

## PERSONALITY IN PRIMARY SCHOOL CHILDREN :

## I.—ABILITY AND ACHIEVEMENT.

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**SUMMARY.** Scores of some 4,000 11-year-old boys and girls on the JEPI were analysed in relation to performance on scholastic and ability tests at the primary school leaving age. Analysis by correlation and analysis of variance methods revealed that extraverted boys and girls are scholastically superior to introverted ones, the regression being linear; that stable boys and girls did only marginally better than unstable ones, the regression being somewhat curvilinear; that interaction effects between N and E only occurred in conjunction with sex, unstable extraverted girls doing unexpectedly well, unstable extraverted boys unexpectedly poorly. Grammar school entrance proportions favoured extraverted and stable boys and girls, and disfavoured 'liars' on the L scale. Personality determined performance on ability/achievement tests more closely in the case of girls than of boys. The results suggest the importance of personality variables, particularly extraversion/introversion, in the attempt to predict scholastic success; it seems likely that introverts are 'late developers' as compared with extraverts, but in the absence of proper follow-up studies this conclusion remains speculative.

## I.—INTRODUCTION.

THERE has been a resurgence of interest in recent years in the investigation of temperamental variables in relation to scholastic achievement. The discovery that intellectual ability is only one of the determinants of achievement is not of course all that recent, but the lack of suitable personality tests seemed to channel most research efforts into the cognitive field. The growth of dimensional theories of personality, together with the availability of inventories for the measurement of some at least of these dimensions, has changed the picture, and now we have quite a large series of studies comparing the intellectual status and the scholastic achievements of introverts and extraverts, or stable and unstable children and students. Cattell *et al.* (1966) have gone as far as to suggest that ability, temperament and motivation all contribute something like 25 per cent to the achievement variance, and such far-reaching claims are certainly worth investigating. However, such studies as have been reported have often seemed to give contradictory results; the same personality variable (e.g., extraversion) might correlate positively or negatively with achievement in different samples. Such contradictions lower one's faith in the validity of the findings, and require explanation.

One obvious hypothesis which would serve to integrate much of the evidence available is related to the concept of the 'late developer'; if introverts, say, develop more slowly than do extraverts, then superiority of achievement in extraverts during the first few years of schooling might turn into inferiority during later years. Evidence in favour of this hypothesis is in fact available, and comes out quite clearly even in such early pioneering

studies as that of MacNitt (1930). This author studied 964 junior and high school pupils aged 13 and upwards, using a specially constructed introversion inventory; he analysed their average school marks in English, Mathematics Social Science, Physical Science and Foreign Languages and came to the following conclusion: "Those tending towards extraversion receive on the average higher marks than the introverts in Grades VII and VIII; slightly higher marks in Grades IX and X; and lower marks in Grades XI and XII. . . Those in the introverted group seem to increase their school marks on the average through the various grades, the extraverts' marks remaining on the average approximately the same. . . In general, there is a substantial relationship between introversion-extraversion and average school marks" (pp. 131-132). Taking Social Science as an example, we find correlations with introversion to be  $-.331$  in the youngest group,  $-.192$  in the middle group, and  $+.380$  in the oldest; for English the figures are  $-.379$ ,  $-.127$ , and  $+.043$ . Physical Science reaches a value of  $+.489$  for the oldest group, an interesting finding in virtue of Hudson's (1966) suggestion of a relationship between introverted personality traits and preference for science; in line with this possibility is the fact that achievement in foreign languages remains obstinately negative, with a value of  $-.494$  in the oldest group. Not too much should be made of these values, but they do suggest (1) a strong relationship, changing in time, between personality (specifically introversion-extraversion) and scholastic achievement, and (2) a differential direction of this relationship, with introversion predisposing pupils towards scientific achievement, and extraversion predisposing them towards linguistic achievement.

A similar inversion over time appears in the more recent work of S. B. G. Eysenck (1965), who correlated JEP1 scores on extraversion with intelligence test scores; this correlation turned from positive at age 11 ( $.22$  for girls,  $.27$  for boys) to negative at age 14 for girls ( $-.25$ ) and at age 15 for boys ( $-.10$ ). Intelligence and achievement are of course two different concepts, but it should be remembered that intelligence tests in schools are often highly contaminated with knowledge, and are thus measures of Vernon's *v-ed* factor rather than of *g*. Other recent studies, mostly using either the Junior MPI or EPI, or else the Cattell scales, have also tended to find positive correlations between achievement and intelligence, on the one hand, and extraversion, on the other (Jones, 1960; Morrison *et al.*, 1965; Ridding, 1967; Rushton, 1966; Savage 1966); the children investigated were on the whole quite young. Thus, the evidence, while not unanimous, does seem to support the superiority of extraverted children in the primary school and at the beginning of the secondary school.

As regards the other main personality dimension studied in several researches, emotionality or neuroticism, the findings tend to suggest that among children high N scores are associated with poor performance (Butcher *et al.*, 1963; Callard and Goodfellow, 1962; Hallworth, 1961; Lunzer, 1960; Entwistle and Cunningham, 1968). These generalizations tend to break down when attention is turned to university students (Holmes, 1960; Furneaux, 1962; Lynn, 1959; Kelvin *et al.*, 1965); these tend to excel when high on introversion and on neuroticism. However, students are clearly a very unusual and highly selected sub-group, and should not necessarily be expected to show similar relations between personality and achievement to school children who tend to be quite unselected. Students must, by definition, have passed successfully through a long series of tests, weeding out those whose N component acted as a hindrance rather than as a motivational variable. In school children no such weeding-out process is likely to have taken place.

In view of the considerable amount of agreement which has become apparent in the relation between personality and achievement, it may seem superfluous to carry out and report yet another study of a similar kind. There are several reasons for believing that such a study might produce useful results; these reasons are related to certain weaknesses in design characteristic of several past studies. These may be briefly listed. (1) Boys and girls may show quite different regressions of achievement or ability on personality variables, yet very little attention has in fact been paid to this point. (The recent study of Entwistle and Cunningham, 1968, supports this argument, and emphasises the need for treating the sexes separately.) (2) Sampling has not always been very thorough; usually just one or two schools have been used, although it is known that schools often differ profoundly from each other, and may give rise to quite different relationships in characteristics measured. (3) Statistical treatment has usually been very simple; mostly product-moment correlation coefficients have been reported. The underlying assumption of linear regression may not be justified; no tests for curvilinearity have been reported in most of the studies consulted. (4) The personality variables studied have usually been treated in isolation; this is not justified unless it can be shown that no interaction is in fact taking place. Suppose that neurotic introverts and stable extraverts do particularly well on achievement tests; simple tests against N or E separately will not disclose any significant correlations. There are too many examples of such interaction in the experimental literature (Eysenck, 1967) to allow us to dismiss this possibility as fanciful. Some form of zone analysis is clearly called for.

It is with these thoughts in mind that the experiment reported here was initiated; the set-up and the analysis were dictated by the hope that more detailed study of such factors as sex or personality interaction might reveal interesting new facts additional to the expected positive correlation between achievement and extraversion, and the equally expected negative correlation between achievement and neuroticism. Our achievement variables contain, in addition to intelligence (verbal reasoning), the English and Mathematics papers of the 11+ examination and the success or failure of the pupil to gain access to a grammar school: this seemed of some interest in view of the prevailing lack of knowledge of the degree to which personality may influence selection. Reading ability is another achievement which is of obvious importance in connection with school work, and was consequently included.

## II.—THE STUDY.

*Subjects.* All schools in Staffordshire with fourth-year junior children were asked to take part in the research. Of those that agreed to do so, 206 with about 6,000 fourth year children participated in all parts of the study and a further 55 with some 1,500 children participated to a more limited degree. In all about 77 per cent of all the 9,750 children in the age group were involved to some extent and all types of rural and urban areas within the county were well represented. At the time the research was done the children ranged in age from 10 years 9 months to 11 years 9 months, and all children in this age group from each school that took part were included.

*General Procedure.* The measuring techniques and instruments used in the research were investigated in a pilot study, but the carrying out of all parts of the main investigation, all scoring and all recording and dispatching of result was left entirely to the individual schools, each of which received a detailed manual of instructions and information,

The data were collected during May, June and July, 1966, and the schools were allowed to administer the tests, etc., at any convenient times during this three months period, although certain stipulations were made regarding conditions of testing and the order in which various tests were to be carried out.

*Main Measuring Techniques and Instruments.*

*The Junior Eysenck Personality Inventory.* The most important measuring instrument for the purpose of the present analysis is the Junior Eysenck Personality Inventory (S. B. G. Eysenck, 1965), which was designed to measure the personality dimensions, neuroticism or emotionality and extraversion/introversion, and which also has a Lie Scale.

The children were asked to read the instructions on the test form, and additional oral explanations, mainly for the benefit of the duller children, were also given. They were not allowed to talk to each other about the questions, and no help was given with reading or in explaining the meanings of words or phrases. Teachers were asked to exclude those children who were unable to read the inventory.

The completed forms were checked to make sure no child had left out any item or had made some other error.

*Abilities and Achievements.* Already available were the results of two Moray House tests of verbal reasoning, one of Mathematics and one of English, taken six months earlier as part of the secondary selection procedure. For each test obtained marks are converted to 'quotients,' which are standard scores with a mean of 100 and a standard deviation of 15. It was also known whether or not a child had qualified for a grammar school place.

Reading level was measured by the Schonell Graded Word Reading Test (Schonell and Schonell, 1960) which is administered individually. Only the obtained score, which is the number of words correctly read, was used in the analysis, although it is usually converted to a Reading Age when the test is used by schools.

*Personality Ratings.\** The four personality traits for which the teachers made ratings were: Emotional Stability, Perseverance, Sociability and Impulsiveness. For each trait there were five scale categories, ranging from 1 (highest) to 5 (lowest), and each category was accompanied by a description of children's behaviour or attributes considered most relevant to that level. The teachers were given the rough proportions of children expected in different categories, with a view to obtaining approximately normal distributions. Every child was rated on one trait before any child was rated on the next.

*Family Background.\** Information on size of family and ordinal position in the family was obtained from the children. The classification of occupations used (Central Advisory Council for Education, 1954) is based on the Registrar-General's classification into social classes and has five categories, ranging from professional and managerial occupations (1) to unskilled occupations (5). Teachers were asked to find out from each child the occupation of his father or guardian.

Teachers rated the degree of interest in their child's progress shown by parents on a four-point scale from 1 (highest level of interest) to 4 (lowest). With each scale category was a description of parental attitudes considered appropriate at that level.

\* These variables will be analysed and discussed in later papers,

*Summary of Main Variables.*

Junior EPI .....	Extraversion (E) Neuroticism (N) Lie Scale (L)
Abilities and Achievements	Verbal Reasoning (Tests 70 and 71) Mathematics English Reading Grammar School pass/fail
Personality Ratings	Emotional Stability Perseverance Sociability Impulsiveness
Family Background	Size of family Ordinal position in family Occupational Classification Parental interest in child's progress.

*Method of analysis.*

On the basis of the distributions of N, E and L scores, a sample was selected for the purpose of an analysis of variance. As a first step all children with L scores over 8 were excluded. An attempt was then made to divide the two distributions (E and N) into thirds, in such a manner that a maximum number of cases should be included in each of the resulting 9 groups, for both sexes. The two sets of scores finally adopted were as follows: Low N, 0-11. Average N, 12-17. High N, 18-24. Low E, 0-15. Average E, 16-18. High E, 19-24. In this way we obtained, for the two sexes separately, 9 groups of children showing all possible combinations of low, average or high N, and low, average or high E. The number of cases in each of the  $2 \times 9$  cells was 160, as a minimum, up to 182, as a maximum; the actual number used varied according to the availability of the achievement scores for the particular children involved. Thus the total number in a given analysis was never smaller than 2,880, and never larger than 3,276. In any particular analysis the number of children in each cell was of course kept constant. The reason for the marked variation in numbers was of course that if one child failed to complete his English test say, then 17 other children had to be dropped from the analysis in order to keep numbers in the cells equal. While these analyses of variance constitute the main part of our results, correlational analyses were also carried out on rather larger numbers in order to obtain data from non-selected groups; the analysis of variance group is of course highly selected, although preserving in its main features the characteristics of the total population.

## III.—RESULTS.

*Verbal Reasoning.* Two tests of verbal reasoning were given, VR 70 and VR 71; both were very similar and both are relatively orthodox measures of verbal intelligence. For the purpose of simplicity we shall refer to the scores on these tests as measures of intelligence, without wishing to beg any of the many questions raised by this term. An analysis of variance was carried out on the data from VR 70; these, it will be remembered, formed a  $2 \times 3 \times 3$  design, with 2 sex groups, 3E groups and 3 N groups. The means for these various groups are given in Table 1. Sex, as expected, produces significant differences (girls higher) at better than the .01 level of probability. E produces even more significant differences ( $p < .001$ ), with the more extraverted having higher

scores; this effect seems to be linear. N produces effects which are barely significant ( $p < .05$ ); the most stable having slightly higher scores than the other two groups. None of the interactions are significant; thus the main effects can be evaluated without regard for possible cross-influences.

TABLE 1  
SCORES ON VR 70.

	Male				Female			
	N—	A	N+	All	N—	A	N+	All
I	92.98	91.43	92.19	92.20	94.64	90.98	94.94	93.52
A	96.55	92.60	94.09	94.41	98.20	95.43	95.80	96.48
E	97.73	99.05	92.92	96.57	101.54	99.34	100.18	100.35
All	95.75	94.36	93.07	94.39	98.13	95.25	96.98	96.78

I=introverts. A=ambiverts, E=extraverts. N—=stable. A=average.  
N+=emotionally unstable.

Results for VR 71 are shown in Table 2. Sex again plays a very significant part ( $p < .001$ ), as does E ( $p < .001$ ), but N is not significant. However, the  $N \times E$  interaction is significant ( $p < .05$ ), as is the  $S \times N \times E$  interaction ( $p < .01$ ). The sex and E differences go in the same direction as before, i.e., girls and extraverts are superior. The significant interactions appear to originate with the emotional extravert groups; for the girls, this group is the second highest (score 103.90), while for the boys this group is near the bottom (score 95.48). A similar difference actually appears in VR 70 also (100.18 as compared with 92.92), but is below the level of significance. This group occupies the position of psychopaths and prospective criminals in Eysenck's scheme (1964, 1967) and it seems possible that for boys (whose criminal propensities are well known to be much higher than those of girls) this combination of personality traits is more lethal, and interferes more with the massed practice involved in traditional intelligence tests (Eysenck, 1959), than in girls. However, before seeking too earnestly for an explanation of the finding it might perhaps be wise to replicate the findings itself; the failure of the interactions to achieve significance in the VR 70 study suggests caution in accepting the results as necessarily genuine. Some support is given by the significant sex  $\times$  E interaction found by Entwistle and Cunningham (1968) in their work with 13-year-old school children.

TABLE 2  
SCORES ON VR 71.

	Male				Female			
	N—	A	N+	All	N—	A	N+	All
I	95.80	94.45	95.09	95.11	98.78	94.25	98.31	97.11
A	99.35	95.46	103.15	99.32	101.96	99.64	98.68	100.09
E	101.21	102.26	95.48	99.65	105.44	103.84	103.90	104.39
All	98.79	97.39	97.90	98.03	102.06	99.24	100.30	100.53

*Mathematics.* The results of the mathematics examination fail to show any difference between the sexes; the often documented superiority of males in dealing with figures apparently just makes good their inferiority in the verbal reasoning tests. (This explanation can be tested by looking at the English marks of the two sexes, where the girls should be very superior according to this hypothesis.) No differences are apparent, either, for N as a main effect, but E is again involved in producing marked differences in achievement ( $p < .001$ )  $N \times E \times S$  and  $S \times N \times E$  interactions are both significant at the  $p < .01$  level. The detailed results are given in Table 3.

TABLE 3  
SCORES ON MATHEMATICS TEST.

	Male				Female			
	N—	A	N+	All	N—	A	M+	All
I	91.08	90.79	91.70	91.19	92.93	87.88	92.76	91.22
A	96.28	91.81	100.11	96.06	95.81	94.46	93.59	94.62
E	98.52	99.32	92.96	96.93	99.85	98.36	97.60	98.60
All	95.29	93.98	94.92	94.73	96.20	93.60	94.65	94.81

The interaction effects are again mainly due to the extraverted, emotional children; the girls in this group do well, the boys poorly, compared to their colleagues in the other groups. It may be surmised that this result is either due to lower intelligence in the male sub-group, or else to the reactive inhibition produced in the examination-taking situation when confronted with massed practice on relatively monotonous material.

*English.* The results for this test are given in Table 4; as far as sex is concerned they bear out our expectation that girls would be very superior to boys ( $p < .001$ ). The other results are identical with those found in the Mathematics paper; N is significant, E highly significant ( $p < .001$ ), and the  $N \times E$  and  $S \times N \times E$  interactions are significant at the .01 level. Extraverts do better than ambiverts or introverts, and the interaction seems largely due to the emotional/extravert group, with the girls having good scores and the boys bad ones.

TABLE 4  
SCORES ON ENGLISH TEST.

	Male				Female			
	N—	A	N+	All	N—	A	N+	All
I	90.85	90.63	92.23	91.23	95.71	92.48	96.67	94.95
A	95.71	91.76	100.89	96.12	98.44	97.78	95.87	97.36
E	97.53	99.21	92.49	96.41	103.42	101.28	100.62	101.77
All	94.70	93.87	95.20	94.59	99.19	97.18	97.72	98.03

*Reading.* The reading test score again shows the familiar pattern, with girls superior ( $p < .001$ ) and extraverts superior ( $p < .001$ ); N shows a significant main effect ( $p < .05$ ) and a very significant interaction with E ( $p < .001$ .) The detailed results are shown in Table 5. The N main effect would appear to be a curvilinear one, with N+ and N- groups having higher scores than A (average) groups. This effect is in fact universal in all our tests, although it is not usually significant; inspection of the VR tests and the Mathematics and English will demonstrate this general tendency quite clearly. It would be idle to speculate at this point about the possible reasons for this curvilinear trend which in any case, while statistically significant over such a large number of children, is effectively very weak and of little practical importance.

TABLE 5  
SCORES ON READING TEST.

	Male				Female			
	N-	A	N+	All	N-	A	N+	All
I	54.29	54.70	61.01	56.67	58.77	59.42	63.16	60.45
A	66.15	59.75	62.17	62.69	65.94	64.15	63.53	64.54
E	67.08	66.56	66.87	66.84	71.38	70.09	70.57	70.68
All	62.51	60.34	63.35	62.07	65.37	64.55	65.76	65.23

*Grammar School Entrants: Proportions.* Table 6 lists the proportions of grammar school entrants for the different personality configurations. Both E and N are highly significant ( $p < .001$ ), while sex and all interactions are non-significant. Extraversion is a favourable sign for grammar school selection (particularly among the girls, it would appear) and neuroticism/emotionality is an unfavourable sign (again the differences are somewhat larger among the girls than among the boys.) The differences are not only statistically significant, but they are clearly of practical importance; the low E—high N girls send 9 per cent to the grammar school, the high E—low N girls 25 per cent. It would be idle to deny the importance in this connection of personality traits, even though some of the variance is presumably mediated through the connection between E and ability/achievement.

TABLE 6  
PROPORTIONS OF GRAMMAR SCHOOL ENTRANTS IN DIFFERENT GROUPS.

	Male				Female			
	N-	A	N+	All	N-	A	N+	All
I	.1538	.1264	.1593	.1465	.2198	.0934	.0934	.1355
A	.1758	.1209	.1264	.1410	.2198	.1319	.1209	.1575
E	.2088	.1593	.1923	.1868	.2527	.2637	.2308	.2491
All	.1795	.1355	.1593	.1581	.2308	.1630	.1484	.1808



*Correlational analysis.* Product-moment correlations were computed between variables discussed above, for altogether 2,162 girls and 1,869 boys. The correlations are given in Table 7; values for boys are set out below the leading diagonal of the matrix, values for girls above. The values in the two halves are reassuringly similar, showing that conclusions can with confidence be drawn from them, and that what is true of boys is equally true of girls. With numbers as large as these, correlations in excess of .04 would be statistically significant, although of course not much psychological importance would be attributed to such very low coefficients.

TABLE 7  
INTERCORRELATIONS OF SELECTED TESTS.

		1	2	3	4	5	6	7	8	9	10
1	Age . . . .										
2	E . . . . .	.07	.06	-.03	-.04	.06	.05	-.05	-.03	-.05	-.01
3	N . . . . .	-.03	-.19	-.21	-.03	.22	.19	.18	.19	.19	.07
4	L . . . . .	-.06	-.03	-.28	-.29	-.06	-.11	-.11	-.11	-.10	-.09
5	Reading	.06	.23	-.06	-.16	-.17	-.15	-.15	-.13	-.15	-.08
6	VR 70 . .	-.05	.19	-.11	-.15	.77	.77	.74	.70	.76	.48
7	VR 71 . .	-.05	.19	-.11	-.14	.74	.94	.94	.90	.84	.69
8	Maths. . .	-.04	.20	-.11	-.12	.70	.87	.89	.89	.84	.64
9	English	-.04	.19	-.10	-.15	.81	.90	.89	.82	.82	.61
10	Grammar school . .	-.01	.08	-.09	-.07	.48	.67	.68	.63	.65	

(Boys lower part, girls upper part of matrix.)

Age has been included in the table for the sake of interest, although of course the variance was very small. Nevertheless, there is a slight positive correlation with E and a slight negative one for N, both in line with the general age trend as set out in the Manual of the JEPI. Age also shows a very slight positive relationship with reading, but an even slighter negative one with intelligence and achievement tests; these are replicated from one group to the other, and must therefore be considered significant statistically. However, the practical importance of these slight values is almost certainly nil, and we will disregard them.

Extraversion, as expected from the analyses of variance, shows positive correlations with the intelligence and achievement tests, ranging from .23 to .19 for the boys, and from .22 to .19 for the girls. Neuroticism gives smaller but still highly significant correlations with intelligence and achievement tests, ranging from -.06 to -.11 for the boys, and from -.06 to -.11 for the girls. The L scale, interestingly enough, also correlates very significantly with intelligence and achievement tests, values ranging from -.12 to -.16 for the boys, and from -.13 to -.17 for the girls. L does not correlate significantly with E, but does correlate significantly with N (-.28 and -.29 respectively for boys and girls); hence one variable could be used as a suppressor variable for the other. Even without doing this, it is clear that the contributions of N and L are additive.

The reading, verbal reasoning, Mathematics and English tests all correlate quite highly together and obviously form the nucleus of a 'scholastic aptitude' factor; all these tests show almost identical relationships with E, N and L. The correlation between VR 70 and VR 71 is of course artificially high because it is

more of the nature of a reliability coefficient. Grammar school entrance is positively correlated with the scores on this scholastic aptitude factor, but the correlations are much lower than those between the tests; they range from  $\cdot48$  to  $\cdot69$ , thus leaving over half the variance to be attributed to non-scholastic factors. Personality features appear to play some part in this; entrants are more likely to be extraverted ( $\cdot08$  and  $\cdot07$  respectively, for boys and girls) and non-neurotic ( $-\cdot09$  for both sexes). In addition low scores on the L scale seem to be regarded with favour; correlations of  $-\cdot07$  and  $-\cdot08$  are found. These correlations are not very high, suggesting that personality as measured contributes only something like 3 per cent to the selection process. This, however, is probably an underestimate; when the figures are corrected for attenuation, as perhaps they ought to be for this purpose, the figure would become somewhat more respectable. Even then, of course, we cannot correct for chance factors in the selection process which probably assume quite a considerable importance, together with home influences and other causes not subject to measurement in this experiment. We would estimate that of the child-contributed variance to the entrance selection procedure, personality factors measured by the JEPI contribute something like 5 per cent to 10 per cent. Such estimates are of course difficult to justify without much more knowledge of all the factors active in the selection process, but they may serve as a base-line on which future research can improve.

*Psychological significance.* The statistical significance of many of the data reported should not blind us to the fact that with such large numbers of children even quite small differences appear significant, and that, even though these differences appear equally with boys and girls, and are hence replicable, yet their psychological and practical importance may be small. What is required is some yardstick to assess the general importance of observed differences, rather than a measure of statistical significance. A difference in IQ of one point may significantly discriminate between two very large groups, but would be dismissed as unimportant. Where does psychological importance begin, and how can it be indexed? The most obvious index would seem to be some adaptation or other of the method of standard scores, i.e., an indication of the strength of the observed difference in terms of the total variance. In Table 8 we have set out, for boys and girls separately, the ratio of observed differences between extraverts and introverts on various tests to the standard deviation of these tests. It will be seen that for boys this ratio is never below one-third, and exceeds one-half in the case of the reading test; for girls the ratio is in all cases but one in excess of one-half. Thus, if we consider the SD of IQ to be 15, the differences between extraverted and introverted boys would amount to something like 6 points, that between extraverted and introverted girls to something like 8 points. These differences are certainly not unimportant from the psychological point of view, and are larger than the sex differences usually reported, and considered of some interest.

TABLE 8

RATIO OF OBSERVED DIFFERENCES TO SDs OF TESTS FOR EXTRAVERTS *v.* INTROVERTS.

	Boys	Girls
VR 70 .....	$\cdot34$	$\cdot52$
VR 71 .....	$\cdot33$	$\cdot52$
Mathematics .....	$\cdot40$	$\cdot50$
English .....	$\cdot38$	$\cdot47$
Reading .....	$\cdot55$	$\cdot55$

It is clear that for girls the ratios given in Table 8 are larger than they are for boys. No explanation is offered for this phenomenon, which in any case may not be replicated in future research; until such replication is reported not too much importance should be attached to this difference. Entwistle and Cunningham (1968) have reported tentatively a similar suggestion.

#### IV.—DISCUSSION.

To what extent may our sample be regarded as representative? With respect to verbal intelligence and achievement in Mathematics and English our 1,869 boys and 2,162 girls are not far removed from the national average of 100; the figures are given below in Table 9. There is a slight inferiority, but it is too small to give much concern.

TABLE 9  
MEAN SCORES ON VR 70, MATHS AND ENGLISH PAPERS.

	Boys	Girls
VR 70.....	98.25	98.35
Maths. ....	98.19	98.20
English .....	97.75	97.62
(N) .....	(1,869)	(2,162)

With respect to personality we would perhaps expect considerable agreement between the figures from this sample and the standardization data on extraversion; the actual figures bear this out. Boys score on the average 17.42, girls 17.42; this compares with standardization figures of 17.69 and 17.32 respectively. Variances too are almost identical. In so far as the standardisation sample may be regarded as a proper national sample, so far can we regard our present group as representative. With respect to L we would of course expect our present sample to have lower scores, because high scores were in fact excluded; the means for our group are 3.86 and 3.86 compared with standardization means of 4.79 and 5.49. Variances are slightly lower, but it is the drop in means which is important and relevant. Concurrent with this drop in L scores, and not unexpected because of the usual negative correlation between L and N, is a rise in N scores. For our group the means are 12.70 and 12.63; these figures should be compared with the standardization means of 11.10 and 11.83. Variances are slightly reduced, but the important and relevant figure is the difference in means. Our sample is obviously not representative, containing fewer 'liars' (high L scorers) and more 'neurotics' (high N scores). This slight failure to be representative is the price we have to pay for excluding potentially invalid inventories with high lie scores; it is impossible to be sure whether our choice was or was not a reasonable one. In any case the deviation from proper sampling norms is only a marginal one; it is unlikely that any of our main conclusions has been much affected by it.

These conclusions may be listed as follows:

(1) Extraverted boys and girls do better scholastically and on verbal reasoning tests than do introverted boys and girls; the relation is linear on the whole, and may be expressed by a product moment correlation coefficient of .20 or thereabouts.

(2) Emotional boys and girls do only slightly less well than do stable ones, and the significance of N as a main effect is marginal. The relation is curvilinear, with high N and low N children doing better than those with average N.

(3) Interaction effects between E and N seem to be related to sex ; emotional extraverts do well in the female group, but badly in the male group. This result is partly in line with the findings of Entwistle and Cunningham (1968).

(4) Sex differences are apparent in the English paper, but neither in VR nor in Mathematics ; the superiority of the girls in English is equalled by their superiority in Reading.

(5) Grammar school entrance proportions favour extraverted and stable boys and girls ; instability is actually a worse prognosticator for girls than for boys.

(6) E scores determine performance of girls more closely than performance of boys.

(7) ' Liars ' on the L scale tend to be rejected from grammar school entrance ; this would of course lower the observed relation between low N scores and acceptance, because of the known negative correlation between N and L. The figures might be more impressive had not very high ' liars ' been excluded from the analysis.

These findings present us with some difficult and complex questions. To what extent can we find answers to the casual question implicit in much of what we have said—does intelligence ' cause ' extraverted behaviour, or does extraversion ' cause ' children to do well in school ? We do not believe that our data enable us to answer this type of question, and indeed we are not certain that the question is a meaningful one as phrased. Further research of a more detailed and experimental kind is obviously called for. It is more easily possible to partial out intelligence scores from the personality-achievement correlations, but we have not done this because of doubts about the VR tests being even reasonably pure measures of Burt's " innate mental ability " ; their very high correlations with the achievement tests suggest that scholastic achievement makes such a large contribution to VR scores as to make the task of partial correlation analysis of doubtful value. An exception to this general rule is presented by the grammar school entrance data ; here clearly we must try and estimate the influence of personality variables when the influence of ability/achievement is held constant, without however wishing to argue necessarily that the causal sequence goes along this direction. An analysis was undertaken, but will not be reported in detail ; it revealed in essence that for most groups the admission rate was governed by ability/achievement, but that introverted boys (but not girls) were accepted more frequently than their VR scores would suggest, and that neurotic boys were selected more frequently, and neurotic girls less frequently, than would be expected on the basis of their VR scores. We do not find it easy to explain these findings. We will come back to these points in a later paper.

Our findings challenge comparison with the Entwistle and Cunningham (1968) paper, which is the only one of those quoted which based its findings on a really adequate number of cases. Working with a sample of 1,472 girls and 1,523 boys aged 13, these authors found a significant, negative, linear correlation between N and school achievement ( $r = -.16$ ) ; our own figure is slightly lower and there is a suggestion of curvilinearity in the analysis of variance. Possibly the differences are due to the differences in age of the two samples ; possibly the curvilinearity is an artefact of the special selection process used to find equal-sized groups for our analysis of variance. In any case there is agreement on the detrimental effect of N school children, as far as school achievement is concerned. Entwistle and Cunningham failed to find a correlation between school achievement and E " because a distinct sex difference produces an overall non-linear relationship. Extraverted girls and introverted boys tend to be

more successful in school work than children with the opposite personality characteristics." We did find a very significant relationship approximating the value of  $r = .2$  between E and school achievement for both sexes; according to our hypothesis of the introvert 'late developer,' this difference between the two investigations would be explained by the age difference between the two samples. Had a 15-year-old sample been tested we would have predicted an actual inversion of our results, with introverts superior to extraverts. There may of course be a sex difference in the point of cross-over from E-superiority to I-superiority; Entwistle and Cunningham's data suggest that this point may occur earlier for boys than for girls (but see S. B. G. Eysenck, 1965). Our data agree with Entwistle and Cunningham in suggesting that extraversion is a more positive influence towards school achievement in girls than in boys, although our data emphasise an  $E \times N$  interaction which does not appear in their data: in ours, of the emotional girls it is the extraverted one that does *best*, while of the emotional boys it is the extraverted one that does *worst*. There is no overall curvilinear regression of school achievement on E, for boys and girls together, or for each sex separately, as in their Fig. 2. This interaction effect ( $N \times E$ ) may also be a function of age, disappearing as the children get older.

It is clear that Entwistle and Cunningham are right when they say that we are dealing with "complex inter-relationships about which we still know all too little." The reason why the problem is a difficult one is clearly related to the differential influence of age and sex on personality and achievement; this makes essential use of very large groups of children, and the coverage of different ages. The present study may serve as an introduction to the analysis of 11-year-old children, while the Entwistle and Cunningham one serves the same purpose for 13-year-old children. A study of 15-year-olds would give us an even better perspective, but of course all this would still only be cross-sectional; what is most urgently needed is a good follow-up study, on large numbers of children, taking into account school achievement and intelligence, as well as personality and home background. The advantage we now have is simply that we can frame more clear-cut hypotheses than was possible a few years ago; we are certainly still very far from having any firm answers to our questions.

Some hypotheses have already been suggested by Entwistle and Cunningham, and by us in a previous section; here we wish merely to point out that the testing of such hypotheses demands a much more analytic approach than has been customary. Eysenck's attempt to make use of the Yerkes-Dodson law in relating achievement in school to N demands for its verification some measure of the *difficulty level* of the school work involved, as this is a crucial parameter of the law in question; what is more, this difficulty level may differ from school to school, or even from class to class, and will almost certainly differ from pupil to pupil. Without measuring these aspects of difficulty level no proper assessment of the value of the theory is possible. Again, motivation is an important variable which is frequently neglected, although it plays a crucial role in the complex of hypotheses which we are considering (Eysenck, 1964); it might with advantage be measured along the lines suggested by Entwistle (1968). Possibly some of the observed differences between extraverts and introverts, and their relation to age, reflect differences in response to social motivation; this may be stronger in the primary school, to give way gradually to intrinsic scholastic motivation. This shift in turn may occur earlier in England than in the U.S.A., where schools are reputed to present a 'softer' option than in England; this may account for the later cross-over between achievement and extraversion in the work of MacNitt (1930) than in that of Eysenck (1965).

Some attempt to measure this variable of 'formal work' will have to be made if we wish to test adequately any of the theories which suggest themselves. Complexity in the data does not preclude scientific analysis, but it does demand corresponding complexity of analysis, theory and measurement.

ACKNOWLEDGEMENTS.—We are most grateful to the many primary school teachers in Staffordshire who supplied the bulk of the research data; for such whole-hearted co-operation, often involving much effort and many hours of work, they deserve every praise. We are also grateful to the Staffordshire County Council Education Committee for permission to carry out the research and to numerous members of the Health and Education Departments for valuable advice and indispensable assistance. The Maudsley and Bethlem Research Fund gave support to the study.

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(Manuscript received 26th October, 1968)