

2. They are equal in magnitude to each other when  $A = B$ ,  $O > 0$ .
3. They decrease as the proportion of  $O$  responses decreases relative to  $A$  and  $B$  responses.
4. They increase when the proportion of  $A$  and  $B$  responses increases relative to  $O$  responses.
5. If a given balance coefficient is greater than its corresponding balance coefficient (if  $\frac{A}{A+B} < \frac{B}{A+B}$ ), then the same relation holds for the corresponding context coefficients.

Since comparison of the two context coefficients yields the same information as a balance coefficient and since the context equation (2) explicitly shows the influence of context upon balance, it is considered that in the study of psychotherapeutic protocols the use of context coefficients is preferable to the use of balance coefficients of the form,  $\frac{A}{A+B}$ .

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## A NOTE ON THE DIFFERENTIATION OF NORMAL AND NEUROTIC CHILDREN BY MEANS OF OBJECTIVE TESTS\*

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#### PROBLEM

In a previous paper<sup>(2)</sup> we have shown that a sample of "normal" monozygotic twins were appreciably more alike with respect to a measure of "neuroticism" based on a battery of objective tests than were a sample of "normal" dizygotic twins, and the conclusion was drawn that the quality underlying these objective tests was to a considerable extent inherited. On the basis of certain somewhat doubtful assumptions<sup>(7)</sup>, it was calculated that the influence of heredity on the factor score amounted to 81%, although no great value was placed on the exact figure. In any case, there appeared to be little doubt that heredity played about as large a part in the genesis of *neuroticism* as in that of *intelligence*. A discussion of an operational definition of neuroticism will be found elsewhere<sup>(3, 4)</sup>.

An attempt was made to obtain an outside verification of our identification of the factor isolated from the intercorrelations of the tests as one of "neuroticism" by showing that tests having high correlations with this factor also discriminated well between our whole group of 100 twins (who might be regarded as a "normal", i.e. unselected section of the total population) and a control group of 21 neurotic children (i.e. children definitely diagnosed as suffering from neurotic disorders by senior staff members of the Maudsley Child Guidance Clinic.) A correlation of .76 was found between the factor loadings of the 17 tests used, and their biserial correlation with the normal-neurotic dichotomy. As this proof is somewhat indirect and dependent on complex statistical argument, and as it does not enable us to state the actual amount of discrimination achieved by the test battery in question, a different method of proof is attempted here to show that the statistical factor isolated can indeed with some show of reason be labelled "neuroticism".

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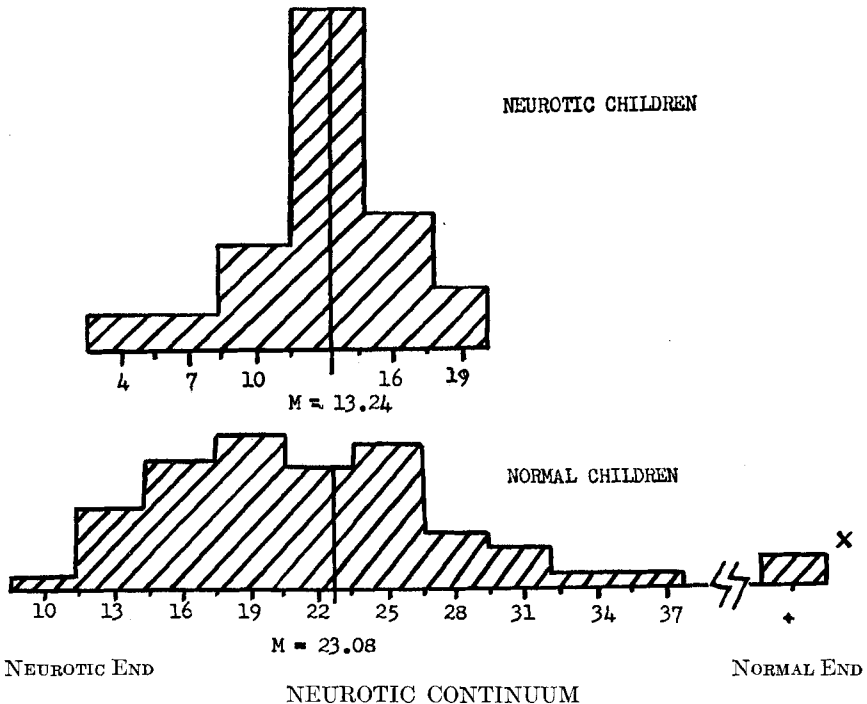
\*We are indebted to the Eugenics Society for a grant which made this study possible.

METHOD AND RESULTS

From our battery of tests we obtain a single, weighted score<sup>1</sup> which, if the quality measured by the tests can really be called "neuroticism", should discriminate at a very high level of statistical significance between our "normal" and our neurotic children. In addition, we should be able to formulate certain other hypotheses capable of being tested in terms of the figures obtained. Thus for instance the neurotic group was very highly selected, and should therefore be rather homogeneous with respect to neuroticism; the "normal" group was completely unselected, and should therefore be relatively heterogeneous. We would therefore expect the "normal" group to show a greater spread of scores (higher variance) on the measure of neuroticism. Again, in view of the strict selection of the neurotic children, we should expect all of them to have definitely neurotic scores; the "normal", unselected group, on the other hand, would be expected to have between 5% and 10% of severely neurotic children in it (cf. R. Fraser<sup>(5)</sup> and Burt<sup>(1)</sup> for data supporting this statement). Consequently, a small proportion of the so-called "normal" group should in fact have neurotic scores.

With these hypotheses in view, factor scores were calculated for the 21 neurotic and the 100 "normal" children. A diagram presenting the main results is given below (Fig. 1.). The portion of the diagram representing the "normal" group was reduced in size in the ratio 21/100 in order to equate the total area of the two distributions for easier comparison. The mean score of the neurotic group was 13.24; that of the "normal" group was 23.08. The significance of this difference was tested by means of a very conservative method (using means of pairs of twins as scores, in

FIG. 1. COMPARISON OF DISTRIBUTION OF SCORES FOR 21 NEUROTIC CHILDREN AND A CONTROL GROUP OF 100 NORMAL CHILDREN.



\*2 sets of normal twins are respectively 8 and 14 times the neurotic S.D. removed from the neurotic mean, so that their proper scale positions would fall outside the limits of this diagram.

<sup>1</sup>Not, be it noted, weighted like a multiple R, but in terms of factor saturations.

order to avoid the pitfalls inherent in the use of separate children's scores, which assumes a complete lack of correlation between the children) and was found to be well beyond the  $p = .001$  level. There remains, therefore, no reasonable doubt that "neuroticism" scores differentiate with considerable accuracy between neurotic and "normal" children. (It may be noted that the mean scores of the monozygotic twins and the dizygotic twins were almost identical—23.20 and 22.96 respectively, and that each of these scores separately is very significantly different from that of the neurotic group.)

It will be evident from Fig. 1 that our expectation with regard to the greater spread of scores of the "normal" children is also borne out. The variance for the "normal" group is several times that for the neurotic group, a difference significant beyond any reasonable doubt. Again the values for pairs of dizygotic twins (50.83) and pairs of monozygotic twins (172.67) taken separately are significantly greater than the value for the neurotic children (12.60). (The difference in variance between pairs of dizygotic and monozygotic twins was already noted in our previous paper; it is almost entirely due to the fact that we are considering scores for *pairs* of twins, and that the correlation between pairs of twins is much higher for monozygotic (.85) than for dizygotic twins (.22). When we take scores for individual children, the variances become 91.55 for monozygotic and 41.47 for dizygotic twins.)

It will also be seen from Fig. 1 that while none of the neurotic children have scores as high as the mean of the "normal" group, about 10% of the "normal" children have scores as low as the mean of the neurotic group. This is of course in part a consequence of the difference in variance between the two groups, but it does seem to indicate the correctness of our hypothesis that our process of selection would ensure that all our neurotic children were really neurotic, but could not ensure the absence of neurotic children in the "normal" group. If psychiatric screening had taken place with respect to the "normal" group, it seems certain that our neuroticism score would have shown much higher discriminatory powers. Such screening would of course have vitiated the main aim of our experiment, i.e. the study of the degree of inheritance of neuroticism, by restricting the range of the phenomenon under consideration; the point is merely mentioned because it is not always kept in mind in assessing the usefulness of objective tests in discriminating groups of neurotics and unscreened "normals".

#### CONCLUSIONS

It may be concluded that the discrimination achieved appears very promising, particularly in view of the doubtful status of some of the "normal" children. It should also be borne in mind that the battery of tests used represents the best that could be done at the time when this experiment was begun, i.e. in 1948; much better batteries of tests are now available through the work of Himmelweit and Petrie<sup>(6)</sup> and others who have improved the older tests, or suggested new ones, and it may be confidently anticipated that research now in progress will show considerably better differentiation than that found in this study. However, even at its present level, objective tests of neuroticism might be of considerable practical use as screening tests, i.e. in isolating the child most in need of psychiatric attention. Taking all these facts into account, it would appear that our identification of our factor with "neuroticism" finds considerable justification in the results here reported.

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