, classified as whorls and not whorls, of different tribes were studied. This data was collected by Julien, de Wilde a.o. A routine SPSS program was applied (**), by which the total and within covariance matrices were calculated. From the between covariance matrix derived from them, the between correlation matrix was determined. A varimax factor analysis gave a first factor (which represents 98.6 % of the total variance), and its factor score coefficients. Another factor analysis was one on the frequencies of the 32 combinations of patterns on the five fingers pro hand (right and left were both comprised in these

(*) Communication présentée le 28 janvier 1980.
(**) Calculations were performed in the computing center of the University in Mobile, Alabama (1978) and in the computing center of the Groningen University.

calculations). Here we found a gradual decrease of the eigenvalues of the factors. There was no gain in such a factor representation to be expected.

Family data

Another data was composed from 202 American families, 32 American families and 83 Dutch families. The original data come from PLATO and WERTELECKI and DE WILDE/IJDENS. We selected all the families with two parents and two children. The birth order of the children was registered too. Finally the family data consists of 317 families (1268 individuals). We got still more data from other colleagues, but the results obtained from them are not comprised in this publication. With the factor score coefficients mentioned before, the factor score for every family member was calculated. Our further analysis is on these factor scores.

Because each family has two children, registered in their birth order, we have the following possible pairs :

1st child	2nd child	Symbol
son	son	SS
son	daughter	SD
daughter	son	DS
daughter	daughter	DD

First sons, daughters are indicated by SI, DI, second ones by SII, DII. Thus SI = SS + SD etc. ; SS = the son after a son ; DS = the son after a daughter etc.

Averages

The average factor scores of the second children in the different combinations with the first child were compared. Only the significances of the differences are given (Table 1).

TABLE 1

Differences in average factor scores between second sibs

	SS	SD	DS	DD	
SS		**	o	***	
SD	**		**		Right Hands
DS	o	o		*	
DD	**	o	o		

Left Hands

Significance levels : *** = 1‰, ** = 1 %, * = 5 %, o = not significant at 5 %.

On both hands there is a significant sex difference between the SS and SD averages. This is also the case between the DS and SD averages on the right hands, but not on the left hands. There is a suggestion in this data that on the left hands it makes a difference if the first child is a son or a daugher, considering the second daughter: the SD-SS difference is significant at the 1% level; the SD-DS difference is not.

TABLE 2

Difference in average factor scores between parents and second children.
Significances as in Table 1.

	SII	SD	DD	DS	SS	
SI	o	***			o	R
DI	o		**	o		
SI	o	o			o	L
DII	*		***	*		

In table 2 we compared all first and second children with the second children in the different combinations: for both hands a significant difference exists between the first daughter and the DD daughters. This means that the first child exerts a significant influence on the second child if the latter is a daughter.

The difference between first and second daughters can still more clearly been demonstrated by comparing the average of all mothers with that of all 1st daughters, all 2nd daughters and all daughters. The 1st daughters score too low, the 2nd too high (P < 5%, P < 1‰), but the average of all daughters does not differ from that of the mothers (P > 5%). The difference between DI and DII is significant (P < 1‰) (Table 3).

TABLE 3

Average factor scores and numbers of individuals in mothers,
first daughters, second daughters and all daughters compared.

	Daughters		
	First	Second	All
Mothers	.717 147	.804 142	.760 289
.751 317	sign. 5%	sign. 1‰	not sign.
First Daughter	—	sign. 1‰	—

Correlations

Pearsonian correlations were computed between father or mother and the averages of the possible child pair combinations.

TABLE 4

Correlations parents-combined offspring.
Fathers have significant higher correlations with second daughters, if the first child is a daughter than when the first child is a son (5 % level). Significances as in Table 1.

			X^2 R	X^2 L
F /SODA	compared with	F /DADA	5.82	5.66
M/SODA	compared with	M/DADA	.55	.46
F /SOSO	compared with	F /DASO	1.93	1.68
M/SOSO	compared with	M/DASO	.16	.47

For both hands significant differences in correlations are found for Father/Son-Daughter compared with Father/Daughter-Daughter ($P < 5\%$). The fathers have higher correlations with the 2nd daughters if the 1st child is a daughter than when the 1st child is a son.

The influence of the first child on the second was also demonstrated by calculating partial correlation coefficients between 2nd child and 1st child after elimination of the (common) parent influences (Table 5).

TABLE 5

Partial correlation between 1st and 2nd child after elimination
of father and mother influences. Significances as in Table 1.

	R	L	R + L	F_R	Eliminations M_R	F_L	M_L
SS/SI	o	o	o	*	*	**	*
SD/SI	o	o	o	o	o	*	*
DS/DI	o	o	o	**	*	o	*
DD/DI	o	*	*	*	***	*	***

In absence of sib-sib influences, the partial correlation between 2nd and 1st sibs must be zero. This is not the case in the 1st daughters and DD sib pairs on the left hands. Here the first child exerts an influence on the second one ($P < 5\%$). Much higher significant influences of the mothers (R and L) on **DD/DI** correlations are found than in the other parent-children combinations.

General aspects

The values of the parent-child and sib-sib correlations theoretically are expected at .50 in a simple oligo- or polygenic system without dominance effects. Where the factor score for each individual practically represents all arch + loop/whorl information of this individual, we might expect to find correlation coefficient values not differing much from .50 and from each other.

In graph I, giving the correlations between parents and first children, the F-D correlations on the left hands are higher than the M-D and M-S correlations. This is found to be true for both hands in the second children. When right and left hands are combined, the differences in parent-offspring correlations for 1st and 2nd kids are remarkably reduced. We assume that the differences between F-D and M-S correlations indicate an X-chromosomal influence. In simple X-chromosomal inheritance, the F-S correlation is zero. However, assuming that autosomal and X-chromosomal factors both determine the fingerpatterns, the theoretical curve calculated for a heritability of 50%, shows a rather good agreement with the actual findings.
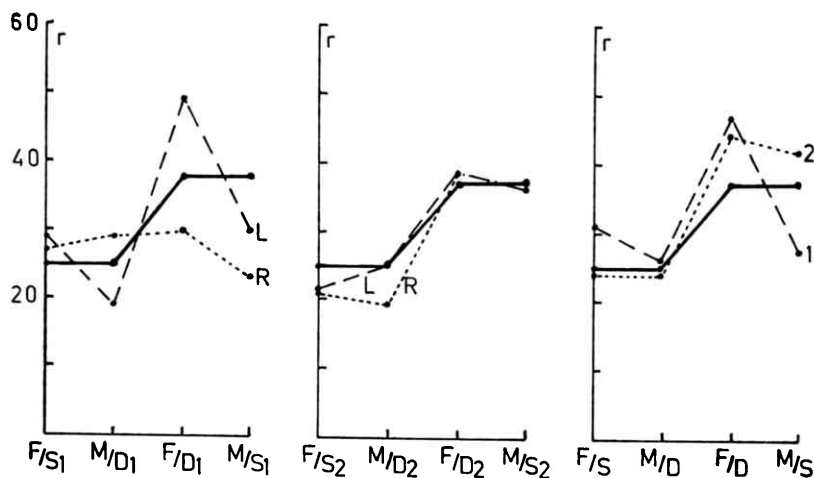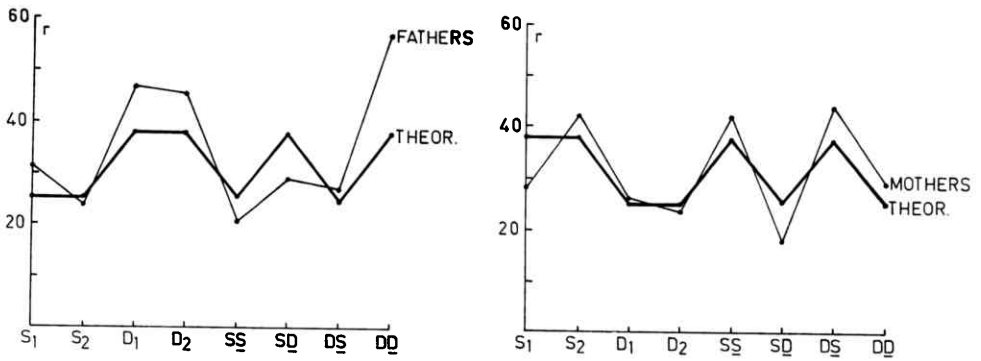

GRAPH I

Here we must not forget that the factor scores do not completely represent the patterns, and that errors in classification etc. do occur. We believe that the X-linked + Autosomal inheritance is an acceptable hypothesis.
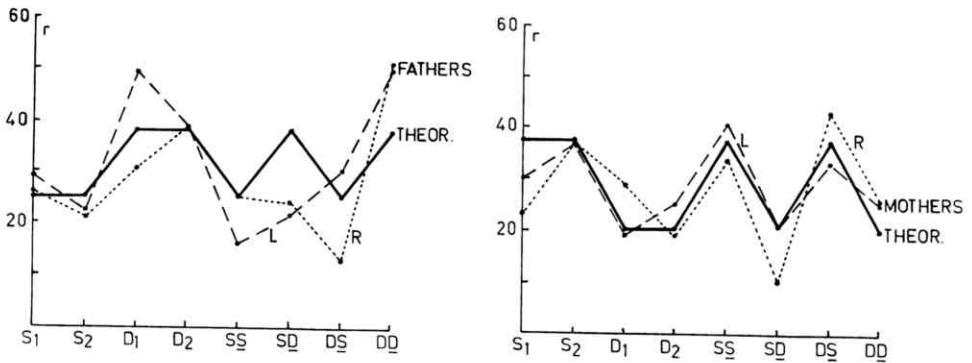
In graph II the sib-sib correlations are given, with the theoretical correlation lines (for a heritability of 50%). The S-S and D-D correlations show a rather good agreement, the S-D and D-S correlations are higher than expected at this heritability-level.
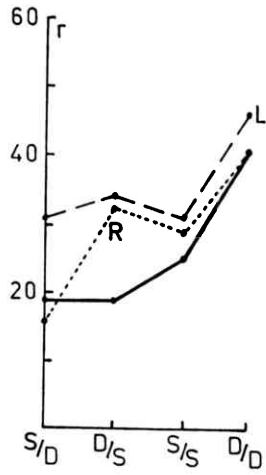
GRAPH II

GRAPH III

GRAPH IV

In graph III the excellent agreement is shown between the actual parent-offspring correlations on both hands combined with the expected ones. The Father-Daughter correlations are somewhat higher than expected, as is probably true for the Mother-Son correlations.

The parent-offspring relations for right and left hands separately demonstrate the same general course (Graph IV). The Mother-first son correlations are too low for both hands, as is found for the Father-SD correlations. The curves for the Father-offspring relations show larger differences between both hands. This is not observed in the Mother-offspring correlation. Probably incomplete penetrance or dominance deviations do occur. Further analysis is needed.

LITERATURE

DE WILDE, A. G. & AMESZ-VOORHOEVE, W. H. M.

    1979   Fingerprints : classification, correlations, and inheritance.
           Birth Defects : Original Article Series, **15** (6) : 95-118.

DE WILDE, A. G.

    1979   Developmental aspects of ridges and creases (dermatoglyphics).
           Coll. Anthropol., **3** (2) : 201-210. Zagreb, Yugoslavia.

Address of the author : Prof. Dr. A. G. DE WILDE
                            Dept. of Anatomy and Embryology
                            Oostersingel 69
                            NE-9713 EZ Groningen