MODEL BUILDING - RACE AND IQ
A MODEL-BUILDING ANALYSIS OF THE JENSEN HYPOTHESIS

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In his article "How much can we boost IQ and scholastic achievements?" (1) Arthur Jensen implies that the observed difference in IQ test scores between the black population and the white population is due primarily to genetic effects. Discussants of this paper have stated that determining the genetic and environmental contributions to this difference is a difficult problem (2). With the presently available techniques and the available data, this not a difficult problem - it is an impossible problem.

IQ studies show that the black population's IQ test scores are about 15 points lower than the test scores of the white population. Even when the populations are matched for environmental variables such as socioeconomic status, the black population scores lower, though the differences are only about half as great (3). There is no doubt that differences in IQ test scores exist; the only question is to their cause.

We will follow a regression model-building approach to study this question. We will show what happens when we try to estimate genetic effects and certain environmental effects. Let us first examine the problem of estimating the effects of genetic differences between a black population and a white population. The data consist of IQ measurements and other measurements such as socioeconomic indices for the individuals being studied. The effects of genetic differences between the two populations can be modeled by an indicator variable which is assigned one of two values - for example, zero for a member of the white population and one for a member of the black population. A regression model can be fitted to the data containing this indicator variable by the method of least squares. The regression coefficient calculated for the indicator variable can be considered to be an estimate of the effect of genetic differences between the two populations. The regression coefficient for the indicator variable will be approximately -15 if it is the only variable in the model; it will be about half as large if environmental variables such as socioeconomic status are included. The above statements summarize the studies that have been run to this time (3).

Now consider the problem of estimating IQ difference caused by certain environmental differences between the black population and the white population. We will consider modeling the total effect of such environmental variables as caste, prejudice, and differential expectations. The difference in IQ test scores between the black population and the white population caused by these environmental variables can be modeled by an indicator variable which has two values - for example, zero for a member of the white population and one for a member of the black population. The regression coefficient calculated for the indicator variable, in this case, can be considered to be an estimate of the sum of the effects of such environmental variables as caste, prejudice, and differential expectations.

For both the genetic model and the environmental model the indicator variable will take on exactly the same values, and the calculated regression coefficient will be exactly the same. That is, if the indicator variable, which in the environmental model accounts for the sum of the effects of certain environmental variables, is the only variable in the model, its regression coefficient will be about -15. If other environmental variables are included, the regression coefficient for the indicator environmental variable will be about half as large.

The effects of the environmental variables accounted for by the indicator variable and the effects of genetic differences accounted for by the indicator variable are exactly "confounded". There is no way of disentangling the relative contributions of genetic variables and the effect of certain environmental variables on observed differences in IQ test scores between the black population and the white population. We can measure the sum of the contributions of the genetic and environmental variables, but we cannot measure either the genetic effects or the environmental effects separately.

Because of the confounding of genetic effects and certain environmental effects, the following three mutually contradictory hypotheses (among others) are consistent with the observed data:

Hypothesis A:

The genetic difference between the black population and the white population causes about a 15-point difference in IQ test scores. The effect of environmental variables on IQ test scores is negligible.

Hypothesis B:

Environmental variables tend to depress

the black population's IQ test scores by about 15 points. The genetic effect is negligible.

Hypothesis C:

The environmental variables tend to depress the black population's IQ test scores by about 30 points. The genetic variable favors the black population by about 15 points.

Generally, some combination of Hypotheses A and B is believed; however, because of the confounding, Hypothesis C is not rejected by the data.

The Problem of Confounded Data

The above problem is caused purely by the kind of data that can be obtained. There is no statistical technique that can resolve the problem without different kinds of data. Standard regression "corrections" for environmental variables such as socioeconomic status give a better analysis than an analysis that makes no environmental correction; however, such an analysis cannot correct for environmental effects due to variables such as caste, prejudice, and differential expectations.

We can design a "thought" experiment that would enable us to measure unambiguously the contribution of environmental and genetic differences to the observed difference in IQ test scores between the black population and the white population. The experiment will take 2N families; N black families and N white families. The families should have at least two children. Pair a black family and a white family whose children are born on the same day and switch children at birth. The parents should not be told of the switch. The white children should receive injections to make them appear black, and the black children treatments to make them appear white. With such an experiment the genetic contribution and the environmental contribution to observed IQ test differences could be estimated unambiguously. Such an experiment is clearly impossible in our society.

Indirect Approaches

Since it is impossible to find the reason for differences in IQ test scores between the black population and the white population directly, indirect approaches have been tried. One approach is to attempt to discredit studies that show environmental effects due to caste, prejudice, or differential expectations. Discrediting these studies would indicate that these environmental effects cause small, if any, changes in IQ test scores. Jensen (1) used this approach in his article when he attacked the study by Rosenthal and Jacobson, "Pygmalion in the Classroom" (4).

Finding areas where the environmental effects are small is a second indirect approach. Kleinberg (5) cites a study by Clark (6), of Los Angeles, on Negroes in 1923. In five elementary schools the average black IQ test score was 104.7, while for all elementary pupils the average IQ test score was 106. Clark indicated that he felt the IQ scores were about 5% too high but that there were no significant differences in IQ test scores between the black population and the white population. Clark's study indicates that in parts of southern California in the 1920s there were only small IQ and environmental differences between the black population and the white population. In the same article Kleinberg, who lived in Canada for 25 years, expressed doubts that Tanser (7), in his Canadian study, had really found an area where environmental effects were small.

Tanser found IQ differences of around 15 points between the black population and the white population in an area where there was little overt prejudice. Table XXIII from Tanser is reproduced as Table I.

TABLE I

Median IQs and Percentiles of White and Negro Pupils on the National Intelligence Test According to Rural or Urban Environment

		Whites	Negroes
No. Pupils	Urban	339	43
	Rural	47	60
Median IQ	Urban	104.68	89.08
	Rural	96.29	90.06
Median Percentile	Urban	57.16	27.0
	Rural	40.75	27.83

In the Urban population the blacks were of a lower socioeconomic class than the whites. The rural populations consisted mainly of farmers who owned their own farms, so the blacks and whites were much more closely matched in background. Shuey (3) excused the poor performance of rural whites. She explained that most of the rural whites had migrated to Canada within the last two generations, so their children were not as familiar with standard English as were urban whites. Recent linguistic work (8) has shown that blacks learn an English that is different from standard English. This tends to lower their IQ test scores, since most IQ tests are based on standard English. Thus, in Table XXIII the IQ scores of all blacks, as well as rural whites, are probably depressed from their true

potential scores. Tanser's table does show that in matched populations, such as the rural black-white population, IQ test scores differences do tend to be significantly smaller than 15 points.

Since the difference in IQ test scores between the black population and the white population may contain both environmental effects and genetic effects, a single large study, such as Clark's, which found less than a two-point spread in IQ test scores, can be used to place an upper limit on the possible genetic effect (9), while studies such as Tanser's, which find the usual difference in IQ test scores, indicate that the usual combination of environmental and genetic variables is having its effect.

Estimating Heritability

Estimating the genetic and environmental components of the observed difference in IQ test scores between the black population and the white population is impossible. Estimating the genetic components and the environmental components of the variability in IQ test scores in a white population (the only ones on which heritability studies have been made) (10) is difficult because of high correlations between environmental variables and genetic variables. With the available data, slight changes in the estimation technique can lead to large changes in the estimates. For example, using the data from Jensen, Light (11) obtained an estimate for heritability of .63 which is appreciably lower than Jensen's estimate of heritability of .75 which was obtained from the same data.

Light used a more complete breakdown of the environmental variability. He considered as a separate environmental component a covariance term which measured such things as a tendency of adoption agencies to match children to foster parents. Including this effect as part of the environment component reduced the estimate of the genetic component.

Heritability estimates apply only to the population being studied. The study by Burt and Howard (12), which estimated environmental and genetic components for a homogeneous white population (London school children), makes the disclaimer "we should like to insist on the very limited nature of the problems we have tried to solve. Neither here nor elsewhere have we attempted to reach any overall statement about the relative contributions of heredity and environment to mental efficiency or 'intelligence' as manifested in ordinary everyday life or among all classes and conditions of men." A bias in the Jensen article is the fact that he carefully makes a similar statement (p. 47), while on a different page he uses heritability estimates obtained from a small population for a larger population which would be expected to have more environmental variation (p. 36).

Since heritability is the variability that can be accounted for by genetic components divided by the total variability, large populations such as the total population of the US have a lower heritability than the heritability estimates obtained from the small homogeneous populations on which heritability studies have been made (13).

Combining the data from the subpopulation studies, which have been made in an attempt to obtain an overall heritability estimate for the population in the United States, involves many methodological difficulties. Jencks (14) discusses these in detail and obtains an estimate of heritability as .45 for the US population. The remaining variability is broken down into environmental effects (35%) and genetic-environmental interactions (20%). This is significantly lower than the .80 heritability usually claimed by Jensen. Jensen's estimate is an average of subpopulation estimates, so it cannot contain all the environmental variability.

Jensen's heritability discussion makes few explicit statements. The implication is that if heritability is very high, environmental effects are small; so observed differences in IQ test scores between the black population and the white population must be due to genetic effects. Small changes in heritability estimates can cause large changes in the inferences that are made. The difference in heritability between the two models -

a) Genetic effects cause all the difference in IQ test scores between the black population and the white,

b) Genetic effects cause none of the difference in IQ test scores between the black population and the white,

- is only 10%! This is shown in (15); it is discussed further in the next paragraph.

Since the proportion of blacks in the US population is small, the difference in the mean between the black population and the white population accounts for a small percentage of the total variance (which is about 225). Jensen [(2) page 81] states, "In terms of proportions of variance, if the number of Negroes and whites were equal, the differences between racial groups would account for 23% of the total variance, but - an important

point - the differences within groups would account for 77% of the total variance." Jensen's statement is misleading; it overestimates the variance caused by black-white differences. Since the black population is only 11.2% of the total population, the difference between racial group means accounts for only 10% of the total variance; thus, the differences within the black and white populations account for 90% of the total variance (15).

Related Results

We should note that a large heritability for IQ test scores does not imply that there will not be large differences in IQ test scores when environmental differences are large. Deutsch (16) examined the intra-pair differences for IQ test scores of identical twins reared apart. In the studies he cited the maximum within-pair difference ranges from 14 to 30 points. The IQ differences were correlated with differences in environment. Where large IQ differences were found, there tended to be large environmental differences, and large differences were rare when environmental differences were small. Reducing environmental deprivation can have good effects regardless of the heritability (16).

Wheeler (18) studied 3,000 Tennessee mountain children between the ages of 6 and 16 whose average IQ was 82 in 1930. After improvements in environment, the average IQ had increased to 92 by 1940. If one is to claim that most of the observed difference in IQ test scores between the black population and the white population is caused by genetic effects, one must argue that the isolation effects suffered by the Tennessee mountain children are much greater than the environmental effects that adversely affect the black population's IQ test scores.

Measuring Environmental Effects

The direct measurements of environmental effects discussed by Jensen (pp. 52-54) will tend to underestimate the environmental effects. The method used is to obtain environmental indices, then to perform a multiple regression using these indices as the independent variable with IQ measurements as the dependent variable (19). The variability accounted for by these indices is taken to be the environmental effect. Few researchers would claim that their indices could account for all the sources of environmental variability; thus, these studies tend to underestimate the variability in IQ test scores accounted for by the environment.

Conclusion

We have shown that the complete confounding of genetic effects and certain environmental effects makes it impossible to determine their relative contribution to observed differences in black-white IQ test scores. The type of data that can be obtained from large scale studies of IQ test scores cannot resolve the question of the cause of IQ test score differences between the black population and the white population. If such studies are to be made, they must be justified on other grounds.

Since black-white IQ test score differences account for only ten percent of the variability in IQ test scores, and since the heritability for IQ in the US population must be less than the .80 estimate Jensen obtains from subpopulation studies (Jencks .45 heritability estimate is more consistent with all the data), an environmental model for observed differences in black-white IQ test scores is very feasible. Policy decisions should not be governed by the assumption of a genetic cause for IQ differences between blacks and whites.

References

(1) Jensen, A.R. How much can we boost IQ and scholastic achievement? Harvard Educational Review, 1969, 39, 1-123

(2) Discussion: How much can we boost IQ and scholastic achievement? Harvard Educational Review, 1969, 39, 273-356

(3) Shuey, A.M. The Testing of Negro Intelligence, Social Science Press, New York 1966. This book summarizes most of the black-white IQ comparisons that have been made. Most of the studies summarized make no correction for environmental variables. Studies which correct for more than one environmental variable are rare.

(4) Rosenthal, R., & Jacobson, L. Pygmalion in the Classroom, New York: Holt, Rinehart, & Winston, 1968

(5) Kleinburg, O. Negro-White Differences in Intelligence Test Performance: A New Look at An Old Problem. Amer. Psychol., 1963, 18, 198-203

(6) Clark, W.W. Education Status of Los Angeles Negro Children, Dept. of Psychology and Educational Research, Los Angeles City Schools, 1923

(7) Tanser, H.A. The Settlement of Negroes in Kent County, Ontario.

Reprint 1970 Negro University Press, Westport, Conn.

(8) Dillard, J.W. Black English. Random House, New York, 1972

(9) Unless (a) Environmental effects favored Los Angeles blacks over Los Angeles whites, (b) there was selective migration of high IQ blacks to the Los Angeles area, or (c) Clark's study was invalid, a genetic difference in IQ test scores between the black population and white population of less than 5 points is indicated. For Clark's data the Z value for a difference in IQ test scores as large as 5 points is $Z=5.3=(5.0-1.3)/(15\sqrt{1/510+1/4326})$ when $\sigma=15$ is assumed for both populations. This gives a probability of about 10^{-7} (one in ten million) that the black-white difference in IQ test scores is greater than 5 points.

(10) Jensen states (p. 64) "... all the major heritability studies reported in the literature are based on samples of white European and North American populations, and our knowledge of the heritability of intelligence in different racial and cultural groups within these populations is nil".

(11) Light, R.J. Biometric issues in measuring the genetic component of human intelligence. The New York Statistician, 1971, 22(5), 3-8

(12) Burt, C., and Howard, M. The multifactorial theory of inheritance and its application to intelligence, Brit. J. of Stat. Psy., 1956, 8, 95-131

(13) Burt and Howard comment on this with respect to the less controversial (than IQ test scores) variable, stature of students. This variable has an extremely high heritability. On a population of University students and their relatives, Burt and Howard calculated the genetic component of stature as 97% leaving only 3% to be accounted for by nongenetic factors. They say: "These figures, of course, hold good only for the particular population studied, namely University students and their relatives. Data obtained from London school children indicate that in boroughs where (at the time of our earlier surveys) poverty and malnutrition were rife, the nongenetic variance might amount to nearly 20%." Heritability estimates must be reduced when generalizing from populations with small environmental effects to those with larger environmental effects.

(14) Jencks, Christopher. Inequality, Basic Books Inc., New York, 1972

(15) The proportion of the total variance accounted for by black-white IQ differences is $B W\Delta^2/\sigma^2$ where Δ is the difference in IQ test scores, σ is the standard deviation of IQ test scores, B is the proportion of blacks and $W=(1-B)$. When $\Delta=\sigma=15$ (the most commonly used value for Δ and σ), the above formula gives 25% for B=.50. This is slightly greater than Jensen's 23%. When the 1970 Census B=.112 is used, the above formula gives slightly less than 10% as the proportion of the total variance accounted for by black-white IQ test score differences!

(16) Deutsch, M. Happenings on the way back to the forum: Social Sciences IQ and race differences revisited. Harvard Educational Review, 1969, 39, 523-557

(17) Unless heritability is 1.0 so that the environment has no effect. Also see (13)

(18) Wheeler, L.R. A comparative study of the intelligence of East Tennessee mountain children. J. Educ. Psychol., 1942, 33, 321-334

(19) Usually only a linear term is entered in the model for each independent variable. Interaction and higher order terms do not enter the model. Thus, only the "additive" effects of environment are estimated. This is a second reason that the environmental effects are underestimated.