*Critique of Hereditarian Accounts of "Intelligence" and Contrary Findings: A Reply to Jensen**

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The confounding of environmental and hereditary influences is a considerable problem in estimating heritability from twin studies. Fred S. Fehr discusses this problem and suggests two ways of calculating heritability which separate these influences more cleanly than the formula commonly used. The importance of heritability in the determination of intelligence is considerably less than suggested by Jensen when the effects of environmental variables are thus more adequately controlled.

"Impenetrability! That's what I say."
"Would you tell me, please," said Alice, "what that means?" .... "I meant by 'impenetrability'," said Humpty Dumpty, "that we've had enough of that subject, and it would be just as well if you'd mention what you mean to do next, as I suppose you don't mean to stop here all the rest of your life." (Lewis Carroll, *Through the Looking Glass*, 1873, Chapter 6)

The purpose of this article is to call attention to some apparently disregarded and/or overlooked findings in the frequently quoted and classic study of Newman,

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Freeman, and Holzinger (1937), and to provide findings derived from the equally noted results of a study by Shields (1962). These findings are indirectly contrary to Jensen's conclusions (1969) regarding the relationship of the heritability of intelligence[1] and social class; they are specifically contrary to the underlying and necessary assumption that individual differences in intelligence can largely (if not almost entirely) be accounted for by hereditary factors.

Confounding of Variables

Before examining these data, several comments and points are in order. One frequently considered objection to correlational studies purporting to demonstrate the importance of heritable, as compared to environmental, factors is that both factors are usually confounded in such efforts. This is particularly relevant in comparisons of the estimated intelligence of monozygotic (MZ) and dizygotic (DZ) twins when the twin pairs live from birth in the same family environment. Thus, the greater resemblance of the estimated intelligence of MZ twins as compared to DZ twins may be due to the environment being more similar for the MZ pairs. That is, the marked similarity of appearance of identical twins causes other people to treat them alike and confuse them with one another. They are often dressed alike and treated as a unit by their family and friends. Wilson (1934) concluded that both fraternal and identical twins share a more similar environment than siblings, and identical twins a more similar environment than fraternal twins. The finding of greater similarity of environments for fraternal twins than for siblings has also been supported by Herrman and Hogben (1932).

Seemingly, the significance of this criticism has generally been little appreciated. However, when one considers the minimal twin pair difference obtained in deriving the percent variance which is purported to be an estimate of heritability, the issue may be placed in more adequate perspective for the data to be subsequently presented here. Specifically, the mean difference between DZ twins reared together has been reported to be 9.9 points and for MZ twins 5.9 points on the Binet IQ test (Newman, Freeman, and Holzinger, 1937). Coefficients of heritability have been estimated from 65 to 80 percent from these same data. The point to be emphasized,

[1] Tests of intelligence in the present context are referred to in the spirit of Hempel's thesis (1965) of liberalized operationism, that is, that tests as operations are presently the most reliable indicators of intelligence and are not necessarily any finalized valid measure of what some authors might claim intelligence to consist of. Thus, intelligence in this frame of reference is indicated by widely utilized test measures.

if not already apparent, is that such minimal mean differences between MZ and DZ twin pairs (4 IQ points in this case) can be accounted for equally well by environmental factors. To reiterate, mean differences between twin pairs of 4 IQ points can be accounted for by the fact that MZ twins share a more similar environment than do DZ twins. Studies of twins separated in early life and reared apart would seem to provide an adequate basis to answer the aforementioned criticism. But an examination of these studies reveals both methodological difficulties and contradictory findings.

Methods of Analysis

As suggested by Jensen (1969), studies of twins reared apart are not only the simplest means of estimating heritability coefficients, but also a methodologically more adequate means of limiting the confounding of environmental and genetic factors. According to Jensen "all they (separated MZ twins) have in common are their genes," a point which will receive attention shortly. As Jensen also notes, there are relatively few studies of separated twins. The ones that are most prominently reported in the literature are those of Newman, Freeman, and Holzinger (1937), Shields (1962), and Burt (1966). With some variations, several formulas have been initiated and/or derived from the Newman, Freeman, and Holzinger study for the estimation of heredity and environment. These include comparisons of (1) MZ and DZ twin pairs reared in the same environment, (2) MZ reared in the same environment and MZ pairs reared in separate environments, and (3) MZ and DZ twins reared in separate environments. These will be elaborated.

(1) *MZ versus DZ (same environment)*

Most twin studies have made comparisons between MZ and DZ twins reared together. In addition to pointing to the relatively high correlations between MZ as compared to DZ twins, a number of investigators have utilized a formula (or derivatives) suggested in the Newman, Freeman, and Holzinger study (1937). This formula has been used to express the intrapair differences in terms of variance (sums of squared deviations from the mean for the pair divided by the number of pairs). One then calculates ratios of the variance observed in DZ twins (V_d) and MZ twins (V_m). From these are derived coefficients of heritability (H) from the formula:

$$H = (V_d - V_m)/V_d$$

When H equals zero the variations are considered to be purely environmental; when H equals 1 they are purely genetic, and intermediate values are claimed as estimates of the relative contributions of either heredity or environment. As already noted, the coefficients of heritability (H) turned out to be 65 to 80 percent; in other words, roughly two-thirds to four-fifths of the variance can be ascribed to heredity. This corresponds to the approximate correlational value of .90 of MZ twins frequently reported in the literature by proponents of the genetic position, and thus explains their claim that 81 percent of the variance, the correlational value squared, can be attributed to hereditary factors. However, this is only one side of the issue and, as will be suggested here, a biased and seemingly incorrect one. This becomes evident in formula 2.

(2) MZ (same environment) versus MZ (separated environment)

There is a second apparently disregarded and/or overlooked formula suggested by and utilized in the Newman, Freeman, and Holzinger study. Compared to the assumption of comparable environments for MZ and DZ twins in the estimations of H reported under (1) above, this method consists of an estimate of the importance of environment (E) in which are computed ratios of the variance of separated MZ twin pairs (V_{mz_s}) and unseparated MZ twin pairs (V_{mz_u}). Thus the formula:

$$E = (V_{mz_s} - V_{mz_u})/V_{mz_s}$$

Compared to the quoted estimate of heritability under (1) above, they reported as well the following for the estimates of the importance of environmental factors (all converted to percentage of the total variance): height 24, weight 87, head width 58, Binet IQ 59, Otis IQ 64, and Stanford Achievement Test 87. These, of course, are considerably higher estimates of the importance of environment than usually reported.

As further support for this position, the present author made similar comparisons from the data of Shields (1962). Ten separated MZ twins were matched for sex and age at separation and compared with ten MZ twins living together. On the Dominoes test the mean difference was 3.1 (greater for the separated twins) and the estimate of environment was 72 percent. For the Mill-Hill vocabulary the mean difference was 1.8 points and the estimate of environment was 62 percent. These values thus compare favorably with those reported by Newman, Freeman, and Holzinger.

Furthermore, and to add to the possibility that these estimates of the importance of environment might be even greater, separated identical twins are not randomly placed in diverse environments. The selection of foster homes by agencies gives preferences to families who have sufficient financial resources to adequately care for the child and who show signs of intellectual and emotional understanding of the child's needs and the problems of adoption. Consequently, separated MZ twins placed for adoption through a professional agency are placed in selective and relatively homogeneous home environments as compared to the diversity that would result from random placement. Thus, the interpair MZ differences of 8.2 (and, inversely, the interpair correlation of .67) reported in the Newman, Freeman, and Holzinger study for separated MZ twins, could be even greater and thereby further enlarge the estimations of the importance of environment.

Moreover, and in addition to the selective tendencies of adoption agencies, there is an even more potent bias in the placement of separated MZ twins which would artificially enhance the genetic estimates and lower the environmental ones. Although most studies do not indicate very clearly (if at all) the nature of the families with whom the separated MZ twins are placed, the detailed work of Shields (1962) does provide adequate data for the point to be emphasized here, namely, that placement of MZ twins with relatives of the family also provides a more homogeneous environment than that found in the general population. Thus, as a specific example, if the mother of MZ twins retains one twin and the second is placed with a maternal aunt, certainly a greater similarity of child-rearing practices would exist between the two than if one twin had been randomly placed in another home. Two-thirds of the separated MZ pairs in the Shields study were placed with relatives of the family in which the MZ twin pairs were born. Again, the interpair MZ difference (and, inversely, the interpair correlation .77, Shields) would be even greater; and, the alternative means of deriving results from the formula of E greater than the percentages of 59 and 63 (Newman, Freeman, and Holzinger, 1937) and the 62 and 72 percent estimates from the data of Shields (1962).

(3) *MZ and DZ (separate environment)*

A third formula, and a means of limiting the confounding of genetic and environmental factors in the estimation of H, and also a method recommended in the Newman, Freeman, and Holzinger study (1937) but apparently disregarded by subsequent investigators, is to utilize the formula in (1) above, but with both separated MZ and separated DZ twin pairs. Assuming the control of such factors as the correct determination of zygosity, age of separation, same-sexed DZ pairs, and the random placement of the individual twins in diverse environments at an early age, to name but a few relevant methodological considerations, a determination of the contribution of H may be more accurately assessed. Unfortunately the data available on separated DZ twin pairs is practically nonexistent. Jensen (1968) reports that the median value for separated DZ twins is approximately .42 (in his graphic illustration, page 50). The work of Erlenmeyer-Kimling and Jarvik (1963) to which Jensen refers *does not* report any such data. The only study of separated DZ twins known to this author is that of Shields (1962). Of 11 separated DZ twin pairs, Shields reports scores on only 4 pairs, hardly adequate data for useful analysis.

It is rather surprising, in view of the long history of the problem, the numerous publications generated, and the specific recommendation of the classic work of Newman, Freeman, and Holzinger (1937), that separated DZ and MZ twins have never been compared. Supposedly, separated DZ cases should be more readily available than MZ ones.

(4) *Alternative Analysis (separated MZ versus separated siblings)*

Whereas data obtained from separated DZ twins is either presently unavailable or has escaped my attention, a substitute may be considered for a reasonable analysis of the problem proposed by Newman, Freeman, and Holzinger (1937). Instead of comparing separated MZ and separated DZ twins as a means of estimating the H coefficient, and thereby controlling for confounding environmental variables, a similar although less satisfactory analysis may be computed between separated MZ twins and separated siblings. Of course, separated siblings do not provide for the most adequate analysis from the environmentalist's position since separated siblings of the same family are usually of different ages at separation, possibly of different sex, exposed initially to different family economic circumstances, and variable child-rearing practices during their early development, to name a few of the factors that would be less influential if separated DZ twins were available for analysis instead. However, even this method provides findings which are contrary to those commonly quoted in support of the hereditarian position.

As in formula (1), the assumption—although not altogether tenable as indicated—is that MZ twins and siblings would have an equally similar environment if separated in early life and that differences between the separated pairs and the derived variances could be ascribed to H. Thus in accordance with formula (1), the ratios of the variance observed in separated siblings (V_{sibs}) and separated MZ twins (V_m) can be used to estimate the coefficient of heritability (H) from the formula:

$$H = (V_{sibs} - V_m)/V_{sibs}$$

While these values are not readily obtained from most published studies, they may be derived from the following and essentially equivalent formula using the Fisher intraclass correlation coefficient (r):[2]

$$H = (r_m - r_{sibs})/(1 - r_{sibs})$$

Taking the median value of .47 for the 33 studies of separated siblings reported by Jensen (1969), one may arrive at H for each of the major studies involving separated MZ twins. The intelligence test correlations and estimates of H are presented in Table 1.

TABLE 1

Estimation of H with Separated MZ Twins and Separated Siblings.

Author	*Type Test*	*Correlation of MZ Pairs*	*Estimates of H (percent Variance)*
Newman, Freeman,	Binet IQ	.67	37.74
and Holzinger (1937)	Otis	.72	47.17
Shields (1962)	Mill-Hill Vocab.		
	and Dominoes	.77	56.6
Burt (1966)	Binet, Pinter-		
	Paterson, and		
	Teacher's Report	.86	73.6
	Group Test (?)	.77	56.6
Jensen (1969)	Median Value	.75	52.8

As can be noted from a perusal of this table, the estimates of "intelligence" attributable to H range from 38 to 74 percent, and the median value reported by Jensen equals 52.8 percent. Similar estimates of H are presented in Table 2 for achievement test scores of separated siblings and separated MZ twins (derived from tables of Burt, 1966). The estimates of H are generally quite small, and the cor-

[2] This formula is based on Jensen's usage, where, unlike the Pearson product-movement correlation, the intraclass correlation is used as a direct estimate of the proportion of the variance accounted for by H; and, consequently, the values need not first be squared as in the formula:

$$H = (r^2_m - r^2_{sibs})/(1 - r^2_{sibs}).$$

The latter formula would result in lower H estimates than provided in the tables.

The intraclass correlation coefficients used to estimate the various proportions of variance differ from the well known product moment correlation coefficients, although Jensen never makes this distinction directly. The intraclass correlation was developed by Fisher and clearly described in his classic, R. A. Fisher, *The Design of Experiments* (London: Oliver-Boyd, 1935).

TABLE 2

Estimates of H on Achievement Tests with Separated MZ Twins and Separated Siblings.

Author	*Type Test*	*Correlations* MZ	*Correlations* Siblings	*Estimates of H (percent of Variance)*
Burt (1966)	Spelling	.597	.49	20.98
	Arithmetic	.705	.56	32.95
	General Attainment	.623	.526	20.46
Newman, Freeman, and Holzinger (1937)	Stanford Achievement	.507	—	—

relation between separated siblings on the general attainment score (Burt) is greater than that between separated MZ twins in the Newman, Freeman, and Holzinger study.

Concluding Remarks

Thus, when the effects of E variables are more adequately controlled, estimates of the importance of heritability in the determination of individual differences in intelligence and academic success are considerably less than suggested by Jensen (1969). Moreover, with separated DZ pairs instead of siblings, the estimates of H could be even less.

Although these findings are based upon formulas suggested in the Newman, Freeman, and Holzinger study, and especially the first utilized by later investigators as well (Eysenck and Prell, 1951; and Osborne, Gregor, and Miele, 1967), one potential criticism deserves elaboration. The claim may be forwarded that the correlation of .47 (Jensen, 1969) between separated siblings reflects "largely" the importance of genetic factors and thus confounds the estimates of H presented here. However, the reported findings in the literature are inconsistent on this point. For example, Freeman, Holzinger, and Mitchell (1928) found that siblings correlated .25 after 7 years of separation and, when foster homes of different grades were considered, the correlation between separated siblings was only .19. The immediate and customary reply to these latter findings is that potentially this relationship is still closer to .50 and the discrepant findings on siblings reared apart are due to differences in the opportunity to learn and/or to a lack of exposure to equally stimulating environments. But this is to beg the question. It is to assume the very point (that potentially siblings correlate .50) raised in the question, that is, do genetic factors account for the similarities between related individuals?

Another means of sidestepping findings contrary to the genetic position is to argue that an intelligence test is not an adequate measure of intelligence or of the hereditary predisposition, potential intelligence. But then "potential intelligence" requires definition and measurable operations other than the tests commonly used. Moreover, to argue in this manner is to be inconsistent both with regard to the operational definition of "intelligence" usually ascribed to and the interpretations usually made from such studies.

In any case, and regardless of the large number of studies which support the genetic position, to the extent that they are subject to the methodological difficulties suggested here, these studies offer limited support to Jensen's claims. In fact, the findings reported here in which these methodological difficulties have been more adequately controlled are contrary to the claim that individual differences in intelligence and academic success can largely be attributed to hereditary factors.

The conclusion favoring the importance of heredity in the determination of intelligence has been with us most perceptively since Galton (1883) stated from his family study of eminence "that the instincts and faculties of different men differ almost as profoundly as animals in different cages of the zoological gardens." The confounding of environmental and hereditary factors has been with us equally long and it would seem that Galton's apprehension was justifiable:

> "My fear is, that my evidence may seem to prove too much, and be discredited on that account, as it appears contrary to all experience that nurture should go for so little." (p. 241).

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