

LET'S UNDERSTAND SKODAK AND SKEELS, FINALLY¹

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ABSTRACT

The well-known study by Skodak and Skeels (1949), in which one hundred infants who were born to unwed mothers of below-average IQ and were adopted into superior foster homes and grew up to obtain Stanford-Binet IQs averaging 20 points higher than the IQs of their biological mothers, has frequently been interpreted as a contradiction of the evidence for the high heritability of intelligence. It is here shown that this is a misinterpretation of the Skodak and Skeels results, based on failure to consider the prediction made from a simple polygenic model of parent-offspring resemblance. The Skodak and Skeels data, when analyzed properly in terms of a quantitative-genetic model, are found to be not all improbable or contradictory of a broad heritability for IQ in the range of .70 to .80. Also, the common fallacy of generalizing the results of Skodak and Skeels as an environmental explanation of the cause of the approximately 1 σ mean white-Negro IQ difference is explicated from the standpoint of genetic theory.

The article by Skodak and Skeels (1949) on the IQs of adopted children is one of the most frequently cited studies in the whole literature of developmental and educational psychology. It is also probably the most frequently misunderstood and misinterpreted study in our literature. This state of affairs should be corrected.

The data of the Skodak and Skeels (S & S) study are unique in one respect: it is the one and only study in the literature in which the IQs of adopted children can be correlated with the IQs of their biological mothers. Other studies of adopted children, which are in many respects methodologically more satisfactory than the S & S study, provide correlations only between the children and their foster parents (e.g., Burks, 1928; Leahy, 1935).

In discussions of the contributions of heredity and environment to individual differences in IQ, the S & S study is usually held up as evidence which supposedly contradicts the evidence, based mostly on twins, for the predominant role of genetic factors in IQ variance. The S & S study has long been pointed to as one of the main supports of the belief that environmental differences are the paramount cause of IQ differences, whether between individuals or between groups. But are the S & S data, in fact, in conflict with the evidence for the high heritability of IQ based on twin correlations and other kinship correlations to which the methods of quantitative genetics have been applied?

Briefly, the S & S study is based on 100 white children born to unmarried mothers with rather low IQs (a range from 53 to 138, with a mean of 85.7 and *SD* of 15.8). The mothers were also below average in amount of formal education. All the children were placed in adoptive homes before six months of age; prior to that they were cared for in

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an orphanage. The adoptive homes are described by S & S as exceptionally good, upper-middle-class families selected by the adoption agency for their superior qualities. The children were given the 1916 Stanford-Binet at approximately ages 2 years, 4 years, 7 years, and 13.5 years. Of the 100 true mothers, 63 were given the 1916 Stanford-Binet near the time of the adoption. The correlation between the 63 true mothers' IQs and the IQs of their children (at age 13.5 years) who had been reared in adoptive homes is +0.38. (The weighted mean of the six studies of parent-child IQ correlations in the literature, totalling 3,282 parent-child pairs, where the children were reared by their true parents, is 0.47, and the *SD* of the six correlations is .076.) The correlations between the children's IQs and the adoptive mothers' and fathers' educational level were, respectively, .04 and .06 (both nonsignificant). (IQs were not obtained on the adoptive parents.) At age 13.5 years, the 1916 Stanford-Binet IQs of the 100 adopted children averaged 107 (*SD*=14.5), or approximately 21 points above the average IQ of their true mothers. (The 63 children whose true mothers' IQs were known had an average IQ of 106, *SD*=15.1, at age 13.5.)

It is this approximately 20 IQ points average difference between the true mothers' IQs and the IQs of their children after being reared in good homes which has given the impression to so many who cite this study that this finding contradicts the conclusions of many other studies to the effect that the broad heritability of IQ is high, in the region of .70 to .80 or more (e.g., Burks, 1928; Burt, 1958; Jensen, 1969; Leahy, 1935; Jinks & Fulker, 1970). This false impression is based on a misunderstanding of what a genetic model would predict, given a broad heritability of, say, .80 for IQ (a value which best fits all the kinship data I reviewed in Jensen, 1969).

Let us look at the S & S data in terms of a rather simple quantitative genetic analysis. What we really wish to know is not the difference between the IQs of the biological mothers and their children, but the amount of discrepancy between the IQs of the children that would be predicted by a genetic model (given the IQs of the true mothers) and the actual IQs obtained by the children when last tested at age 13.5 years, after the good adoptive environment has had its fullest impact.

A formula which can be found in textbooks on quantitative genetics and population genetics (e.g., Crow & Kimura, 1970, pp. 140, 229), shows the predicted IQ of the offspring, given the IQ of the midparent (i.e., the average of both parents):

$$O = M + h_n^2 (P - M)$$

where O = the predicted average of the offspring

M = the population mean

h_n^2 = heritability in the narrow sense (i.e., the proportion of additive genetic variance, or that part of the genetic variance which "breeds true" and accounts for resemblance between parents and offspring)²

P = midparent mean

As with the application of all theoretical models, certain basic assumptions are involved. Our simple genetic model in this case assumes that (*a*) the mothers of the children whose

² The narrow heritability, used in the regression equation above, does not include variance due to nonadditive effects—dominance deviation, epistasis (i.e., interaction among genes at different loci) or genotype X environment interaction. By definition, epistasis does not alter h_n^2 , but it does slightly raise the regression coefficient (in this case, the regression of offspring on parents) (Falconer, 1960, pp. 157-158). It is probably a negligible effect, and, in fact, is ignored by Jinks and Fulker (1970) in their analysis. Also, the lack of any evidence of genotype X environment interaction for IQ (Jinks & Fulker, 1970, pp. 323-324) justifies the omission of this component from the regression equation. O , M , and P in the above equation are all based on phenotypic values and imply no assumptions about the degree of genetic determination.

IQs we wish to predict represent a random sample of the population of young women with IQs averaging 85.7, $SD = 15.75$, and (b) their children are reared in a random sample of environments in the general population, i.e. average environmental conditions.

To apply this formula to the present data, we need estimates of the population mean, M , the midparent IQ, P , and the narrow heritability, h_n^2 . The white population mean for the Stanford-Binet is approximately IQ 100. The midparent IQ can be estimated under the simple assumption of random mating and under the assumption of the same degree of assortative mating (i.e. the tendency for positive correlation between mates on the trait in question) as exists in the populations for which the heritability of IQ has been estimated. Since the mothers in the S & S study were unmarried, little is known of their children's paternity; the fathers' IQs are unknown, and it is likely that the degree of assortative mating in such cases is something between random mating (in which case the fathers would be a random sample of the population, with an average IQ of 100) and the degree of assortative mating that exists for IQ in the general population of married parents. So we will make two estimates based on each of these "boundary" assumptions, viz., random mating (i.e. zero correlation between mates) and the degree of assortative mating found in the general population.

The most sophisticated biometrical estimates of genetic and environmental parameters to be found in the literature on the quantitative genetics of mental ability are those derived by Jinks and Fulker (1970) from the existing data which permit the methodologically most rigorous estimates of heritability in samples from white populations. The narrow heritability, h_n^2 , is estimated by Jinks and Fulker (p. 342) to be 0.706 for the data they analyzed. So we shall use this value of h_n^2 in our predictive formula. Under the assumption of random mating, the mean IQ of the fathers is 100, so the midparent mean (i.e., the average of the mean IQs of the mothers and fathers) is $(85.7 + 100)/2 = 92.85$. Thus, substituting these values in the formula, we have:

$$O = 100 + .706 (92.85 - 100) = 94.95$$

which is the predicted IQ of the children under the assumption of random mating.

Jinks and Fulker (p. 339) give as their coefficient of assortative mating (correlation between parents' IQs) 0.3875. We shall use this value, which is based on the same population as the estimate of h_n^2 . (The assortative mating coefficient in various population samples reported in the literature ranges from about .30 to over .60, and since we do not know the degree of assortative mating in the S & S sample, this increases the uncertainty of our prediction. One could, of course, solve the formula using the most extreme values, 0 or 1, for the assortative mating coefficient, but we shall here use the value given by Jinks and Fulker as a realistic estimate.) With this coefficient of assortative mating, the estimated average IQ of the father is $.3875 (85.7 - 100) + 100 = 94.485$. The average midparent IQ would therefore be $(87.5 + 94.485)/2 = 90.98$. Again, substituting in the formula to predict the mean IQ of offspring under the assumption of assortative mating, we have:

$$O = 100 + .706 (90.98 - 100) = 93.63$$

Now, how far off are the predictions? Since the children's average IQ at age 13.5 was actually 106, this is 11.05 points above the predicted value under the random mating assumption and 12.37 points above the predicted value under the assortative mating assumption. Is this discrepancy of 11 or 12 IQ points inconsistent with a broad heritability, h_b^2 , of .80 for IQ? (Broad heritability is the proportion of total variance attributable to all genetic factors, not just the additive genetic components that constitute narrow heritability.) If the broad heritability of IQ is .80, then the proportion of IQ variance attribut-

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able to nongenetic (i.e. environmental variance plus measurement error) factors is $1 - .80 = .20$. If the total variance for IQ is $15^2 = 225$, therefore, the variance attributable to nongenetic sources is $.20 \times 225 = 45$, and the standard deviation of nongenetic effects on IQ would be $\sqrt{45} = 6.71$. In other words, one standard deviation of environmental advantage or disadvantage should push the IQ about 6 to 7 points up or down, if the broad heritability is .80. Compare this with the conclusion of Burks (1928), based on the direct measurement of the environments of adopted children: "Measurable environment one standard deviation above or below the mean of the population does not shift the IQ by more than 6 to 9 points above or below the value it would have had under normal environmental conditions" (p. 308).

The IQ discrepancy of 11 or 12 points found for the S & S subjects is what would be expected for environmental conditions which average about $1.7SDs$ above the average of the general population. This is close to the average environmental deviation one should expect (1.52, assuming a normal distribution) if all the adoptive families were one SD or more above the population average in environmental advantages favoring mental development. From what S & S say in their account of the adoptive families, they were at least one SD above the general average in socioeconomic status and were probably a good deal higher in other qualities deemed desirable in adoptive parents. The adoptive homes are described in such terms as "cultured, educated parents," "highly regarded by the town's business, professional, and religious leaders." Also, 3 to 4 times as many of the adoptive fathers were professional men as are found in the general population, and there were more than twice as many in managerial positions as in the general population; none were unemployed or unskilled workers. So an 11 or 12 IQ point gain over the average environment falls well within what we should expect in this situation, even if genetic factors contribute 80% of the IQ variance. Generally, children who are born into similar families have an average IQ of about 115.

But the 11 or 12 points apparent gain is more likely than not an over-estimate, given the assumptions underlying our prediction, since these children were selected by the adoption agency as suitable for adoption. They were not just a random selection of children born to low-IQ mothers. Also, these children were born to unwed mothers, and as indicated in Leahy's (1935) study, illegitimate children who become adopted have a higher average IQ than illegitimate children in general or than legitimate children placed for adoption. Still, the S & S sample had 11 adopted children whose true mothers had IQs below 70. The IQs of these children averaged 25 points lower than the IQs of the 8 adopted children whose true mothers had IQs above 105. It is also interesting to note that the 1916 Stanford-Binet IQs of the adopted children showed an average decline from age 2 to age 13 of 10 IQ points, which is significant beyond the .01 level. Such IQ decline with increasing age is commonly found among low SES children; just the opposite trend is generally found among high SES children in homes typical of the environments provided by the adoptive families in the S & S study.

Certain technical refinements can be introduced into the prediction equation which would decrease the discrepancy between the predicted and obtained values, but these have been avoided here for the sake of simplicity. The precision of the data and the parameter estimates used in the prediction equation hardly warrant such refinements. For example, one could take into account attenuation due to errors of measurement and to the age differences between mothers and children at the time of testing. When allowances are made for such factors as these, the discrepancy between predicted and obtained IQs is

reduced by 1 to 2 IQ points.

Thus I conclude that the S & S results are not in the least inconsistent with the polygenic model of the inheritance of intelligence proposed by Burt (1958, 1971, 1972), Jinks & Fulker (1970), and others (see Jensen, 1973). Geneticists have drawn similar conclusions from S & S. One, for example, wrote in reference to the S & S data that this evidence "indicates the existence of a high genetic component" in IQ (Lerner, 1968, p. 159). Surely there is nothing in the S & S data that would in any way affirm the polygenic model and the estimated broad heritability of IQ in the range of .70 to .80.

In any case, no strong conclusions of any kind from S & S would seem warranted in view of the various points in the study that are technically and methodologically questionable, as was noted many years ago in critiques of earlier reports of the study by Terman (1940, pp. 462-467) and McNemar (1940). It is a pity that S & S is the only study of adopted children in which the IQs of the true mothers were determined. We should have a better study of this kind, preferably one in which the IQs of both of the natural parents and of the adoptive parents are determined with a variety of mental tests.

There is still one other illegitimate use made of the S & S study which warrants comment. This concerns arguments about the cause of the one standard deviation or so difference between the average IQs of Negroes and whites in the United States. It has been argued that since the children of white mothers with an average IQ of 85 (the Negro average) develop an average IQ of 106 when adopted into good homes, the average Negro if reared in an environment similar to that of the S & S adoptive homes would also average some 11 or 12 points higher than his present IQ. But from the model we have used, this is an incorrect prediction. The reason, of course, is that the value for M in the prediction equation would in this case be the mean for the Negro population, which is best estimated at close to 85 (Jensen, 1973b, pp. 59-67). So the S & S result does not warrant the inference that the same gain of 11 or 12 IQ points would result if the children were Negro instead of white, though the adoptive environments remained the same. Solving the same equation with 85 as the Negro population mean yields a predicted IQ (under random mating) of 85.25, or 9.70 IQ points lower than the predicted value for the white population. (The prediction would be the same in the case of assortative mating, since the mothers' average IQ is at the Negro population mean). The predicted IQ would fall short to the extent that the average environment of the adoptive homes was superior to that for Negroes in the general population. Therefore, a study paralleling that of S & S but based on a representative sample of Negro children adopted into upper-class Negro or white homes would be relevant and informative. Needless to say, in order to make such a prediction we should have a good estimate of the heritability of IQ in the U. S. Negro population. It could well be different from the white population. But at present there exist no satisfactory estimates of IQ heritability in the U. S. Negro population (see Eaves & Jinks, 1972; Jensen, 1973 b, pp. 179-187).

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