DISCREPANCIES BETWEEN THE PATTERN OF ABILITIES FOR NORMAL AND NEUROTIC CHILDREN

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Introduction

In the WISC manual Wechsler (1949) gives correlation matrices for his battery of 12 cognitive tests for three random samples of normal children aged 7½, 10½ and 13½ years respectively. A factor analysis of each of these matrices, excluding the *information* and *mazes* tests which are seldom used in Britain, is reported elsewhere (Maxwell, 1959), and it is shown that the pattern of loadings is similar for all three age groups. The question then arose as to how the pattern of loadings for a sample of children attending a psychiatric clinic would compare with that obtained for normal children. The problem is investigated in this article.

The Sample

From the files of the Bethlem Royal and Maudsley Hospital children's department all children born in the years 1944, 1945 and 1946, for whom complete scores (first administration) on the 10 subtests of the WISC listed in Table II were extracted. This yielded a sample of children ranging in age from 8 to 13 years inclusive as shown in Table I.

Table I

Children by Age and Sex for Whom Complete Scores on Ten Tests of the WISC were Available

Age in Years	Boys	Girls	Total
Not recorded	5	–	5
8	5	3	8
9	37	8	45
10	50	24	74
11	51	23	74
12	46	23	69
13	11	6	17
Total	205	87	292
Average age	10·6	10·8	

The majority of these children had been referred to the clinic because of behaviour disorders—stealing, lying, truancy, temper tantrums, aggressiveness, anxiety states, enuresis, sleep walking, etc. But the sample also contained a small percentage of epileptics and brain-damaged children and a few who were possibly mentally defective. As a diagnosis for all the children was not available an exact statement of the cause of referral for the full sample of 292 children cannot be given.

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The Data

Both the raw scores and the "scaled scores" (mean=10, S.D.=3) for each child on each test were tabulated. The raw scores were used when finding the correlations between the tests but the means and standard deviations given in Table II are for the "scaled" scores. These were chosen because standard deviations for "scaled" scores for samples of normal children are reported in the WISC manual thus enabling a comparison between the standard deviations for the normal and the experimental groups to be made.

Table II

Means and Standard Deviations

	Boys (205)		Girls (87)		Boys and Girls	Wechsler's 10½-Year Olds (200)	F-ratio
	Mean	S.D.	Mean	S.D.	S.D.	S.D.	
Comprehension ..	*9·17*	*3·46*	*8·70*	3·57	*3·49*	3·1	*1·33*
Arithmetic ..	*8·69*	*3·54*	*8·87*	3·51	*3·53*	3·1	*1·30*
Similarities ..	10·07	3·19	10·03	3·49	*3·28*	3·0	1·20
Vocabulary ..	10·12	3·21	9·46	3·40	*3·26*	3·1	1·11
Digit span ..	*8·41*	2·93	*9·20*	3·39	3·07	2·9	1·20
Picture completion	*10·44*	*3·66*	*9·11*	3·50	*3·61*	3·0	*1·45*
Picture arrangement	*8·97*	*3·31*	*8·53*	3·56	*3·38*	3·1	1·19
Block design ..	10·10	*3·26*	9·30	3·45	*3·31*	3·0	1·22
Object assembly ..	*9·51*	*3·53*	*8·45*	*3·74*	*3·59*	2·9	*1·53*
Coding	*7·44*	3·23	*8·37*	3·47	3·30	3·1	1·13

(Means italicized differ significantly from the expected values of 10; S.D.s from the expected value of 3; the F-ratios italicized are significant beyond the 5 per cent. level.)

An examination of the means in Table II shows that, with the exception of the girls' mean on Similarities and the boys' means on the same test, and on Vocabulary, Picture Completion and Block Design, all the means are below the expected value of 10 (for normal children), some of them—Coding for instance—being noticeably so. Since the population standard deviation of each test is 3 a deviation of 0·63 in the case of girls (N=87), and 0·41 in the case of boys (N=205), on either side of the mean of 10 would represent a significant difference at the 5 per cent. level. On these criteria the means underlined differ significantly from the expected values for normal children, all—except that for Picture Completion for boys—being below these values. From these results it seems that the sample of psychiatric children, whatever the reasons, obtain on the average lower scores on the WISC tests than do normal children.

In Table II the standard deviations of the scores are also given—separately for boys and girls and then for the sexes combined. When the latter (the average age of the sample being 10½ years) are tested against the standard deviations for Wechsler's 10½-year old normal sample, reproduced for convenience in Table II, four of the F-ratios of the variances are found to be significant. These are for Comprehension, Arithmetic, Picture Completion and Object Assembly. Closer examination of the standard deviations, however, shows that those for our sample are consistently greater than those for Wechsler's. To emphasize this point each standard deviation was now tested against its population value of 3, by the appropriate chi-square test, and in cases where

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the difference was found to be significant the value was italicized. The italicized values in Table II show that whereas none of the standard deviations for Wechsler's data differs from its expected value, all the standard deviations for our sample, with the exception of that for Digit Span, do differ from their expected values. From these results we may conclude that, though the scores for Wechsler's sample cannot be considered to depart significantly from the population values as regards dispersion, those for our sample of psychiatric children do. It is well too to note that ours is a highly selected sample where the population at large is concerned, and that children who were too dull or too mentally disturbed to complete all 10 tests of the battery were excluded from it. This means that the standard deviations we obtained may underestimate the true values for the population of children who require psychiatric help. It would appear then that the dispersion of scores in the latter population is greater for the tests in question than it is for normal children.

The Correlations

The intercorrelation of the ten tests for our combined sample of 292 children were now found, and are given in Table III. They were obtained from the raw, rather than the scaled, scores to avoid possible contamination due to transformation; though Wechsler states that the scaled scores are obtained from his raw scores by a direct linear transformation and so would not have affected the magnitude of his correlations the same would not necessarily be true for our data. When the correlations in Table III are compared with those for normal

Table III

The Intercorrelations of Ten Subtests for Sample of 292 Children

	Arithmetic	Similarities	Vocabulary	Digit Span	Picture Completion	Picture Arrangement	Block Design	Object Assembly	Coding
Comprehension ..	0·618	0·716	0·713	0·512	0·634	0·645	0·476	0·556	0·606
Arithmetic ..		0·687	0·617	0·587	0·551	0·603	0·650	0·503	0·636
Similarities ..			0·743	0·479	0·582	0·627	0·566	0·572	0·607
Vocabulary ..				0·539	0·638	0·634	0·577	0·595	0·600
Digit span ..					0·449	0·494	0·463	0·429	0·511
Picture completion						0·673	0·635	0·677	0·615
Picture arrangement							0·605	0·674	0·648
Block design ..								0·682	0·627
Object assembly ..									0·613

children given by Wechsler they are seen to be considerably and consistently larger—the average increase is about 60 per cent. The differences too are almost everywhere significant. Greater correlations for our sample, of course, were expected since our standard deviations are the larger, but examination of the distributions of the scores showed them to be remarkably normal—with slight deficiencies in the tails—so that the larger correlations cannot be explained away in terms of bimodality or skewness. The larger age range in our sample than in Wechsler's samples however, may be partly responsible for the larger correlations and this point will be investigated in a further study.

Factor Analysis

The matrix of correlations, Table III, was now factor analysed using the Mercury Programme (Nixon, and Maxwell 1960) for Lawley's maximum

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likelihood method of analysis. After three factors had been fitted a chi-square test on the residuals showed them to be still significant, though only just at the 5 per cent. level. However, an estimate of the loadings for a fourth factor revealed that they were uniformly low and in all would extract only 1 per cent. of the total variance so the analysis was not continued further. A factor analysis of Wechsler's correlation matrix for 10½-year-old boys and girls has already been reported (Maxwell, 1959) and these loadings are given in Table IV for easy comparison.

When the factors for the two samples are examined the striking feature is the greater percentage of variance extracted by the common factors in the case of our sample (68·9 per cent.) when compared with Wechsler's sample (48·8 per cent.). This was to be expected since our correlations were uniformly

TABLE IV

Unrotated Factor Loadings for 10 WISC Tests for the Psychiatric Sample and Wechsler's 10½ Year Normal Sample

	Psychiatric Sample				Normal Sample		
Tests	I	II	III	h^2	I	II	h^2
Comprehension ..	·778	−·152	−·352	·768	·76	·06	·57
Arithmetic	·874	·381	·041	·911	·74	·06	·55
Similarities	·814	−·043	−·213	·710	·73	·24	·59
Vocabulary	·798	−·170	−·204	·707	·88	·03	·78
Digit span	·641	·070	−·042	·418	·54	·02	·29
Picture completion	·755	−·298	·067	·663	·52	−·25	·33
Picture arrangement	·782	−·221	·028	·661	·64	−·12	·42
Block design ..	·767	−·091	·358	·725	·66	−·47	·66
Object assembly ..	·733	−·384	·229	·737	·49	−·49	·48
Coding	·771	−·101	·071	·610	·45	·00	·21
Percentage variance	59·81	5·07	4·05	68·93	42·8	6·0	48·8

greater than his. The greatest discrepancy between the studies is on factor I where our first factor extracts 59·8 per cent. of the total variance as compared with 42·8 per cent. for his. Most of this increase comes from increased loadings for the last five—the so-called "performance" tests—for the psychiatric sample.

To facilitate further comparison of the two sets of results the factors for the psychiatric sample, Table IV, were rotated—the rotated loadings are given in Table V—so that the Vocabulary test had zero loadings on factors II and III. As a result the first factor is heavily loaded on the verbal side, but as it is also a general factor it is best to label it *verbal-intellectual*. It still extracts much more variance in the case of the psychiatric sample than it does in the case of the normal sample, where the first factor had also been interpreted as a "verbal-intellectual" factor. On the second factor, which may be labelled *space-performance* in view of its high loadings on Block Design and Object Assembly, moderate discrepancies between the loadings for the two samples are found on the similarities and coding tests, but otherwise the loadings are very alike. The third factor has its highest loadings on Arithmetic and Digit Span. It is known (Davis, 1956) that the Digit Span test is a good measure of "fluency" and "uninhibitedness" and this finding may well reflect the tendency towards aggressiveness often observed in children attending a psychiatric clinic.

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TABLE V

Rotated Factor Loadings for Psychiatric Sample and Loadings for Wechsler's Sample with Signs on Factor II Reversed

	Psychiatric Sample			Wechsler's Sample	
Tests	I	II	III	I	II
Comprehension ..	·864	—·146	·025	·76	—·06
Arithmetic	·742	·256	·544	·74	—·06
Similarities	·833	·005	·130	·73	—·24
Vocabulary	·841	·000	·002	·88	—·03
Digit span	·604	·118	·197	·54	—·02
Picture completion ..	·761	·252	—·146	·52	·25
Picture arrangement	·780	·221	—·063	·64	·12
Block design ..	·659	·537	·044	·66	·47
Object assembly ..	·718	·404	—·243	·49	·49
Coding	·734	·260	·050	·45	·00
Percentage variance	57·4	7·3	4·4	42·8	6·0

PSYCHIATRIC VARIABLES

It is often claimed that social conditions, child-parent relationships, sibling rivalry and such factors influence the results obtained by children on intelligence tests. To enable some estimate of the effect of such factors to be made seven "psychiatric" variables, in which the psychiatrists in charge were particularly interested, were included. They were:

1. Maternal solicitude or anxiety greater than average;
2. Maternity solicitude or anxiety less than average;
3. Paternal lack, due to death, divorce, etc. before the age of five;
4. Paternal lack after the age of five;
5. Parental over-restriction;
6. Disturbances of function (alimentary, eneuretic, parosis, hyperactivity, tics, sleep, eating);
7. Disturbed family or social relationships (parental, school, sibling rivalry).

As the data for these variables were dichotomous, associations between them and the cognitive variables were tested by dichotomizing the latter at their medians and performing chi-square tests. The few chi-square values which reached a reasonable level of significance are shown in Table VI. The signs in the table indicate the directions of the associations; for example, a minus sign indicates that an above average score on a test tends to be associated with the absence of the psychiatric variable, and *vice versa*; while a positive sign indicates that an above average score on the test tends to be associated with the presence of the psychiatric variable, and *vice versa*.

Turning now to Table VI we see that psychiatric variable 4, namely "paternal lack after the age of five" is negatively associated with five of the tests, a finding which is complimentary to fathers. Variable 2, namely "maternal solicitude or anxiety less than average" is negatively associated with the Picture Completion test, a finding which indicates that lack of interest on the part of the mother has an adverse effect on the child's performance on the test. On the other hand variable 7, that is "disturbed family and social relationships", is positively associated with two of the cognitive tests namely Block Design

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TABLE VI

Chi Square Values with Signs Showing the Direction of the Associations Between the Psychiatric and Cognitive Variables

Cognitive Variables	1	2	3	4	5	6	7
Comprehension ..				−7·75			
Vocabulary				−3·72			
Picture completion				−4·59	4·94		
Picture arrangement	5·18	−6·83		−3·56			
Block design ..							4·25
Object assembly ..							5·19
Coding				−4·41			

(A chi-square of 3·84 is significant at 5 per cent. level, one of 6·63 is significant at 1 per cent. level.)

and Object Assembly, indicating that the presence of such disturbed relationships tends to increase children's scores on these tests—a strange thing! Two further positive associations exist, involving the variables "maternal solicitude or anxiety greater than average" and "paternal over-restriction", and the tests Picture Arrangement and Picture Completion respectively. But apart from these few significant associations the children's performance on the cognitive tests seems not to be affected by the "psychiatric" variables. It may be well too to note that even in cases where significant associations exist their effect on the correlations between the tests, which is a problem of considerable interest in this article, are slight. For instance if we adjust the correlation of 0·682 between the tests Object Assembly and Block Design to eliminate the effect of the significant associations of like sign between them and psychiatric variable 7, the adjusted value is 0·674, so that the change in the correlation is negligible. Here we may note that had the two associations concerned been of unlike sign the correlation would have been increased rather than decreased after adjustment. It appears then that, provided the seven psychiatric variables included in this study are representative of such variables, the possibility of accounting in terms of such variables for the large differences between the intercorrelations of the cognitive tests, for our sample of children from the clinic and a normal sample, is remote.

BRITISH NORMS FOR THE WISC

When seeking an explanation of the apparently greater dispersion and intercorrelation of test scores for our psychiatric sample, as compared with a normal sample, it must be remembered that the WISC battery of tests has not been standardized for British children. Consequently the comparisons made above between our data and Wechsler's are, to a greater or less extent, suspect. However, some information about the performance of normal British children on the WISC is available. Jones (1959) reports data for three stratified samples of 80 children each—boys and girls in equal numbers—of 8, 9 and 10-year-old London children. She found that whereas the means of the standard scores on the separate tests for her samples tended to be greater than the expected values of 10, the standard deviations tended to be considerably lower than the expected values of 3. In addition the intercorrelations of the test scores for her samples were also lower, especially for the so-called "Verbal" tests, than those given in the test Manual. Mean scores somewhat similar to those reported by Jones were also found—for 10-year-old British, as distinct from London,

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children—in an investigation carried out by the Committee of Professional Psychologists, but the standard deviations were on the average similar to Wechsler's. Jones attributes the relatively small standard deviations which she obtained to the uniformity of instruction and of teaching methods within the L.C.C. schools from which her samples were drawn. However, the bulk of the children in our psychiatric sample come from similar L.C.C. schools and this would appear to support the contention that a real difference in the dispersions and intercorrelations of the WISC tests does exist between psychiatric and normal children. Critics, who are sceptical that this is so, have rightly pointed out the possibility that our psychiatric group may be composed of two or more subgroups having different mean scores on the tests. If this were so the combination of such subgroups into one overall group would exaggerate the standard deviations, and possibly the correlation coefficients, obtained. However, under these conditions one would have expected to find bimodality or other signs of non-normality in the test scores and this, as far as can be seen, is not the case. It would appear worth while then to look for some explanation other than those so far considered of the discrepancy in dispersion and intercorrelation of test scores between psychiatric and normal samples and the problem is under investigation.

Summary

Means, standard deviations, correlations and factor loadings for a sample of children attending a psychiatric clinic are reported for the subtests of the WISC, and the results are compared with the normative data given in the WISC Manual and with data for normal British children.

The mean scores for the psychiatric sample, as expected, were found to be lower than those for normal children, but apart from the Coding test—where the decrement is large—the discrepancies were on the average alike for "Verbal" and "Performance" tests. On the other hand the dispersions of the test scores were found to be consistently greater for the psychiatric sample than for the normal samples.

This is a bit surprising for it is reasonable to assume that most children referred to a psychiatric clinic are referred for reasons other than abnormal cognitive development. Because of this they would normally be thought of as providing a "selected" sample where intelligence is concerned and by virtue of such selection should show a dispersion of cognitive tests scores smaller than that obtained in the population at large. This problem requires further investigation.

Due, no doubt, to the greater dispersion of the test scores the intercorrelations of the tests for the psychiatric samples were found to be considerably greater than those for normal children—the "Performance" tests in particular being affected. The effect of these larger correlations shows itself especially in the loadings of the tests on a general factor of ability, which in the psychiatric sample is much more pronounced than it is in the normal sample. It is as well to note, however, that this increased emphasis on a general factor does not imply any diminution of emphasis on the group factors present, as is clear from Table V.

A few interesting associations between cognitive test scores and a number of "psychiatric" variables were also demonstrated. In particular it was seen that the lack of a father in the home tended to have an adverse affect on children's performance on some of the WISC subtests, for example on Comprehension,

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Picture Completion and Coding. Other interesting associations, for which ready explanations are not always available, are given in Table VI.

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