

NEUROTICISM IN TWINS*

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SIR FRANCIS GALTON, in his description of the eugenic Utopia, which he called Kantsaywhere, pictured a country in which "a system of competitive examination for girls, as well as for youths, had been so developed as to embrace every important quality of mind and body." The status of the individual as well as the number of children which he would be permitted to raise depended on the results of this examination. It will be noticed that Galton did not confine himself to the measurement of intellectual qualities but also stressed traits of character and temperament. In a short paper published in this *Journal* a few years ago¹ I tried to show to what extent psychology had succeeded in furnishing the type of test which Galton would have required for such a searching examination. It was concluded that while we had succeeded in isolating and measuring some of the main dimensions of personality, we knew little about their genesis, their distribution in the population and their connection with age, sex, social status and birth order.

Of all these unknown variables the one which is of most interest to eugenics is, of course, the genetic one. It would not be true to say that no research had been done into the inheritance of personal qualities other than cognitive ones; elsewhere² I have given a review of about a hundred studies dealing with precisely this problem. The results, however, are unsatisfactory for a variety of reasons. In the first place the investigations using objective tests are mostly very limited in scope, dealing with traits of a very low order of complexity, such as scribbling, angle of handwriting, eidetic imagery, reaction times, spatial orientation. The interest in the particular tests used is usually dependent on the acceptance of a particular system of typology; thus eidetic imagery would be of interest to the followers of Jaensch, conditioned reflexes to the Pavlovians and details

of handwriting to the graphologists. In the absence of any convincing proof that these systems and typologies are of any great value, the interest in the specific tests used diminishes accordingly.

In the second place, it must be noted that when an attempt is made to study higher order concepts, such as criminal predisposition or mental abnormality, the concepts chosen are of an ethical, sociological or psychiatric, rather than of a psychological nature, and the investigations usually proceed along lines far removed from the objectivity of psychometric testing procedures.

In the third place, the results of previous studies are frequently difficult to interpret for a variety of reasons. We often do not know just what it is that a given test is measuring. Many tests have very low reliabilities, so that clear-cut results cannot be expected. There are many experimental errors (lack of proper statistical treatment; faulty sampling practices; faulty diagnosis of mono-zygoticity or di-zygoticity) which may account for the frequent inexplicable differences in the contributions of different students, using what are apparently identical tests and procedures.

More important than these faults, which could be obviated by suitable statistical, diagnostic and sampling techniques, is a fundamental methodological error which pervades nearly all the studies reported in the literature. All these studies make use of the so-called "twin method" developed in Germany, which consists in comparing the average resemblance of identical twins with

* The study discussed in this paper was carried out jointly by Mr. D. B. Prell and the author; it was made possible through a financial grant from the *Eugenics Society*. A full account of the details of the experiment and the numerical results is being published under the title "Inheritance of Neuroticism: an experimental study" in the June issue of the *Journal of Mental Science*.

that of fraternal twins. The differences between identical twins due to environment alone are compared with the differences between fraternal twins due to both heredity and environment; if differences between fraternal twins are much greater than differences between identical twins, heredity appears to be a powerful causal influence, while, if differences are small or non-existent, the influence of heredity as a causal factor in individual differences is discounted. The assumption is made, of course, that the influence is as similar for a pair of fraternal as for a pair of identical twins; this assumption, while it would be difficult to prove, is not contradicted by such studies as have been done in order to investigate it more closely.

This method of twin study has many advantages, but it has led, in the past, to certain unjustified conclusions because those who have used it have tended to make a quite unjustified intellectual jump which may best be illustrated by reference to studies in intelligence.

In a typical investigation, an experimenter might give a certain test of intelligence, such as the Binet, to groups of identical and fraternal twins, show that the intra-class correlation between identical twins was far larger than that between fraternal twins, and conclude that intelligence was inherited to the extent of, say, 80 per cent. Even if we assume that the assumptions underlying the mathematical calculations are unexceptionable, it will be seen that somewhere in the argument there is a jump from a given test (the Binet) to the conclusion on the inheritance of *intelligence*. Now it is well known that a test like the Binet measures in addition to intelligence a number of other factors, such as memory, visuo-spatial ability, verbal ability, numerical ability, and so forth, as well as certain specific factors which it does not share with any other test. What is inherited to the extent of 80 per cent is the ability to do well on the Binet; this ability is only in part identical with intelligence and there is no direct way of equating the two.

This mistake of drawing *general* conclusions from *specific* tests is so widespread as to vitiate most twin investigations in the

psychological field. In these circumstances we may be somewhat doubtful of the general conclusions drawn by Newman, Freeman and Holzinger³ from their own investigations, who maintained that* "*the only group of traits in which identical twins are not much more alike (than fraternal twins) consists of those commonly classed under the heading of personality. . . . The difference in resemblance of the two classes of twins is not the same in the different groups of traits. In general the contrast is greatest in physical traits, next in tests of general ability (intelligence), less in achievement tests and least in tests of personality or temperament. In certain instances, viz. . . . tapping, will-temperament and neurotic disposition, the correlations of identical twins are but little higher than those of fraternal twins.*" The conclusion is appropriate not to traits of personality but to the results of certain very poorly chosen tests which may or may not measure those traits to a degree which is almost certainly very limited.

These doubts and criticisms have determined the set-up of an experiment radically different from those mentioned above. We have tried to investigate the inheritance not of a given *test score* but of certain important underlying *general traits*. Again we can clarify this idea by reference to intelligence. Instead of giving one test of intelligence the proper procedure would be to give a large number of tests, intercorrelate these and demonstrate by means of factor analysis the existence of the different abilities which are measured by them (general intelligence, numerical ability, verbal ability, memory, etc.). We could then derive, through suitable mathematical procedures, an expression of the ability of our twins, not for each *test*, but for each of these *factors*, and study the degree of inheritance of general intelligence, numerical ability, verbal ability, memory, etc.

This is what has been done in the present investigation. The trait investigated was chosen because of its social importance, its interest to eugenics and the availability of a

* Italics not in original.

battery of tests known to measure it with a fair degree of accuracy. Some of these tests have been described in my previous paper in this *Journal*,¹ and it would therefore not be worth while to describe them again. Suffice it to say that seventeen tests in all were given to twenty-five pairs of mono-zygotic twins and twenty-five pairs of di-zygotic twins born during the period 1935 to 1937 and discovered after searching through the birth records for five boroughs in South London for all twins of the same sex born during that period. The diagnosis of zygosity was established by means of fourteen criteria including: close resemblance of ears, teeth and facial features; iris pigmentation; standing height; the presence or absence of mid-digital hair; ability to taste phenyl-thio-carbamide; scapular shape; and blood groups A_1A_2BO , Rh, MNS, P, Lewis, Kell and Lutheran. All these children were normal in the sense that they had never been to a child-guidance clinic and had never had any kind of psychiatric treatment.

In addition to these twins, twenty-one children of a similar age were selected from out-patients at the Maudsley Child Guidance Clinic to constitute a neurotic control group. Great care was taken to exclude children with organic complications or with possible psychiatric traits, or who were not considered "unstable" by the examining psychiatrist. The resulting sample approaches as closely as is possible, at the present stage of psychiatric knowledge, to a "pure" neurotic group with relatively little mixture of mental and physical disorders.

The tests used were intercorrelated for the total sample of twins, a factor analysis was carried out, and a factor of "neuroticism" or emotional instability found. The interpretation of this factor was validated by showing that those tests which had a high saturation on the factor were also those tests which gave the best discrimination between our experimental group of normal twins and our control group of neurotic children. Next intra-class correlations were calculated for the identical and fraternal twins separately on each of the seventeen tests used; we also calculated the neuroticism score for all the

twins by suitably weighting all the test scores by their factor saturations. Lastly the percentage of heredity determination for each test and for the neuroticism score was calculated using Holzinger's h^2 statistic. This purports to give the degree to which a given score is determined by inherited factors as opposed to environmental factors and in spite of certain dubious assumptions made in its derivation, this statistic does give a quick and probably fairly accurate measure of the degree of hereditary determination.

Using this statistic, it was found that for the neuroticism score the correlation between identical twins was $\cdot851$, whereas that for the fraternal twins was only $\cdot217$; $h^2 = \cdot810$, and if we accept Holzinger's derivation we would conclude that neuroticism or emotional instability is inherited to the extent of 81 per cent for the particular cultural conditions in which this sample of children was brought up.

It is particularly interesting to note that none of the individual tests have as high an h^2 value as does the factor score of neuroticism; this is important because it demonstrates conclusively a point which has often been disputed, namely the fact that a factor derived through statistical analysis need not be a "statistical artefact", but may have biological reality.

We may summarize our results. Our first step was to show that a battery of suitably chosen tests defined a general factor of neuroticism or emotional instability; this interpretation was validated by comparing the scores on our tests of normal and neurotic children. Our second step consisted in calculating scores on this factor of neuroticism for identical and fraternal twins. Our third step consisted in correlating these scores for the two groups of twins separately and to show that the correlation for identical twins ($\cdot851$) was considerably higher than that for fraternal twins ($\cdot217$), thus arguing strongly in favour of the inheritance of this particular trait. Our last step consisted in the calculation of a statistic purporting to show the percentage of hereditary determination of this trait, which worked out at 81 per cent.

In view of the smallness of the sample

used and the doubtfulness of some of the assumptions underlying the derivation of the h^2 statistic, it would not be correct to attribute too much importance to the exact value obtained for the degree of hereditary determination of neuroticism. There can, however, be little doubt that our study demonstrates the fact that individual differences in emotional stability in our type of cultural pattern are determined very strongly by inherited genetic factors and to a very much smaller extent by environmental influences of one kind or another. It is hoped that this experiment may be repeated soon with a

better selection of tests than we were able to make at the time this work was begun, and using larger numbers of children than we were able to use, so that we might be able to verify our conclusions and to give a more correct estimate of the exact degree to which neuroticism is inherited in our society.

REFERENCES

- ¹ Eysenck, H. J. "The Measurement of Socially Valuable Qualities." *EUGENICS REVIEW*, 1947.
² Eysenck, H. J. "The Inheritance of Neuroticism: An Experimental Study." *J. Ment. Science*, 1951.
³ Newman, H. H., *et al.* "Twins: A Study of Heredity and Environment." Chicago, 1937: Chicago University Press.

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