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Digital dermatoglyphics in some West African peoples

Derek ROBERTS, Alison REDMAYNE and Elisabeth COOPE

The dermatoglyphic features in populations of West Africa are probably better known than in those of any other part of the Continent. Yet many peoples in West Africa remain unstudied, and most of the information that there is derives from those in the territories formerly under French jurisdiction. The lack of data from Nigeria (still limited to the single Yoruba sample of Jantz and Brehme, 1979) prompted Dr. Redmayne to begin collecting dermatoglyphic prints when she was a member of Ahmadu Bello University in Zaria in northern Nigeria. But there then occurred one of those natural disasters that furnish unexpected opportunities for research — the first of the recent great famines in the Sahel. This famine led to a major southward migration of people from the most severely affected areas, particularly men from Niger looking for paid work, and thus between 1972 and 1974 it was possible to obtain dermatoglyphic prints from a large male sample (364) of Tuareg who had come to Zaria for that purpose. This is a population from which it would have been very difficult to obtain such a large sample in ordinary circumstances. When looking for work in Nigeria they needed to carry identity cards which included a photograph and a thumb print. They were therefore not afraid to provide their finger and palm prints, especially if they were rewarded with a passport style photograph.

Normally many Tuareg are transhumant and travel widely in order to care for their camels, donkeys, sheep and goats, or to trade. A few, mainly young, unmarried men, may travel to seek wage labour, particularly in the dry season. Others who are sedentary farmers in the oases may keep some cattle. They are widely dispersed throughout the western Sahara and adjacent areas and include people of very diverse origins. Their society is divided into a number of territorial groups which they claim are endogamous. It is also a stratified society with distinct groups, descended from former freemen and former serfs, which are also, in theory, endogamous. However, while the lightest skins and the finest features ("white") usually indicate those descended from former freemen, and the darkest skins and most negroid features ("black") those descended from former serfs, there are many whose social status cannot be deduced from their physical appearance. The sample contains both "white" and "black".

This sample consists of Tuareg males from the Tahoua and Agadiz regions of Niger who reached Zaria in their search for work. It also contains a much smaller number from the Tanout region of Niger, a few who had been in settled employment in Nigeria for a number of years, also originally from Niger, and a very small number who had come from Mali, sometimes after spending some time in Niger on the way. The sample was restricted to those who had no parent in common and who believed that they had no close relationship, such as a common grandparent, with any other subject.

The results of the analysis of these prints are presented here together with those of smaller male samples from two Nigerian populations, Bura (54) and Tiv (39). The Bura live in northeastern Nigeria in an area which includes Biu, Shaffa and Garkida, while the Tiv live mainly in Benue state, east central Nigeria, in an area which includes Makurdi, Gboko and Katsina Ala.

Altogether full prints of 457 adult males were obtained by the inkless Kleenprint method, and later analysed in England.

RESULTS

Finger Pattern Types

Table 1 shows the number of qualitative patterns of different types that occur on each digit for each sample. There is a suggestion that the Tuareg have fewer arches (3.96 %) than the other samples, to which the significant deficit on the right thumb contributes, but on no other digit is there any significant difference amongst the three samples. However in this low arch frequency the Tuareg tend towards the Kel Kummer Tuareg sample of Chaventré and Jakobi (1979), from the Ioullemedden round Menaka in North East Mali, which has the lowest arch frequency (males 2.03, females 2.17) reported in Africa. But the arch frequency in Bura also is lower than that in all West African samples except the Bassari (Dankmeijer, 1947; de Lestrange, 1953), Peul and Guineans (de Lestrange, 1953), and Sierra Leone/ Liberian (Cummins, 1930; Dankmeijer, 1938). Lower values are however found in some Bantu from further south and east. The arch frequency in the Tiv, though higher than in the Dogon (Glanville and Huizinga, 1966), Biwol (Gomila *et al.*, 1967) and Congo Forest Bantu (Gessain, 1961), does not reach the level of the majority of West African samples.

The overall frequencies of whorls and loops in the Tuareg are closest to those in Dogon (Glanville and Huizinga, 1966), Biwol (Gomila *et al.*, 1967) and Arab (Gessain, 1961). The majority of the radial loops occur as expected on digit 2, though there are occurrences on each of the other digits in Tuareg. Ulnar loops show the expected peak occurrence on digit 5 in both hands.

Quantitative

The mean total ridge count (TRC) of the Tuareg is significantly greater than that of the Tiv, but not of the Bura. By contrast with the low total ridge counts characteristic of much of Africa, and indeed the extreme low counts of pygmy and bushman, the occurrence of some pockets of peoples with high counts in West Africa has been suspected since Glanville's study amongst the Fali in 1968. In the present data the mean total ridge count (table 2) amongst the Tuareg (141.7) is the highest on record for Africa. This is closely followed by that amongst the Bura (139.8), while that amongst the Tiv is near the middle of the West African range. Comparing the three samples, all show the expected feature of the highest counts occurring on digits 1 and 4. The Tuareg show a particularly high count on the thumb. The high total counts amongst the Tuareg and the Bura are due to high counts on every digit. The lower mean total count amongst the Tiv is due to lower counts on the radial digits, but not on the ulnar. Similarly by comparison with other African samples, the elevated total ridge count of the Tuareg is due to the high counts on digits 1-3, and particularly digit 1, which exceed all other African samples to date; counts on digits 4 and 5 fall into the range of the latter.

The high absolute ridge counts, mean 184.7, sd 81.6 amongst the Tuareg, and mean 181.5, sd 78.5 amongst the Bura, by comparison with the mean of 163.8, sd 78.4 amongst the Tiv, reflect the high whorl frequency. The Tiv however also tend to have slightly lower absolute counts in each pattern type (table 3).

	364 TUAREG				54 BURA				39 TIV			
	Arch	Radial Loop	Ulnar Loop	Whorl	Arch	Radial Loop	Ulnar Loop	Whorl	Arch	Radial Loop	Ulnar Loop	Whorl
Right												
1	14	3	162	185	6	0	21	27	6	0	16	17
2	26	21	175	142	2	2	28	22	2	6	18	13
3	16	3	268	77	3	0	35	16	2	1	26	10
4	3	2	205	154	1	1	29	23	0	0	23	16
5	5	2	298	59	1	0	44	9	0	0	38	1
Total No	64	31	1108	617	13	3	157	97	10	7	121	57
%	3.52	1.70	60.88	33.90	4.81	1.11	58.15	35.93	5.13	3.59	62.05	29.23
Left												
1	23	2	172	167	3	0	26	25	7	0	16	16
2	25	40	157	142	5	4	22	23	6	5	18	10
3	20	2	251	91	5	1	35	13	3	0	23	13
4	7	0	216	141	2	0	33	19	1	0	25	13
5	5	3	306	50	0	0	45	9	0	0	35	4
Total No	80	47	1102	591	15	5	161	89	17	5	117	56
%	4.40	2.58	60.55	32.47	5.56	1.85	59.63	32.96	8.72	2.56	60.00	28.72
Both hands												
Total No	144	78	2210	1208	28	8	318	186	27	12	238	113
%	3.96	2.14	60.71	33.19	5.19	1.48	58.89	34.44	6.92	3.08	61.03	29.00

Table 1 : Numbers of pattern types by digit.

	Digit	364 Tuareg Mean	S.D.	54 Bura Mean	S.D.	39 Tiv Mean	S.D.
	1	18.63	6.60	15.83	8.01	14.31	8.20
	2	12.12	6.33	12.35	5.17	10.18	6.05
Right	3	11.84	5.67	12.48	5.36	11.51	5.98
	4	15.54	5.60	16.78	6.36	15.74	5.66
	5	13.27	4.79	13.44	4.61	13.77	4.06
	1	17.10	6.79	14.98	6.92	12.59	7.23
	2	11.70	6.39	11.67	5.94	9.28	6.66
Left	3	12.74	6.31	12.65	6.24	11.67	6.43
	4	15.52	5.56	15.30	5.97	15.62	6.17
	5	13.26	4.56	14.28	4.11	13.46	3.73
Total ridge count		141.74	4.62	139.76	4.65	128.13	4.75

Table 2 : Ridge count by digit.

	Tuareg m	S.D.	Bura m	S.D.	Tiv m	S.D.
Radial loop	12.7	5.43	13.0	4.92	12.1	5.28
Ulnar loop	12.9	5.37	13.0	4.81	11.9	5.17
Whorl	31.0	8.51	29.9	9.00	29.6	7.39

Table 3 : Absolute ridge count (ARC) by pattern type.

There are few inter–digital correlation matrices published for Africans. By comparison with the Hehe (Roberts *et al.*, 1974), each of the three samples shows lower coefficients (table 4). The highest correlations occur between homologous digits, but the usual pattern, of correlations that are higher the closer the digits, is not so clear in the present data, and in particular it is the correlations involving the first digit that are responsible for disturbing the pattern. The matrices for the Bura and Tiv should perhaps be discounted, on account of the relatively small sample size, but numbers are sufficient for reliable estimates in the Tuareg. The coefficients are lower than in Holt's (1951) English sample except in one or two instances (R2 with R3, L2 with L3 and L5, L3 with L5). The coefficients are similarly below those occurring in the Yoruba sample described by Jantz and Brehme (1978).

With a sample the size of the Tuareg, it is worth attempting a further, multivariate analysis, to enquire whether the same components of ridge count variation can be discerned as in other samples, whether they account for the same proportions of the variances, and whether their distributions over the fingers show the same loading patterns.

By contrast to the few principal components required to account for most of the variance detected in skin colour where four account for over 95 % (Leguebe, 1976), the Tuareg data, as with other dermatoglyphic series, require a large number, suggesting that the genetic control of ridge count variation is more complex than that of skin colour and requires a greater number of genetic determinants. The Tuareg eigenvalues by comparison with other male populations are set out in table 5. Four components are required to account for 80 % of the total variance, by contrast to the eight required for the rural and urban Oxfordshire and rural Berkshire samples, nine in urban Berkshire, six in Hehe, and five in Cumbrian males; ten components are required to account for 95 %.

The loading of component 1, which has been interpreted as a general size factor, is very regular across all digits and remarkably low (fig. 1), approximately one quarter that in the Berkshire, Oxfordshire, Basque, and Hehe, though its levels are approached in the Cumbrian male sample. Component 2 which contrasts the ulnar and radial sides of the digits, and especially digits 3, 4 and 5, has lower loadings (+.2 to -.2) than in Oxfordshire (+.4 to -.3), Berkshire (+.3 to -.3), and is much more similar in loading level and distribution to that in the Cumbrian males, with which it is practically identical except for digit 1, where it has a positive instead of a negative loading. It differs from the Hehe in whom it does not contrast the thumb with the other digits. Component 3 is similar to the Berkshire and Hehe male third component, the Cumbrian fourth and the Oxfordshire fifth, taking the general form of a gradient across the fingers from the radial to the ulnar side, while again being involved in the ulnar/radial contrast on each digit. Component 4 contrasts the mesial with the

		1	2	3	4	5	1	2	3	4	5
						TUAREG					
Right	1	1.000	.397	.400	.376	.420	.801	.411	.407	.382	.419
	2		1.000	.782	.589	.528	.382	.802	.778	.620	.576
	3			1.000	.672	.596	.376	.720	.823	.657	.608
	4				1.000	.750	.364	.661	.740	.799	.721
	5					1.000	.398	.604	.610	.683	.803
Left	1						1.000	.396	.380	.381	.437
	2							1.000	.762	.640	.626
	3								1.000	.763	.662
	4									1.000	.717
	5										1.000
						BURA					
Right	1	1.000	.392	.514	.494	.493	.816	.280	.417	.447	.403
	2		1.000	.821	.637	.558	.414	.658	.796	.769	.475
	3			1.000	.787	.615	.571	.698	.859	.772	.486
	4				1.000	.687	.561	.612	.767	.823	.650
	5					1.000	.385	.491	.649	.611	.665
Left	1						1.000	.317	.426	.531	.372
	2							1.000	.646	.673	.480
	3								1.000	.836	566
	4									1.000	.627
	5										1.000
						TIV					
Right	1	1.000	.435	.420	.280	.304	.958	.431	.537	.392	.404
	2		1.000	.751	.661	.512	.435	.836	.816	.715	.531
	3			1.000	.687	.454	.361	.896	.855	.748	.583
	4				1.000	.630	.229	.702	.739	.765	.653
	5					1.000	.265	.437	.514	.694	.738
Left	1						1.000	.391	.523	.348	.388
	2							1.000	.828	.703	.570
	3								1.000	.744	.656
	4									1.000	.626
	5										1.000

Table 4 : Interdigital correlation coefficients.

Component	Oxfordshire				Berkshire				Cumbrian		Hehe		Tuareg	
	Urban (n=189)		Rural (n=329)		Urban (n=322)		Rural (n=348)		(n=407)		(n=107)		(n=364)	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b
1	8.68	0.43	8.17	0.41	7.92	.40	8.49	.42	7.76	.50	10.21	0.51	8.52	.52
2	1.72	0.52	1.85	0.50	1.91	.49	1.98	.52	1.67	.61	1.99	0.61	2.03	.64
3	1.46	0.59	1.49	0.58	1.37	.56	1.53	.60	1.29	.69	1.51	0.69	1.55	.74
4	1.26	0.66	1.33	0.64	1.31	.63	1.30	.67	1.13	.76	1.13	0.74	0.99	.80
5	1.17	0.71	1.16	0.70	.98	.67	.97	.71	0.86	.82	0.79	0.78	0.75	.84
6	0.82	0.75	0.89	0.75	.83	.72	.74	.75	0.63	.86	0.71	0.82	0.68	.89
7	0.72	0.79	0.75	0.78	.75	.75	.63	.78	0.51	.89	0.56	0.84	0.41	.91
8	0.59	0.82	0.62	0.81	.69	.79	.58	.81	0.40	.92	0.53	0.87	0.34	.93
9	0.54	0.85	0.54	0.84	.57	.82	.49	.84	0.31	.94	0.44	0.89	0.24	.95
10	0.48	0.87	0.43	0.86	.55	.84	.44	.86	0.29	.96	0.35	0.91	0.23	.96

Table 5 : Eigenvalues of the first 10 components in male samples (a =eigenvalues — b =cumulative proportion).

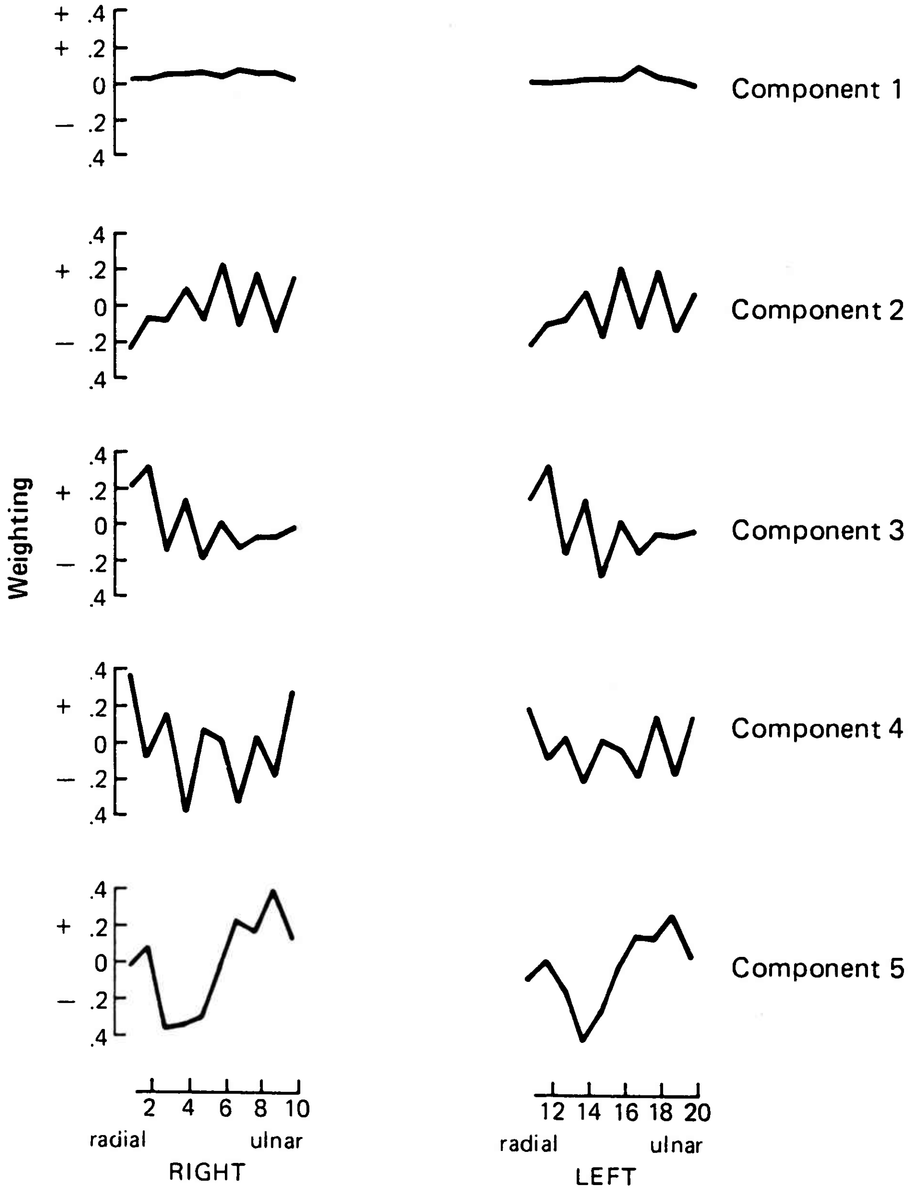

Fig. 1 : Distribution of eigenvector loadings over the digits.

lateral digits, while component 5 further emphasises this contrast especially for digits 2 and 3, again like Cumbria, but somewhat different from Oxfordshire and Berkshire which include digit 4 with the middle digits.

CONCLUSION

Comparing the principal component results for Tuareg with other populations, (Roberts and Coope, 1975, 1979; Roberts, 1979, 1982) the impression is given that in the different samples the principal components identified are very similar, though each may well vary from one population to another in the proportion of the variance for which it accounts, and so will occupy a different rank order. The population differences in distribution of loadings of the components across the digits suggest that the morphogenetic fields, which, it is argued, the principal components describe, vary slightly in their extent from one population to another, so that the fingers sample them at slightly different positions, e.g. the inclusion of digit 4 with 5 in Tuareg instead of with digits 2 and 3 as in Oxfordshire and Berkshire. The population differences in levels suggest that the loading at the sampled point in the field is heavier in some populations, for example in component 2 the level of loading on the thumb in Tuareg is clearly quite different from the Cumbrian sample.

This Tuareg material is important for it is the first African sample of sufficient size to which this particular method of analysis has been applied – the Hehe sample was rather too small for reliability. The general similarity of the results of the analysis to other populations suggests that the principal components are indeed a reflection of biological factors inducing gradients common to all populations. The differences from the other populations studied suggest slight variation in field extent and loading. Similar analyses of other large samples from Africa are desirable, to see whether these differences represent a continental or merely regional variation.

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Authors' addresses :
D.F. ROBERTS, A. REDMAYNE and E. COOPE
University of Newcastle upon Tyne
Department Human Genetics
19, Claremont Place
NEWCASTLE UPON TYNE NE2 4AA (G.B.)