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Qualitative Value in Finger Prints

Mother/child Correlation

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Introduction

As early as 1891, in his article " Method of indexing finger marks ", F. Galton emphasized the possibility of using finger prints in anthropological work. R. Heindl (1922) improved Galton's classification with a division of the dermatoglyphics of the fingers into several types of pattern with " ridge-counting " as subclassification within respective type of pattern.

K. Bonnevie (1924) showed, however, through an investigation of 24,518 Norwegians that between Galton's types there were successive transition forms, why she advertised for a more distinct classification. This she considered she effected through acquiring seizin of the whorl form, possible tendency for twin loop formation, and the quantitative value. Particularly the total quantitative value has been very closely attended to in a large number of investigations, above all by S. Holt (1949, 52, 54, 55, 61) who, among other things, has shown a mother/child correlation with values which not significantly differ from 0.5 (however on a material consisting of only 53 couples).

Also family investigations have been carried out. Already in 1928 Grüneberg tried to prove the hereditary transmission of the various types of pattern: loop, arch, and whorl patterns, through proposing a hereditary mechanism with two polymeric gene pairs, where the relative number of dominating genes should determine the type of pattern. After that several investigations of twins have been undertaken, among others by Meyer-Heydenhagen (1934) and Steffens (1938). The latter has proved a correlation with $r = 0.78$ for qualitative and 0.84 for quantitative values between monozygotic twin pairs.

Methodology

The investigations that have hitherto been undertaken concerning the qualitative value have mainly treated the patterns in the fingers as separate units. The author has instead tried to create a total qualitative value — a comprehension of

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the types of pattern occurring on both hands. However, this has met with certain difficulties concerning the systematics which the author has solved as follows:

I. Dividing the patterns of the fingers into 3 main types:

1. *Whorl pattern* (*W*): comprises pure whorl patterns, ellipse patterns, twin loops, and cp-patterns.
2. *Loop patterns* (*L*): comprises radial as well as ulnar loops.
3. *Arch pattern* (*A*): comprises pure arch patterns and T-patterns.

II. Collocating the results of the analysis of the 10 fingers and the total qualitative value is obtained in accordance with the following example:

Left hand:

Finger:	1	2	3	4	5	
Pattern:	A	L	L	L	W =	1 A, 3 L, and 1 W-patterns

Right hand:

Finger:	1	2	3	4	5	
Pattern:	L	L	L	W	W =	3 *L*, and 2 W-patterns
					Total	1 A, 6 L, and 3 W-patterns

Here the L-pattern is evidently the dominating type of pattern and consequently the patient should have a total qualitative value called L, under the presumption that a limit is set at the occurrence of the pattern in 4 fingers or more. If the limit is set at 3 the person in question should have an LW-pattern instead etc. How the types of pattern are divided among the fingers of the hands is consequently of no importance; it is only the number of the respective types of pattern that affects the total qualitative value.

In order to find out where the limit conveniently ought to be set and what effect the limit has on the pattern distribution Tab. 1 was set up.

Tab. 1

Limit	A		AL		ALW		L		LW		W		Total	
1	0	0	118	16.4	102	14.2	83	11.6	404	56.3	11	1.5	718	100.0
2	3	0.4	111	15.5	23	3.2	207	28.8	351	48.9	23	3.2	718	100.0
3	8	1.1	71	9.9	1	0.1	350	48.7	241	33.6	47	6.5	718	100.0
4	21	2.9	26	3.6	0	0	437	60.9	152	21.2	82	11.4	718	100.0
5	29	4.1	2	0.3			514	71.9	47	6.6	123	17.2	715	99.6
6	27	4.2					495	77.1			120	18.7	642	89.4
7	21	4.2					400	80.2			78	15.6	499	69.5
8	8	2.2					312	85.7			44	12.1	364	50.7
9	2	0.9					194	88.6			23	10.5	219	30.5
10							83	88.3			11	11.7	94	13.1

A given claim for the carrying through of the systematics is that all occurring pattern combinations could be systematized. Of this reason the limit must, as is shown in Tab. 1, be set lower than at 5. To achieve the best possible differentiation of the equal types of pattern it is, on the other hand, desirable that the limit is set at as high a number as possible with regard to the above said, why the limit has been set at an occurrence of the type of pattern in 4 fingers or more.

Material

The material consists of finger prints collected in connection with anthropological paternity investigations at the Government Institute for Forensic Medicine, Stockholm. In connection with a paternity investigation a maternity investigation is carried-out on routine. The investigation comprises cases analysed at the Department in the years 1958-63 and amounts to 291 women, 291 children, and 427 men.

Only such cases are examined at the Institute where the blood-group report has not given any guidance. That the material is selective on this account must be regarded as excluded.

Frequency determination

The distribution of the various types of pattern for the analysed material is shown in Tab. 2. and Fig. 1.

Tab. 2

		A	AL	L	LW	W	Total
Women	n	10	7	183	59	32	291
	%	3.4	2.4	62.9	20.3	11.0	
Men	n	11	19	254	93	50	427
	%	2.6	4.4	59.5	21.8	11.7	
Girls	n	2	5	82	27	10	126
	%	1.6	4.0	65.1	21.4	7.9	
Boys	n	—	4	105	37	19	165
	%	—	2.4	63.6	22.4	11.5	
Total	n	23	35	624	216	111	1,009
	%	2.3	3.5	61.8	21.4	11.0	

The table shows that the pattern distribution for the two sexes is very similar. The sex difference is not significant for any type of pattern.

Interesting enough there are no AW-patterns independant of where the limit is set (see Tab. 1), and also the frequency of ALW-patterns is very low — ALW-patterns occurs only in one case at a 3-limit and no case occurs if the limit is set higher.

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This observation has led to the thought that the A-pattern and the W-pattern would be two extreme groups with the L-type as a middle group and possible link in a chain of development.

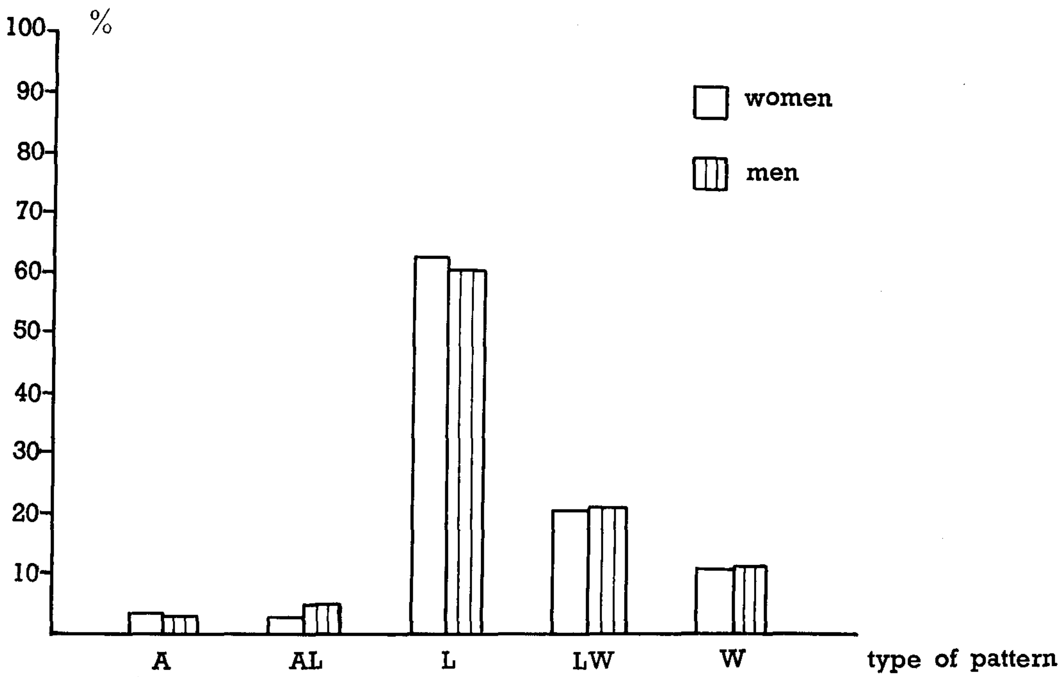

Fig. 1

Calculation of correlations

Calculation of correlations with χ^2-analysis have been performed on the mother/child material (see Tab. 3) to ascertain whether a correlation exists and, if this is the case, its value and significance.

Tab. 3

Mother/child	A	AL	L	LW	W	Total
A	—	—	8	1	—	9
AL	—	—	6	2	—	8
L	1	9	132	34	8	184
LW	—	—	31	16	11	58
W	1	—	10	11	10	32
Total	2	9	187	64	29	291

Of what has been said above concerning a development transmission with the types of pattern forming different stages of development one should expect that the strongest correlation would appear concerning A-patterns contra W-patterns. On account of the low frequency of A-patterns (totally 2.3%), however, such calculations are impossible to carry out. The next strongest correlation should for the same reason be to be expected with L contra W-patterns and the lowest with LW contra W respective AL contra L-patterns.

At arrangement in tetrachoric tables the following results are obtained:

1. L/W : $\chi^2 = 34.38$; $r = 0.46 \pm 0.06$;
2. A, AL, L/LW, W : $\chi^2 = 27.38$; $r = 0.31 \pm 0.05$;
3. L/LW : $\chi^2 = 3.75$; $r = 0.13 \pm 0.07$.

These calculations show that there is a strong correlation on the 99.9% level for L-patterns/W-patterns.

Summary

1. The author has worked-out a new system of finger-prints analysis through bringing together the types of pattern of the various fingers to a total qualitative value of the following 5 types: A-pattern 2.3%, AL-pattern 3.5%, L-pattern 61.8%, LW-pattern 21.4%, W-pattern 11.0%.

2. Calculations of frequency have shown that sex difference does not exist with respect to the various types of total qualitative value.

3. Mother/child calculations of correlation in tetrachoric tables have given the following results:

a) L/W : $\chi^2 = 34.38$; $r = 0.46 \pm 0.06$;
b) A, AL, L/LW, W : $\chi^2 = 27.38$; $r = 0.31 \pm 0.05$;
c) L/LW : $\chi^2 = 3.75$; $r = 0.13 \pm 0.07$.

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RIASSUNTO

1. L'autore ha elaborato un nuovo sistema di analisi delle impronte digitali dividendole in 5 tipi diversi, aventi diversi valori qualitativi totali: 2,3% tipo A; 3,5% tipo AL; 61,8% tipo L; 21,4% tipo LW; 11,0% tipo W.

2. Il calcolo della frequenza dei diversi tipi non ha dimostrato alcuna differenza qualitativa totale dipendente dal sesso.

3. Il calcolo della correlazione madre-figlio secondo le tabelle tetracoriche ha dato i seguenti risultati:

a. L/W : $\chi^2 = 34{,}38$; $r = 0{,}46 \pm 0{,}06$;
b. A, AL, L/LW, W : $\chi^2 = 27{,}38$; $r = 0{,}31 \pm 0{,}05$;
c. L/LW : $\chi^2 = 3{,}75$; $r = 0{,}13 \pm 0{,}07$;

RÉSUMÉ

1. L'auteur a élaboré un nouveau système d'analyse des empreintes digitales en rapprochant les types des différents doigts à une valeur qualitative totale des 5 types suivants: type A, 2,3%; type AL, 3,5%; type L, 61,8%; type LW, 21,4%; type W, 11,0%.

2. Des calculs de fréquence ont montré qu'il n'y a aucune différence de sexe concernant les différents types de valeur qualitative totale.

3. Des calculs de corrélation mère-enfant en tableaux tétrachoriques ont donné les résultats suivants:

a. L/W : $\chi^2 = 34{,}38$; $r = 0{,}46 \pm 0{,}06$;
b. A, AL, L/LW, W : $\chi^2 = 27{,}38$; $r = 0{,}31 \pm 0{,}05$;
c. L/LW : $\chi^2 = 3{,}75$; $r = 0{,}13 \pm 0{,}07$;

ZUSAMMENFASSUNG

1. Der Verfasser hat eine neue Systematik, was betrifft die Dermatoglyphik in den Fingern durch die Mustertypen den verschiedenen Fingern an einem totalen qualitativen Wert von den folgenden 5 Typen zusammenzuführen, herausarbeitet: A-Mustern, 2,3%; AL-Mustern, 3,5%; L-Mustern, 61,8%; LW-Mustern, 21,4%; W-Mustern, 11,0%.

2. Frequenzberechnungen haben gezeigt, dass es kein Geschlechtsunterschied, was betrifft die verschiedenen Typen von totalem qualitativen Wert gibt.

3. Korrelationsberechnungen Mutter-Kind in tetrachoric Tabellen haben dem folgenden Resultat gegeben:

a. L/W : $\chi^2 = 34{,}38$; $r = 0{,}46 \pm 0{,}06$;
b. A, AL, L/LW, W : $\chi^2 = 27{,}38$; $r = 0{,}31 \pm 0{,}05$;
c. L/LW : $\chi^2 = 3{,}75$; $r = 0{,}13 \pm 0{,}07$;