Social Class, Race, and Genetics: Implications for Education[1]

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In discussing the genetic and environmental determinants of individual differences in intelligence and educability, with their implications concerning social-class and race differences, I must first emphasize the tentative nature of our knowledge on these topics. Indeed, my main thesis is that we do not know nearly as much as we should about these subjects, and I am urging researchers in the behavioral and biological sciences to make a large-scale effort to come to grips with the important questions in this area.

PROBLEMS OF EDUCATION

The most pressing concerns of education today have their origin in several socially significant problems that arise from the following conditions:

1. There is a decreasing need for unskilled workers and an increasing demand for better educated, more technically skilled personnel. As the demands of our society have been changing in this direction since the turn of the century, the level of intelligence and education required for self-sufficiency and a productive role in society has inevitably risen. For many years the borderline for mental retardation was set two standard deviations below the

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mean, that is, an IQ of 70. Now the National Association for Mental Retardation has set the borderline at only one standard deviation below the mean, that is, an IQ of 85. The principal reason for this change in criterion is that today individuals with IQ's below 85 seem less competent in getting along on their own than was the case in former generations. Most occupations today call for a higher level of developed ability than was true for yesteryears.

2. Our present methods of education do not work for a sizable segment of our population, in the sense that for many of our children—perhaps as many as 20 percent—school is an experience of frustration and lack of accomplishment. This condition prevails disproportionately in various socioeconomic and racial groups.

3. The existing inequalities of educational opportunities and facilities do not account for more than a fraction of the variation among individuals or socially identifiable groups in educational attainment. At most, some 10 to 20 percent of the variability in educational attainment is associated with school variables. The well-known Coleman report on *Equality of Educational Opportunity*, based on more than 645,000 pupils in 4000 of the nation's public schools, presents massive evidence that discrepancies in educational achievement by different social class and racial groups are correlated to only a slight degree with inequalities in those variables over which schools traditionally have control (Coleman, et al., 1966). Biological and social environmental factors associated with social class, race, and family background account for most of the variance in intellectual ability and school performance.

4. There is a question concerning the future implications of the differential birth rates among social classes. This phenomenon, which contributes to the correlation of about —.30 between intelligence and family size, is a matter of potentially tremendous social and educational implications. These have not been adequately evaluated, especially in the U.S. Negro population. The whole issue has been more or less dismissed from the research arena since the Scottish National Survey in 1947, which produced inconclusive results and which, even if conclusive, cannot be generalized to our situation in the United States. The possible consequences of differential birth rate could make the educational and social problems of today seem trifling as viewed by future generations, since one of the possible consequences is an increasing separation of

racial and social class groups on traits that are highly related to educational potential. It would be reassuring to know that research is being conducted on this problem, but I know of none at present.

EQUALITY OF EDUCATIONAL OPPORTUNITY

If we fail to take account either of innate or acquired differences in abilities and traits, the ideal of equality of educational opportunity can too easily be interpreted so literally as to be actually harmful, just as it would be harmful for a physician to give all his patients the same medicine.

One child's opportunity can be another's defeat. I was struck by this observation when I began sitting in the back of classrooms of schools in which most of the pupils were Negro children from poor neighborhoods. One school was especially interesting because it seemed to me to be a model of equality with the very best schools one would find in a white upper-middle class suburb anywhere in this country. The teachers, both white and Negro, were well-educated and dedicated. Most of them had previous successful teaching records in other schools attended largely by children from middle-class homes near a university. The mean achievement level of these teachers' former classes was consistently above the 90th percentile on national norms. In the school I observed, however, the mean achievement was somewhere below the 20th percentile in every grade. But this fact is not as disturbing to me as my distinct impression that for many of these children the educational experience from first grade on—not in kindergarten, but from first grade, when reading and writing and numbers are formally introduced—becomes psychologically damaging. This damage results, I believe, not from prejudice or hostility or any other unfavorable attitudes on the part of teachers, as some critics of the schools might claim. The teachers I observed seemed altruistically motivated to do their best for these children. But what they were doing did not work. Observing many of these children, I could not help but recall Pavlov's description of what happened when dogs in the conditioning procedure were put on extinction schedules—that is, the withholding of reinforcements —and more especially when forced to learn sensory discriminations beyond their sensory abilities. You will recall these were the two conditions in Pavlov's experiments that lead to "conditioned

inhibition," and "experimental neurosis" (Pavlov, 1927, pp. 68-87, 284-319). The human analogues of these phenomena, I believe, can be observed in some elementary schools as early as the first grade. The symptoms are like those described by Pavlov. The whole educational process—classroom, desks, blackboards, books, and especially teachers—seem to become conditioned inhibitors for all forms of classroom learning. We know that conditioned inhibitors can become aversive stimuli. I began to wonder how much of the inattentiveness, aimless hyperactivity, and active resistance to learning that I observed in some first-graders was a result of undesirable environmental influences outside the school and how much was actually generated in the classroom—a manifestation of Pavlov's "experimental neurosis." If this analogy is more than just analogy and is indeed the phenomenon described by Pavlov, we know it should be harder to cure than to prevent. At present we are not sure just how to prevent it.

Repeated inappropriate and unrewarding experiences early in the child's schooling may act as insurmountable barriers for children who, through a different approach, might have been capable of achieving a rewarding education. Insistence on surmounting uniform requirements, such as acquiring the three Rs at an early stage of schooling, could screen out some children from ever entering upon *any* path of educational fulfillment in our present system.

I believe individual differences and group differences must be studied—in both their genetic and environmental aspects—for the purpose of creating optimal *diversity* of educational opportunity. The goal should not be literal equality of opportunity, meaning uniform treatment, but equality of opportunity for diversity of educational experiences. This means increased diversity in our methods of instruction. Now, for the first time in history, the new educational technology makes this a feasible goal. Do not misconstrue the aims of this approach as being that of the school's teaching Johnny set theory while it teaches Billy to weave baskets. Both Johnny and Billy will learn as much set theory as they can at the most appropriate time for them and by the means best suited to their individual abilities. There will always be individual differences in educational paths and their outcomes, but it may be hoped that the reality of individual differences need not mean

educational rewards for some and utter frustration and defeat for others.

The whole complex process of classroom instruction as we know it has evolved in relation to a relatively small upper-class segment of Anglo-European stock. The modal pattern of development in learning abilities of this group has probably shaped to a considerable degree the particular educational procedures public education has long regarded as standard for everyone, regardless of differences in cultural background or inherited patterns of ability. So far, we have not successfully met the challenge presented by our ideal of a rewarding education for all segments of the population rather than for just one segment relatively homogeneous in genetic and cultural background.

Since one of the aims of educational research is the discovery and manipulation of sources of variance in school learning, I wish to outline what appears to me to be the present status of our knowledge concerning hereditary sources of variance in intelligence and educability and their relations to social class and race. The variables of social class and race are becoming increasingly prominent in educational research, with its current emphasis on children called culturally disadvantaged.

HEREDITARY BASIS OF INDIVIDUAL DIFFERENCES

That individual differences in mental abilities are largely hereditary in origin is well established. We still do not know all the causal links in the chain from genes to mental test scores, but this is another matter and not a necessary condition for establishing the heritability of a trait.

The polemics of the heredity-environment question have largely revolved around certain unfortunate misconceptions. One misconception is the idea that heredity-environment is a dichotomy —that a given trait is the result of *either* heredity *or* environment. Actually, the concept of heritability refers to the genetically determined proportion of variance in individual differences in a trait. Heritability is a continuous variable, taking values between 0 and 1.

Another misconception is the idea that inherited characteristics are immutable while environmentally acquired characteristics are easily changed. According to this view, to say that a trait is hered-

itary is tantamount to fatalism. This is incorrect. The degree of heritability of a behavioral trait simply indicates the extent to which variability is controlled by internal biological rather than social-psychological influences. Determination of the heritability of a behavior trait tells us the source of influences—biological or psychological—to which the trait is most susceptible, rather than the degree of immutability of the trait. A well-known example is the hereditary defect called PKU (phenylketonuria), a metabolic abnormality which formerly resulted in mental retardation but which today can be alleviated by eliminating a certain amino acid (phenylalanine) from the child's diet.

A more subtle misconception, which has been the basis for more needless argument than perhaps any other, concerns quantitative statements about heritability. These used to be referred to as the nature-nurture ratio. The misconception here is that a single *true* value for the heritability of a given trait can eventually be established by making more and more careful and precise measurements with better and better instruments. Thus we still hear arguments concerning whether the hereditary contribution to variance in intelligence is 50 percent, 60 percent, 75 percent, or some other amount. In the form in which this question is usually posed and argued, it is unanswerable. But the usual counterargument is equally incorrect: it consists of asserting that we cannot say anything about the relative influences of heredity and environment. The fact is that we can make meaningful statements about the relative roles of heredity and environment in determining individual differences in a trait, provided we are clear about what a given heritability estimate actually tells us.

Ideally, an estimate of heritability should include specification of the relevant amounts of both environmental and genetic variation. Since psychologists do not yet have a true metric for environmental and genetic variation, we have to resort to the next best means of providing answers to the heredity-environment question. This consists of sampling subjects from a specified population and making heritability estimates in this sample. Note that this procedure does not involve direct measurement of either environmental or genetic variation, and this is its shortcoming. The kind of conclusion we can draw from such studies, however, is that, given the environmental and genetic variation in the population we have

sampled, the heritability of the trait we are measuring is such and such a value. Actually this is best thought of as a probable range of values, if we take into account sampling error, measurement error, and the particular formula by which heritability is computed (Jensen, 1967).

There are now a number of excellent studies that have used this approach for estimating the heritability of intelligence. Despite the fact that they have used different intelligence tests and different populations, they are in remarkably close agreement (Erlenmeyer-Kimling & Jarvik, 1963). One reason that heritability estimates are in such close agreement even when the populations sampled may differ in the amount of environmental variation is that there is probably a positive correlation between the quality of environment and genetic potential for intelligence. The result is that when we sample a wider range of environmental variation, we concomitantly obtain a wider range of genetic variation. The fact that we can determine the heritability of a trait like intelligence in a given population does not, of course, answer the question of what are the extreme limits through which intelligence can be affected by environmental influences. Nevertheless it is meaningful and useful to know the heritability of a trait under the prevailing conditions. It should be noted that as social conditions improve, as environmental disadvantages are lessened, as equality of educational opportunity becomes a reality, the heritability of intelligence and achievement will *increase*, because of the decrease in environmental sources of variation. Advancement toward the humanitarian goals of a democratic society ensures that diversity of abilities and achievement will be due more and more to heredity than to environment.

Table 1 shows quite typical data of the type used to estimate heritability. This Table summarizes a number of studies by Sir Cyril Burt (1955, 1958). No other heritability studies, to my knowledge, have sampled from a population so clearly defined or with a wider range of environmental variation. Burt's population consisted of London school children. In addition to intelligence, measured both by individual and group tests, Burt also obtained measures of scholastic achievement and various physical characteristics, such as height and weight. The data are presented in Table 1. Figure 1 highlights some interesting comparisons.

TABLE 1

*Correlations for Intelligence, Scholastic Assessments, and Physical Traits**

	Identical twins reared together	*Identical twins reared apart*	*Fraternal twins reared together*	*Siblings reared together*	*Siblings reared apart*	*Unrelated children reared together*
Intelligence	$N = 83$	$N = 30$	$N = 172$	$N = 853$	$N = 131$	$N = 287$
Group Test	.944	.771	.542	.515	.441	.281
Individual Test	.921	.843	.526	.491	.463	.252
Final Assessment	.925	.876	.551	.538	.517	.269
Mean	*.929*	*.829*	*.539*	*.514*	*.473*	*.267*
Scholastic						
General	.898	.681	.831	.814	.526	.535
Reading & Spelling	.944	.647	.915	.853	.490	.548
Arithmetic	.862	.723	.748	.769	.563	.476
Mean	*.900*	*.683*	*.831*	*.811*	*.526*	*.519*
Physical						
Height	.956	.942	.472	.503	.536	—.069
Weight	.929	.884	.586	.568	.427	.243
Head Length	.961	.958	.495	.481	.536	.116
Head Breadth	.977	.960	.541	.507	.472	.082
Eye Color	1.000	1.000	.516	.553	.504	.104
Mean	*.965*	*.949*	*.522*	*.522*	*.495*	*.095*

* From: Burt, C. The inheritance of mental ability. *Amer. Psychol.*, 1958, 13, 1-15.
Burt, C. The evidence for the concept of intelligence. *Brit.J. Educ. Psychol.*, 1955, 25, 158-177.

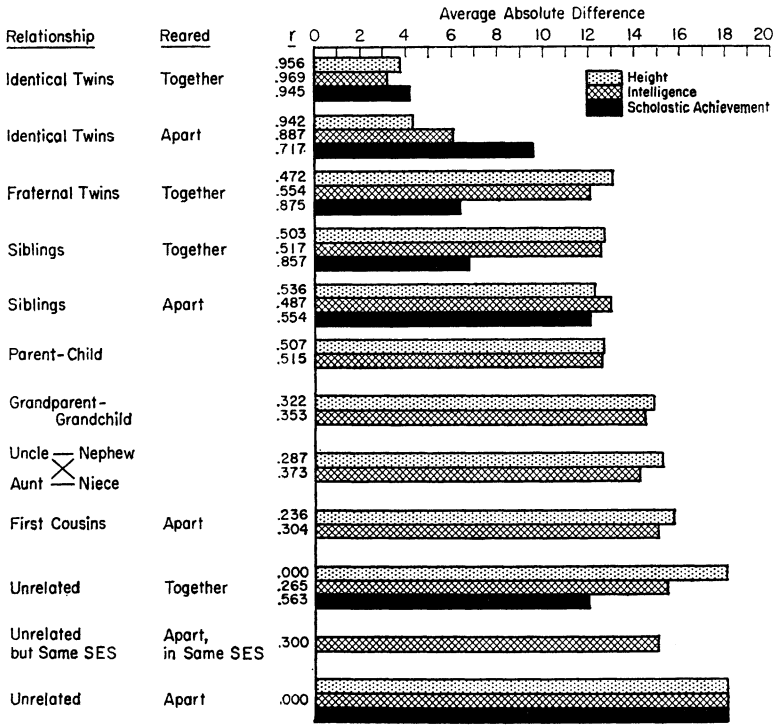

FIG. 1

Correlations between individuals having different degrees of genetic relationship and reared together or apart. The average absolute difference between pairs of individuals is based on the same scale for height, intelligence, and scholastic achievement, with a standard deviation of 16, which is the standard deviation of Stanford-Binet IQs in the normative population.

Since the reliabilities of measurements of height, intelligence and school achievement are different, the correlations shown in Figure 1 have been corrected for attenuation in order to permit direct comparison.[3] (It should be pointed out that these correlations represent directly the proportion of common variance; the correlations in this case should not be squared.) Also, height and scholastic achievement have been put on the same scale of measurement as the IQ, with a standard deviation of 16 points. Thus we can ex-

3. The reliability of intelligence and scholastic tests is estimated as .95; that of height is virtually unity.

press correlations also in terms of the average absolute difference between the correlated individuals on the IQ scale.[4] The higher the correlation, the smaller the difference. We see in Figure 1 that as degree of genetic relationship decreases, the correlation between related individuals becomes smaller and the average difference between them becomes greater. This is most clear for height, which is highly heritable. But notice how closely height is paralleled by intelligence. In this population intelligence is only slightly less heritable than height. From data such as these, it is possible to derive an overall estimate of the heritability of intelligence. The estimate arrived at by Burt is .88; that is, 88 percent of the variance in intelligence in this English population is attributable to genetic variation. The case is quite different for scholastic achievement, in which non-genetic sources of variability obviously have a relatively stronger influence. Note, for example, that unrelated children reared together are as much alike in scholastic achievement as siblings reared apart. Children with identical genotypes (identical twins) who are reared apart, however, are still more alike in scholastic achievement than unrelated children reared together. This means that in this population heredity contributes more to variability in scholastic achievement than does environment. Other major heritability studies are consistent with this conclusion and have been summarized elsewhere (Jensen, 1967).

ENVIRONMENT AS A THRESHOLD VARIABLE

The question arises: if intelligence is nearly as heritable as height, as indicated by Burt's and other similar studies, what about studies such as those of Harold Skeels and his colleagues that show large upward shifts in IQ, amounting in some cases to as much as 20 or 30 points, when children are moved from a poor to a good environment (Skeels & Dye, 1939; Skeels, 1942, 1966)? We can make some sense out of these studies and show their compatibility with the major heritability studies (Burt, 1958; Newman, Freeman, and Holzinger, 1937; Nichols, 1965; Shields, 1962), by regarding environment as a threshold variable. What this means is that for a particular mental ability, realization of genetic po-

4. In a normal distribution the mean absolute difference between all possible pairs of scores is equal to $2\sigma/\sqrt{\pi}$.

tential depends upon the presence of certain environmental influences. Beyond some threshold level of favorable environmental influences, however, further increases do not make for appreciable increments in ability. An analogy is the effect of diet on physical stature. When the diet is deficient in certain vitamins and minerals, growth is stunted, but when the minimal daily requirement is provided, growth will be normal and further supplements to the diet will produce no appreciable effect. If the bulk of the population sampled in a heritability study is above the threshold value on the relevant environmental variable, the heritability estimate will be very high, as in Burt's study. This concept is illustrated in Figure 2.

The phenotype/genotype ratio can be thought of as the degree to which the potential for development (genotype) is realized in

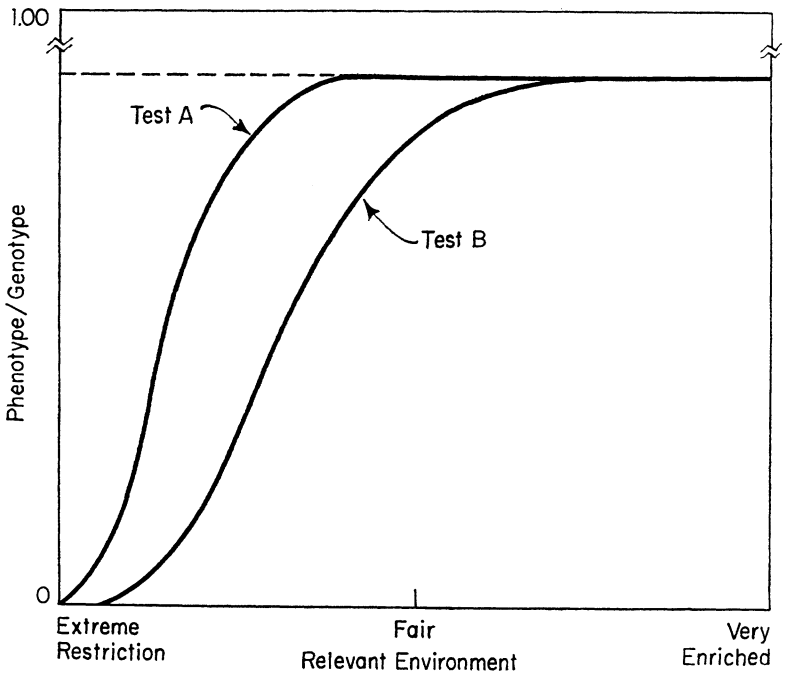

FIG. 2

Hypothetical curves showing the relationship between the degree to which genetic potential is realized in the phenotype (performance) and the quality of the environment. Test A represents a relatively culture-free test, Test B a more culturally loaded test.

actual development or performance (phenotype). It is assumed that phenotypic performance cannot exceed genotypic potential. The curves showing the hypothesized relationship between environment and the phenotype/genotype ratio are made to asymptote at some point below 1.00, since I do not wish to engage in the futile debate over whether a person ever realizes his full intellectual potential. It should be understood that the asymptotic values of these curves for individuals are assumed to be approximately normally distributed in the population. Test A in Figure 2 represents a relatively culture-free or culture-fair test; Test B is a more culturally loaded test. The key question, of course, is the nature of the environment represented by various points along the base line. The published research seems to show that a quite severe degree of environmental deprivation is needed to cause a lowering of the IQ, even on a test such as the Stanford-Binet. It is likely, for example, that over 90 percent of the children in Burt's London sample were reared in environments which permitted the phenotype/genotype ratio for Stanford-Binet intelligence to assume asymptotic values.

Now let us return to the Skeels studies, which show dramatic boosts in IQ. Let me give you some impression of the early environmental conditions in which children were reared in the most frequently cited study by Skeels. The study has been interpreted as demonstrating that when such deprived children between two and three years of age are transferred from a less to a more stimulating environment and then are reared to adulthood in good foster homes, their IQs show an average rise of about 30 points. The infants in the Skeels study were kept in an orphanage nursery up to about 2 to 3 years of age, then were placed in a psychologically much more favorable environment prior to adoption into good homes. Here is Skeels' description of these children's environment during this period: "The babies were kept in standard hospital cribs that often had protective sheeting on the sides, thus effectively limiting visual stimulation; no toys or other objects were hung in the infant's line of vision. Human interactions were limited to busy nurses who, with the speed born of practice and necessity, changed diapers or bedding, bathed and medicated the infants, and fed them efficiently with propped bottles" (Skeels, 1966, p.3). Beyond infancy the children were moved into small dormi-

tories containing two to five large cribs. Skeels comments that up to two years of age "Interactions with adults were largely limited to feeding, dressing, and toilet details. Few play materials were available, and there was little time for teaching play techniques. Most of the children had a brief play period on the floor; a few toys were available in the beginning of such periods, but if any rolled out of reach there was no one to retrieve it. Except for short walks out of doors, the children were seldom out of the nursery room" (Skeels, 1966, p. 4).

Despite this extreme deprivation in early life, these children's average IQ at 6 years of age was 95.9, with a standard deviation of 16.3. Thus, they were only four points below the national average and had about the same variability as the general population. Most of them became average, self-sufficient adults (Skeels, 1966). Environmentalists who cite these studies, however, apparently fail to note an important difference in the behavior of these children prior to their placement in a stimulating environment and the behavior of the majority of culturally disadvantaged children to whom these results are often generalized. The typical culturally disadvantaged child in his first two years does not show deficiencies in performance on the usual infant tests of intelligence, such as the Gessell or Bayley scales (Bayley, 1965). Behavior and development appear quite normal up to this age. On the other hand, the average IQ of the children in Skeels' study, at an average age of 19 months, was only 64. The deficits of the Skeels' children are thus not directly comparable to those of the typical disadvantaged child.

A number of researchers are now attempting to pinpoint environmental variables relevant to various stages of intellectual development. The working hypothesis essentially is that certain psychological environmental variables, largely those involving parent-child interaction, are distributed differently in the disadvantaged segment of the population than in the rest of the population. This hypothesis is illustrated in Figure 3. Keep in mind the functions represented by Test A in Figure 2. As an aid in keeping both figures in mind, a trace of this curve is shown in Figure 3.

Figure 3 shows one hypothesis concerning Negro-white differences in tested intelligence. The distribution of Negroes on the environmental continuum is represented as placing the majority of them in

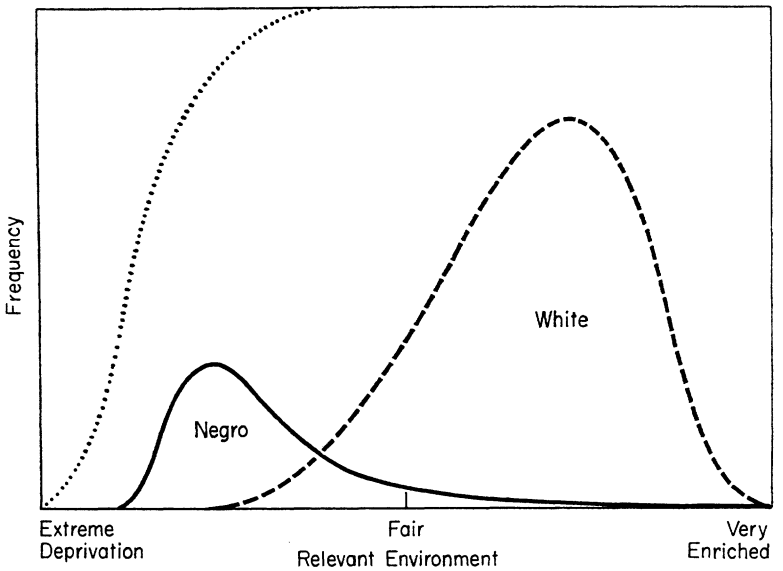

FIG. 3

Hypothetical frequency distributions of Negro and white populations of the United States with respect to environmental variables relevant to intellectual development. The dotted curve represents a trace of the curve (Test A) in Figure 2, to illustrate the hypothesis that many Negroes may be reared in environmental conditions that do not permit the full development of genetic intellectual potential.

a region in which genetic potential for intellectual development is not fully realized in performance. This seems a plausible hypothesis.

One way of testing the hypothesis that a particular segment of the population is intellectually handicapped because of its position on the environmental continuum would be to carry out a heritability study within this segment of the population. If the hypothesis represented by Figure 2 has any merit, heritability estimates should be significantly lower for groups reared in the more disadvantaged part of the environmental continuum. Here, then, is one feasible means of directly testing the hypothesis that Negroes perform below most other groups on tests of intelligence and scholastic achievement because of environmental rather than genetic differences.

SOCIAL CLASS DIFFERENCES

Socioeconomic status (SES) is generally recognized as one of the most prominent correlates of tested intelligence and school achievement. The occupational hierarchy associated with SES, which is highly related to the amount of knowledge, skill, and education required for performance in various occupations, acts as an intellectual screening device. The fewer restraints society places on social mobility, the more the assortment into various occupations and socioeconomic strata will be determined by innate potential. It should not be surprising, therefore, to find that a substantial proportion of the differences in intelligence and achievement among SES levels has a hereditary basis. This is not to say, however, that SES differences in life style, child-rearing practices, and the like, do not also play an important role in the development of educationally relevant skills, attitudes, and values.

Let me emphasize that this statement applies only *within* racial groups but cannot now be generalized *across* racial groups. The reason is obvious: if intellectually irrelevant racial characteristics such as skin color act to any degree as a barrier to social mobility —as is unfortunately still the case in many parts of our society— innate ability will be denied full opportunity for its development or expression.

As we have already seen, individual intelligence tests such as the Stanford-Binet are not so culturally biased as to be incapable of reflecting genetic factors, at least for a large majority of the population. If the results of heritability studies such as those of Burt, of Newman, Freeman and Holzinger, and of Shields, are accepted as valid, as I believe they must be until contrary evidence is forthcoming—it almost inevitably follows that some of the variance in intelligence among social classes must be genetic. This is important for us to know, because it is unrealistic to expect social or educational reforms to wipe our ability differences between groups, when the groups differ in part because of genetic factors.

There are several lines of evidence for this conclusion that SES differences have a genetic as well as an environmental basis. I will mention only three of the least technical.

The first is a *reductio ad absurdum* of the position that *individual* differences are largely determined by heredity but that *social class* differences are entirely determined by non-genetic factors.

When we look at a population such as the one in which the Stanford-Binet intelligence test was standardized, and within this population we classify children into six groups according to socioeconomic status (based largely on father's occupation), we find that at least 30 percent of the total variance in IQ is attributable to the classification by SES (Terman and Merrill, 1937, p. 48). In other words, approximately 30 percent of the variance in the children's IQs is attributable to differences *between* the social classes and approximately 70 percent of the variance is attributable to individual differences *within* social classes. On the other hand, heritability studies based on the Stanford-Binet on samples from essentially the same population show that about 80 percent of the variance in IQ is attributable to hereditary factors and 20 percent or less to environmental factors. Now, when we try to put these two sets of facts together, it becomes apparent that some of the variance among SES groups must very likely have a hereditary basis. In short, since 30 percent of the variance is associated with SES, and since heritability studies show that in the same population something less than 20 percent of the variance in IQ is due to environmental factors, then at most only two-thirds of the SES variance can be attributed to environmental differences and the remaining variance must be due to heredity.

A second line of evidence comes from the phenomenon of regression. This is illustrated in Figure 4. If we look at the average IQ of parents in the six occupational categories of the U.S. Census, and then look at the mean IQs of their children, we see the well-known regression phenomenon. This is true regression, not regression due to errors of measurement. The phenomenon shown in Figure 4 is especially interesting because it is perfectly predicted by a simple polygenic model. The same model predicts the amount of regression for other polygenically inherited characteristics such as height and cephalic index (the ratio of head breadth to head length). The predicted amount of regression is half the distance between the parental mean and the population mean. Examination of Figure 4 shows that the fit is nearly perfect. There is no strictly environmental hypothesis from which this precise prediction could be made nor from which one would expect exactly the same relative amount of regression of the means from parents to children for each SES group. It is interesting, too, that the relatively

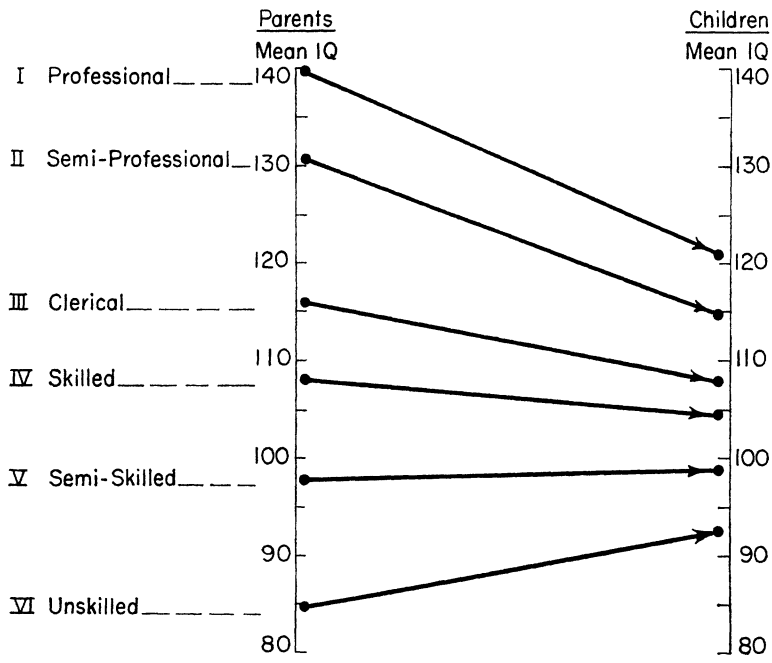

FIG. 4
An illustration of the phenomenon of regression to the mean, originally established by Sir Francis Galton. (Data from Burt, 1961)

more intelligent upper-middle-class parents generally provide a presumably excellent environment for their children's intellectual development—on the average a better environment than the parents themselves enjoyed in their formative years—and yet their children on the average have lower IQs than the parents. At the other extreme, the less intelligent parents in the unskilled labor class, who are generally thought to provide a less intellectually stimulating environment for their children, nevertheless produce children who are brighter than their parents.

An important feature that is intentionally omitted from Figure 4 for the sake of graphic clarity is that each of the points represents the mean of a *distribution* of IQs, and each distribution has considerable dispersion about its mean. Thus one can find extremely dull children born to brilliant parents and extremely bright children born to very dull parents. The observation that "like begets like" is seldom surprising either on the basis of heredity or en-

vironment. However, for polygenically inherited traits it is often that "like begets *un*like". This is expected from genetic principles, and it is what we find in the case of intelligence.

A third line of evidence is the simplest and most direct of all. It is based on the study of children reared in orphanages. One of the best studies examined 269 illegitimate children who were placed in an orphanage before the age of one year and kept there until at least age 10½. The occupational status of each child's father was rated on a five-point scale. This occupational rating, which is the best single index of SES, showed a correlation of .23 with the children's Stanford-Binet IQs at the age of 10½, which did not differ significantly from the correlation of .24 in a control group of home-reared children (Lawrence, 1931).

RACIAL DIFFERENCES

Racial differences in mental abilities, whatever their sources, must be taken into account if programs are to be developed to make schooling more beneficial for more of our population. This, of course, is the intention of large-scale programs such as Project Head Start.

One may ask, why bring race into the picture? Are not all differences in mental test scores and school performance due to environmental and social-class differences? If we cannot define "race" with perfect precision, have we any business using it as a variable in our psychological or educational research? My answer to these questions, as an educational psychologist, is wholly operational and pragmatic. I assume that one legitimate aim of research is to discover the sources of individual differences in educationally relevant variables such as IQ and school performance. Now, if we have a multiple regression equation made up of a host of socioeconomic and other environmental variables that predict educationally important criteria, and if the prediction is substantially improved by adding the variable called race to the prediction equation, I maintain that race is by definition a relevant and valid variable. For this purpose no more precise definition or criterion for classification by race is needed than the teacher's judgment. In the studies I have reviewed which used this multiple regression approach, the addition of race along with environmental variables has always substantially boosted the total variance accounted for.

For example, in a study by Alan B. Wilson, the dichotomy "Negro-non-Negro," when included among eleven other variables, made the largest independent contribution to the prediction of intelligence test scores of 6th grade students in Berkeley schools (Wilson, Jensen, & Elliott, 1966). Whether we are investigating the environmental or genetic aspects of the total variance is another matter entirely. To the extent that Negro-white differences are due to environmental influences, this method can tell us whether or not we had succeeded in identifying these influences. We only have to hypothesize what they are, measure them, and include them in the multiple-regression equation. If our hypotheses are correct, the variance contributed by "race" would be absorbed by the hypothesized environmental variables. Many of these environmental variables, I believe, are important and as yet unidentified. Research of this kind is presently going on in various parts of the country, typified, for example, by the work of Martin Deutsch of New York University and Robert Hess of the University of Chicago (e.g., Deutsch, 1966; Hess & Shipman, 1965). One aim of these researchers has been to go beyond crude socioeconomic variables to find the truly causal environmental influences on educability which are now thought to lie in more subtle psychological aspects of intra-family and inter-personal interactions during the child's development. Our hope is that if such environmental effects can be clearly identified it might be possible through some kind of early educational intervention to boost the child's chances of doing well in school.

There is no question about the large average difference between Negroes and whites in performance on standard intelligence tests and in school performance. The differences, whatever their cause, are so large as to be a major concern to educators. For example, of a national sample of 10 million men between the ages of 18 and 26 tested on the Armed Forces Qualification Test, 68 percent of Negroes as compared with 19 percent of whites failed the test (*U.S. News and World Report*, Oct. 17, 1966, p. 78). The failure cut-off score that yields these percentages is equivalent to a Stanford-Binet IQ of 86. Figure 5 shows the results of the best normative study we have of Negroes on the Stanford-Binet, based on 1800 children (Kennedy, Van de Riet, & White, 1963). Since these norms are based on a sample of the population of five

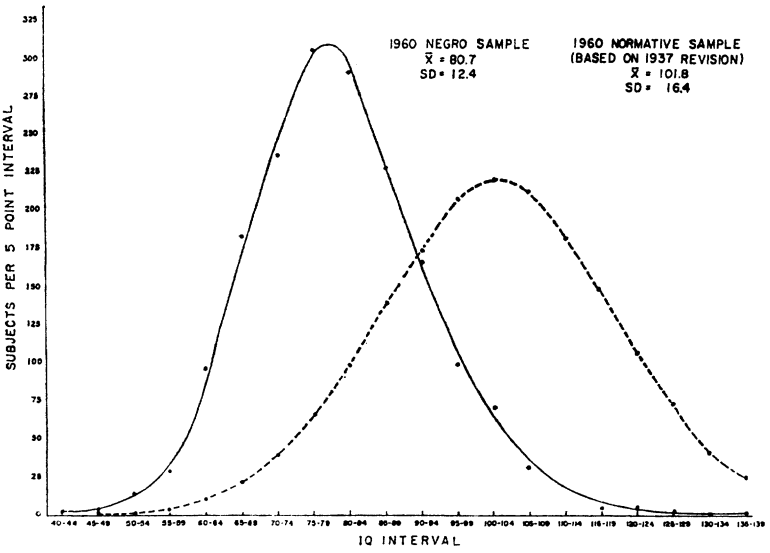

FIG. 5
Stanford-Binet IQ distribution of Negro children in five Southeastern states (solid line) and of white children in the 1960 normative sample. (Kennedy, Van de Riet, & White, 1963.)

Southeastern states, they cannot be regarded as an unbiased representation of the Negro population of the United States. The median Negro-white overlap is only 7 percent in this figure, as compared with 8 per cent in the Armed Forces Qualification Test on a national sample of the male population between ages 18 and 26. But since there is a significant sex difference among Negroes in IQ—almost certainly a cultural phenomenon—the addition of female scores to the distribution would cause the overlap to be a good deal higher. A fair estimate would be about 12 percent Negro-white overlap for the total U.S. population. Merely to point out that the Stanford-Binet or the Armed Forces Qualification Test may be culturally biased, which they no doubt are, does not in itself solve the major problem, since the tests do, in fact, predict educational and occupational performance.

Let us now look a bit further into these data to see if what is revealed by the distributions of total IQ might be concealing some important complexities in the situation. Figure 6 shows a comparison of Negro and white children on two of the Stanford-Binet

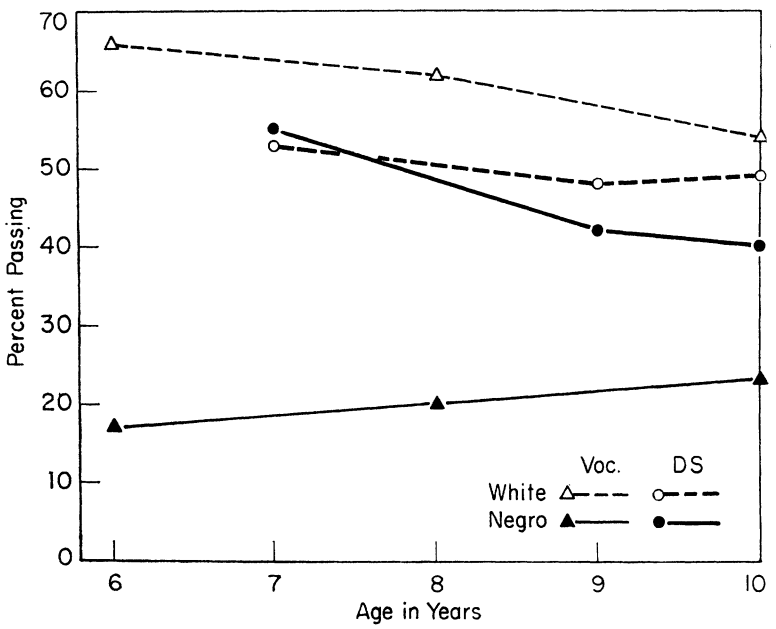

FIG. 6

Percentage of Negro and white children passing the Vocabulary and Digit Span tests of the Stanford-Binet at various ages. (Data from Kennedy, Van de Riet, & White, 1963, and Terman & Merrill, 1960.)

subtests: Vocabulary and Digit Span. The degree to which other subtests differentiate between Negro and white children falls between these extremes. Intuitively, we would say that digit span is less culturally biased than vocabulary. You may be surprised, in view of this fact, that past attempts to develop so-called culture-fair or culture-free intelligence tests have not used the digit span technique. The tests that were hopefully devised to be culture-fair, like the now defunct Davis-Eells Games, showed almost as large Negro-white and social-class differences as tests like the Stanford-Binet and even group-administered paper-and-pencil tests. Why has digit span been neglected as a potentially valuable method of assessing intellectual ability among persons across a wide range of environmental variation? Much of the reason, I believe, is that the low reliability of the meager digit span tests in standard batteries has made them appear inferior to other tests. For example,

corrected for attenuation the digit-span test in the Weschler Adult Intelligence Scale correlates .75 with total IQ (minus digit-span) and has a loading of .80 on the general factor common to all the subtests (Wechsler, 1958, p. 122). The ability to repeat two digits at age 2½ correlates .62 with Stanford-Binet IQ—uncorrected for attenuation (Terman and Merrill, 1960, p. 342). We have been able to devise memory-span tests administered under laboratory conditions which have reliabilities comparable to those for height and weight. By manipulating procedural variables, such as stimulus modality (auditory or visual), by varying the interval between presentation and recall, and by several other more complex variations of the digit-span paradigm, it is possible to obtain a profile of factorially independent scores for each subject. These factors derived from laboratory measures of short-term memory are not psychologically trivial. In a sample of 50 University of California undergraduates these factors had a multiple correlation of .76 (.68 after correction for shrinkage) with college grade-point average (Jensen, 1965b).

One of the conclusions I draw from the large discrepancies between various subtest scores on standard intelligence tests administered to Negroes is that we probably will not advance our understanding of group differences markedly by collecting more data with global, omnibus tests of general intelligence. Practically all the evidence of Negro-white intellectual differences based on such tests has been reviewed by Shuey (1966). While this mass of evidence shows great consistency and leaves no doubt concerning the presence of mean differences in measures of the phenotype, I find little information about the extent to which Negro-white differences have a genetic basis. Racial variations have been identified in just about every anatomical or physiological characteristic anyone has chosen to study, and it would be surprising indeed if the brain alone were exempt from this generalization. But the relevance of physiological differences to behavior will still have to be proved in the psychological realm by psychological techniques. As far as I can tell from my search of the relevant literature, research on racial differences does not even begin to permit one to sort out the hereditary and environmental components of the demonstrated phenotypic differences in mental abilities. Therefore, statements concerning the relative importance of

genetic and environmental factors in racial differences can at present be nothing but conjecture and surmise. The only answer, I submit, is to transmute conjecture into scientifically testable hypotheses and then do the necessary research. It is good scientific strategy to begin with the simplest possible hypothesis, that is, the one that adds the fewest assumptions to what is already established. Stated in the simplest form, the hypothesis is that the difference between the means of Negroes and whites in tested intelligence is caused by the same factors, operating in the same degrees, that cause differences in intelligence between individuals within either group. I can find no evidence to date in the published literature which would permit rejection of this hypothesis. Nor do I believe that appropriate data for a direct test of the hypothesis have yet been obtained. But the question arises whether there has been an official decision to create the impression that such hypotheses have already been scientifically tested with conclusive results. A recent publication of the U.S. Office of Education states: "It is a demonstrable fact that the talent pool in any one ethnic group is substantially the same as that in any other ethnic group" (U.S. Office of Education, 1966). A Department of Labor report on the Negro family says: "Intelligence potential is distributed among Negro infants in the same proportion and pattern as among Icelanders or Chinese, or any other group" (Department of Labor, 1965). Such statements entirely lack a factual basis and uncritical acceptance of them may unwittingly harm many Negro children born and unborn.

Future research in this area will contribute little more to our understanding of human differences and will have only meagre educational implications if the emphasis is placed solely on differences in global intelligence tests scores, which reflect only an undifferentiated composite of abilities having unknown weightings in the total test scores. Perhaps our greatest hope of achieving equality of educational opportunity lies in the possibility of finding significant *patterns* of individual differences in the development of abilities and in taking advantage of these differences to create the optimal Instruction x Pupil interaction. We have some evidence that this can happen in the learning laboratory (Jensen, 1966f). If it is a false hope for school learning, we can find this out only by making a serious attempt.

PATTERNS OF ABILITIES

As an example of patterns of abilities, I refer to a study by Lesser, Fifer, and Clark (1965). I select this study not because I think the abilities that were measured are the most important educationally or the most enlightening to study, but only because they clearly show consistent interactions with ethnic classification. The in-

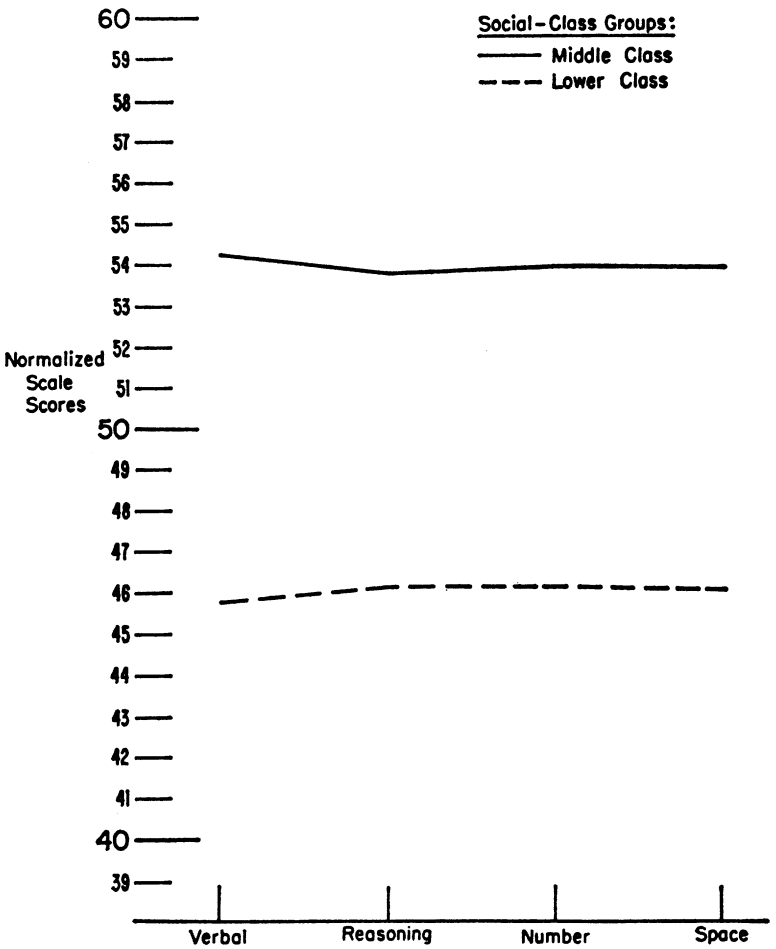

FIG. 7
Pattern of normalized mental-ability scores for each social-class group, all ethnic groups combined. (From Lesser, Fifer, & Clark, 1965.)

vestigators compared middle- and lower-class children of four ethnic groups in New York schools: Chinese, Jews, Negroes, and Puerto Ricans. The abilities measured were: Verbal, Reasoning, Numerical, and Spatial. The results are shown in Figures 7 through 12. The overall social class difference is significant but shows no interactions with specific abilities (Figure 7). The ethnic groups not only differ in overall ability but show significant in-

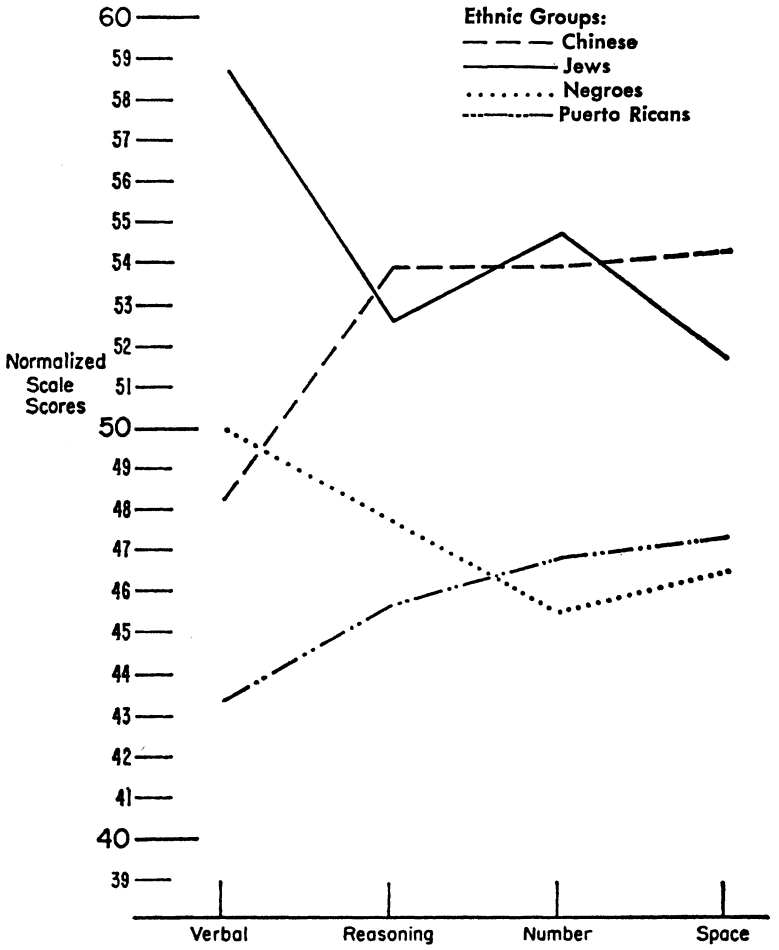

FIG. 8

Pattern of normalized mental-ability scores for each ethnic group. (From Lesser, Fifer, & Clark, 1965.)

teractions with special abilities (Figure 8). The most impressive finding is that the pattern of abilities, which is distinct for each ethnic group, remains invariant across social classes despite gross environmental differences (Figures 9-12).

There is no way of inferring from these data the relative contributions of heredity and environment to any of these differences. From what has already been said about social-class differ-

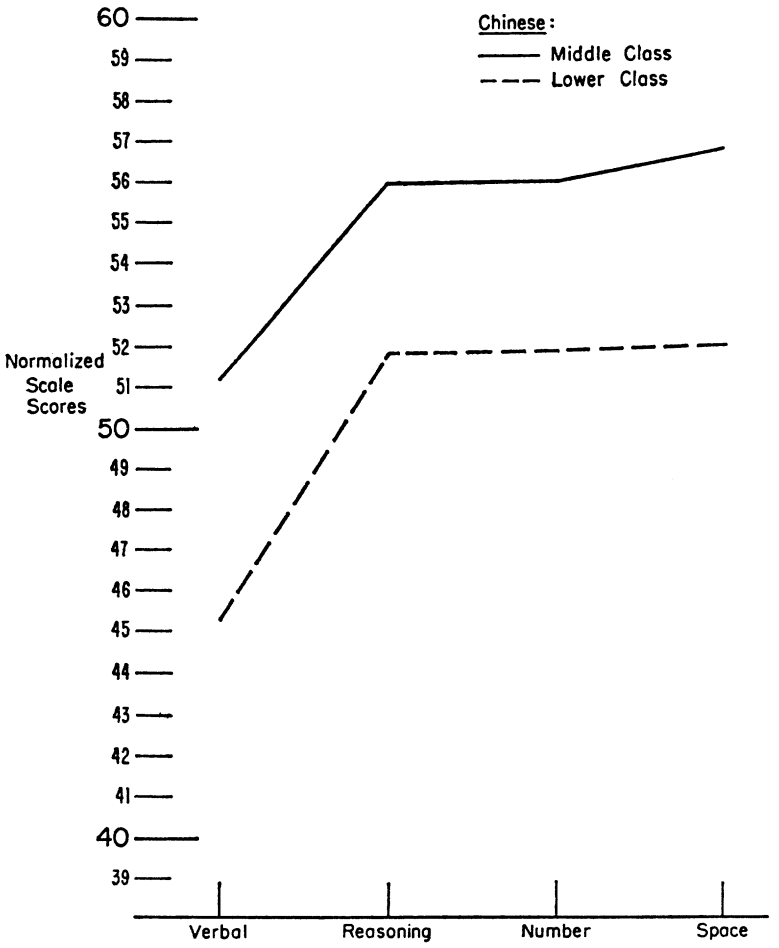

FIG. 9
Patterns of normalized mental-ability scores for middle- and lower-class Chinese children. (From Lesser, Fifer, & Clark, 1965.)

ences in ethnic groups, we would expect a substantial proportion of the SES difference to have a genetic basis. The basis of ethnically distinctive patterns of ability is a greater unknown. They could be due largely to distinctive cultural influences pervading

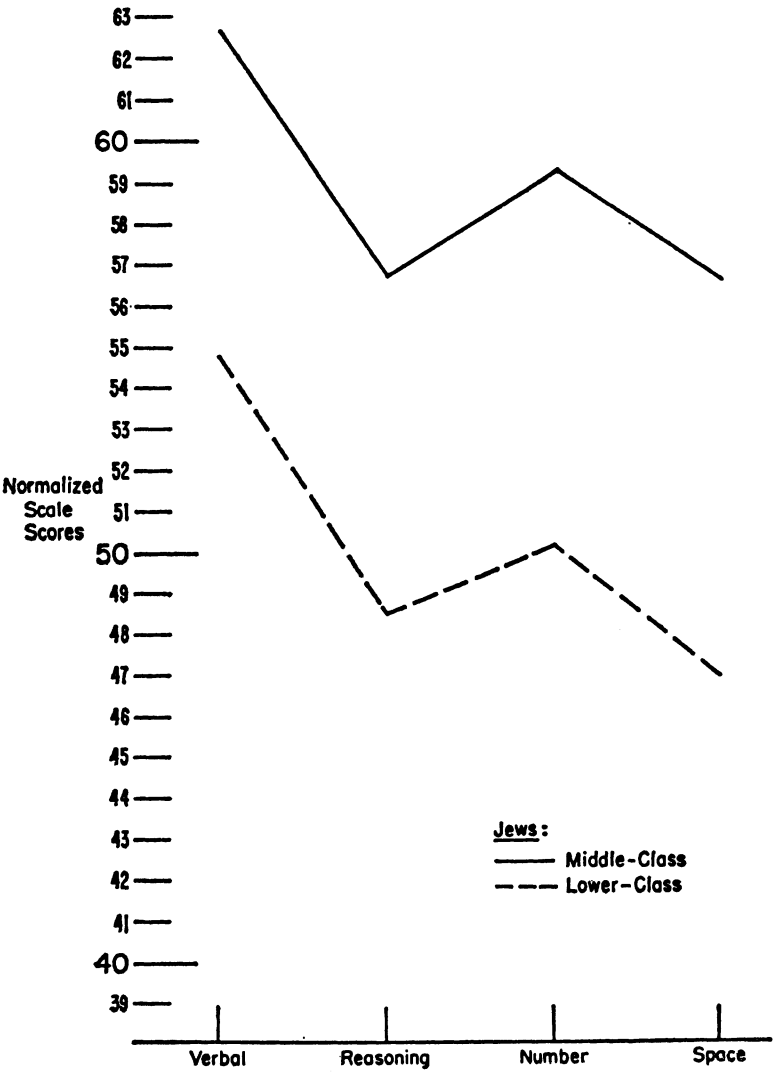

FIG. 10

Patterns of normalized mental-ability scores for middle- and lower-class Jewish children. (From Lesser, Fifer, & Clark, 1965.)

the whole range of SES within each ethnic group, but it is equally probable that the genotypes for these abilities are not equally distributed among various ethnic groups. Studies by Blewett (1954), Nichols (1965a, 1965b), and Vandenberg (1966) have obtained heritability estimates on special abilities after partialling out the general factor. Special abilities show almost as high heritability

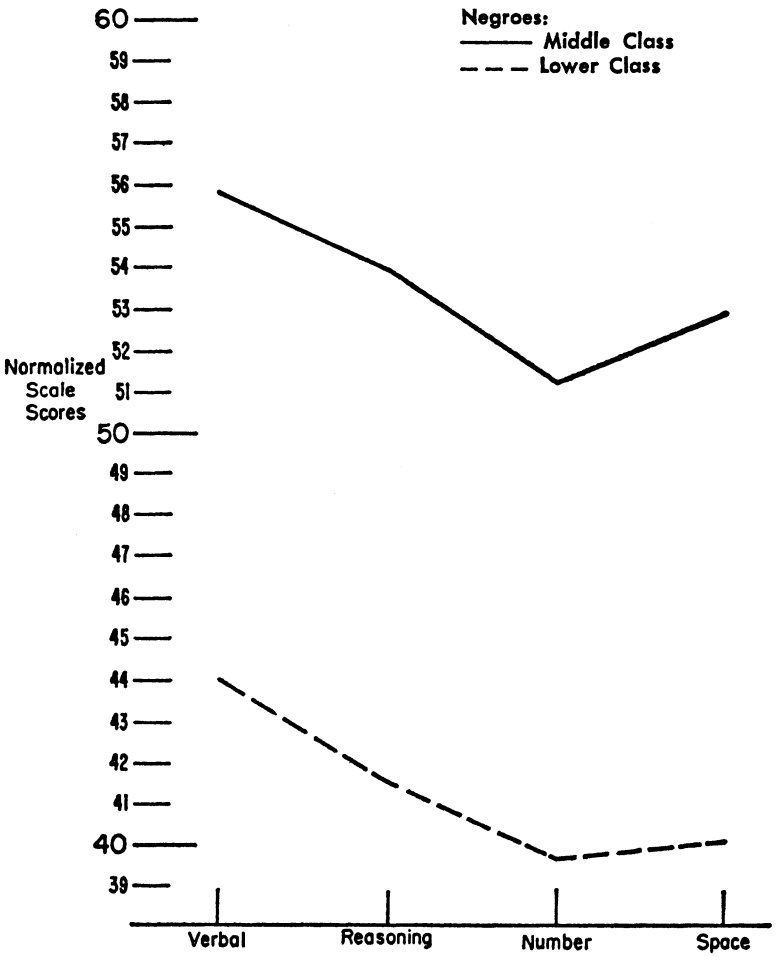

FIG. 11
Patterns of normalized mental-ability scores for middle- and lower-class Negro children. (From Lesser, Fifer, & Clark, 1965.)

as general ability, with about 70 percent of the individual differences variance attributable to genetic factors.

DIFFERENTIAL BIRTH RATES

I return to the unresolved problem of the differential birth rate as a function of SES, since this phenomenon contains a mechanism by which, through social and economic inequalities, possible racial differences in a largely genetically determined characteristic such

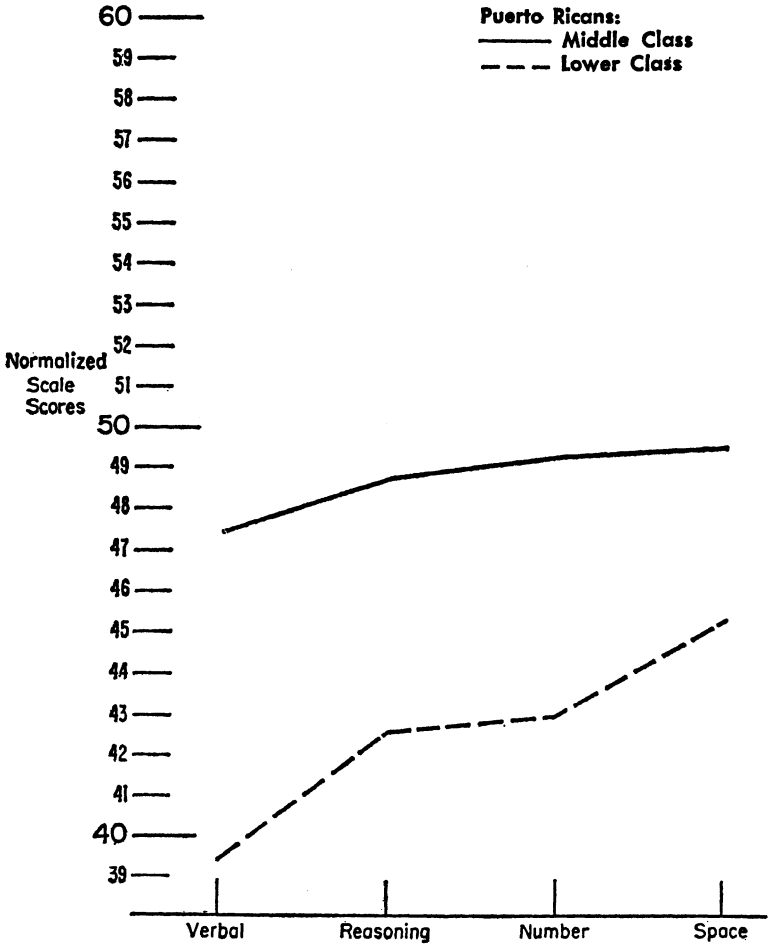

FIG. 12

Patterns of normalized mental-ability scores for middle- and lower-class Puerto Rican children. (From Lesser, Fifer, & Clark, 1965).

as intelligence can be both created and widened. If SES level has any relation to genetic factors, and if the differential birth rate for lower and upper socioeconomic classes is appreciably greater in one racial group than in another, one would predict a genetically determined divergence of the means of the two racial groups. The rate of this divergence could be masked for a period of time by improved social, economic, and educational conditions, but this masking would not continue indefinitely if there were some threshold of environmental favorability beyond which further improvements had little effect on the development of intelligence (the hypothesis expressed in Figure 2). This concatenation of factors would have extremely important implications for public education's concern with reducing disparities in scholastic achievement among major segments of the population. My attempts to find comprehensive, scientifically based discussions of these issues lead me to the conclusion that the matter is not being studied or explored in any or all of its socially important ramifications. The policy of ignoring this problem might well be viewed by future generations as our society's greatest injustice to Negro Americans.

The factual basis of this concern can be found in a recent article by Moynihan (1966). The SES differential birth rate is much greater for Negroes than for other groups. Negro middle- and upper-class families have fewer children than their white counterparts, while Negro lower-class families have more. In 1960, Negro women of ages 35 to 44 who were married to unskilled laborers had 4.7 children as compared with 3.8 for non-Negro women in the same situation. Negro women married to professional or technical workers had only 1.9 children, as against 2.4 for white women in the same circumstances. Negro women below the so-called poverty line, with incomes below $2000, averaged 5.3 children. Three out of four Negroes failing the Armed Forces Qualification Test come from families of four or more children; one out of two come from families of six or more children. The poverty rate for families with five or six children is 3½ times as high as that for families with one or two children (Hill and Jaffe, 1966).

I would like to see competent delineation of the social, economic, and educational implications of these trends for the future. For example, there is some suggestion, though based on inconclusive evidence, from the Office of the Surgeon-General, U.S.

Army, of a decreasing Negro-white overlap in mental test scores since World War I. And the noted social psychologist, Kenneth Clark, has claimed that children in Harlem have been falling further and further below white norms in school achievement since the 1920s and '30s (Clark, 1965). There could be many causes of this, but the point is, we do not know them. To eschew the testing of genetic as well as environmental hypotheses concerning this issue strikes me as indefensible on either scientific or humanitarian grounds.

CULTURE-FREE AND CULTURE-FAIR TESTS

The 1950s saw many attempts to devise "culture-free," "culture-fair," or "culture-controlled" tests of intelligence (e.g. Eells, *et al.*, 1951). The purpose of such tests was to discover or demonstrate a true level of intellectual ability in socioeconomically disadvantaged children, presumed to be grossly underestimated by traditional intelligence tests. The usual tests were shown to contain some items which discriminated more than others among social classes. Such items were said to be culturally biased in favor of the middle-class child, and for many test items this was obviously true: identification of musical instruments or exotic animals, the interpretation of bookish proverbs, and the like. Attempts to overcome cultural bias in tests were of two main types. The first was to make up tests of abstract items that would seem to be more or less equally unfamiliar in all social classes; Raven's *Progressive Matrices* is a good example of this approach. The other approach was to use only items with realistic content presumed to be equally familiar in all socioeconomic strata. The Davis-Eells Games are the best example of this approach. There was one scientific peculiarity about these efforts. In devising a culture-free or culture-fair test, the main criterion of success was the extent to which one could narrow the mean difference between SES groups in measured intelligence. The very same test devised to this criterion, it was hoped, could then be used to show that different socioeconomic classes do not differ in intelligence. Though the argument would have been challenged on logical grounds even if this had been demonstrated, the tests failed to perform as expected. All the attempts to make culturally unbiased tests persisted in showing significant SES differences. For example, the Davis-Eells Games, spe-

cifically designed to minimize SES differences, was found to reveal the same disparities between high and low SES groups as the standard group intelligence tests (Ludlow, 1956).

Part of the failure to eliminate cultural bias from tests probably resulted from an over-simplified notion of essential cultural differences. Such differences were largely identified with specific bits of knowledge or information and with verbal ability of the type measured by specific word knowledge. Environmental deficits, we now believe, are much more profound and pervasive than would be indicated by differences in sheer informational input. The differences appear to involve a complex hierarchy of cognitive coping mechanisms for processing environmental inputs and for symbolically mediating behavior in situations that call for any kind of problem solving. I have spelled out some of these processes in detail elsewhere (Jensen, 1963, 1965, 1966a, b, c, d, e). My present hunch is that it is probably impossible to devise perfectly culture-free or culture-fair tests of intelligence because performance depends upon the mediational processes which are heavily involved in all forms of problem-solving and abstract and conceptual thinking —in the essence of what we recognize as intelligence.

Nevertheless, I persist in claiming that culturally unbiased tests —if we could only devise good ones—would be useful and perhaps even necessary as a research tool in tackling some of the problems I have discussed. We recognize that the notion of a culture-free test refers to a *continuum* of possible tests with different degrees of cultural loading, the zero point of which can only be an idealized conception, like the conception of a straight line in geometry. Though the idealized end-point of the continuum cannot be attained, the ability to measure differences between various other points on the continuum can be useful and informative.

The proper criterion for assessing the degree of culture-fairness of a test is not, however, the extent to which the test fails to discriminate among social classes or ethnic groups. The extent to which the test does this is an incidental matter. A test devised against this criterion cannot then be used to test hypotheses concerning group differences. Some external criteria are needed. I bring up this subject in the present context because the criteria I would propose for culture-free tests involve genetic considerations. I suggest two essential criteria for a culture-free test: *(a)*

high correlation with other standard tests of intelligence within culturally homogeneous groups in which the standard tests have been validated, and (*b*) high heritability estimates across a wide range of environmental variation. If and when these criteria are met, I shall be satisfied that we have a culture-free test, at least within the population in which these two criteria are met.

LEARNING ABILITY AND EDUCABILITY

My approach to these problems has been to think in terms of what I call "basic learning abilities." By "basic" I mean only that we use learning tests that depend relatively little upon mediational processes or specific transfer from previous learning. These learning tests are usually taken individually in the laboratory. The tasks consist of selective trial-and-error learning, free recall, serial and paired-associate learning under various experimental conditions. These techniques yield measures of cognitive learning ability. Let me emphasize that the tasks are *not* measures of perceptual or motor abilities. Here is the rationale behind this approach: If a child has good basic learning ability, he should be able, given the appropriate environmental input, to acquire the learning sets, mediational habits, verbal associative network, and the reservoir of transferable skills that largely constitute educability. Thus, I think of learning ability as a psychologically more fundamental process than intelligence. The precise nature of the connection between intelligence and the basic learning abilities is one of the main questions in our research (Jensen, 1966f).

Summarizing the results obtained thus far can be facilitated by means of Figure 13, which shows a composite average of several learning tests administered to various socioeconomic and ethnic groups. There is such a remarkable consistency in the results that when they are shown graphically, one study looks much like another. The essential finding, illustrated in Figure 13, has occurred in comparisons of Mexican-American and Anglo-American children (Jensen, 1961), lower- and upper-middle class Caucasian children (Rapier, 1966), and has just recently been tested on Negro children, with similar results. In brief, the learning tests clearly differentiate between high and low IQ's within groups of middle- and upper-class children. The obtained correlations between learning ability and IQ among middle-class children are about as high as reliabilities

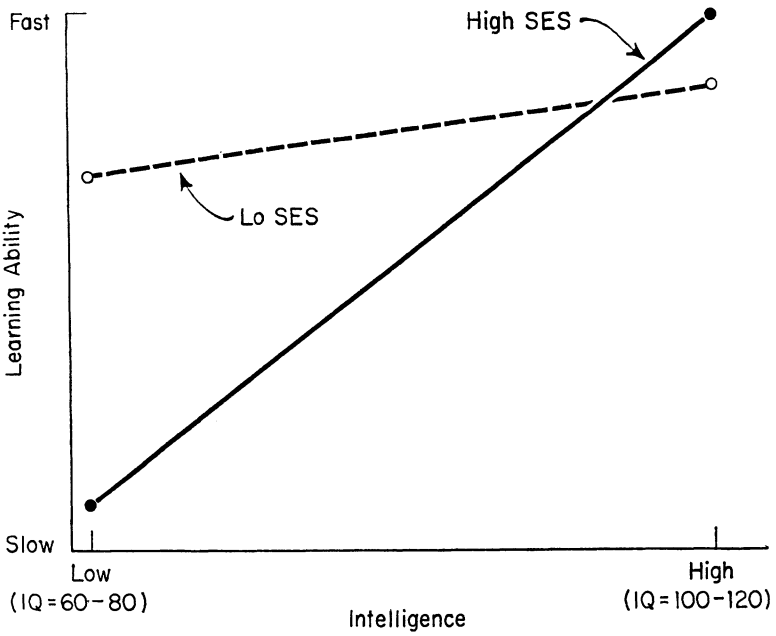

FIG. 13
Summary graph of a number of studies showing relationship between learning ability (free recall, serial and paired-associate learning) and IQ as a function of socioeconomic status (SES).

of the current tests permit—in the region of .50 to .70. In low SES groups, on the other hand, the learning tests do not differentiate markedly between high and low IQs. Correlations between the learning and IQ measures in this group are generally below .20. For reasons that are still obscure, upper and lower SES groups with above average IQ's differ very little on these learning tasks. This does not seem to be a ceiling effect, although this possibility has not yet been completely ruled out. The most striking finding is the great disparity in learning ability between high and low SES groups in the lower part of the IQ distribution. In these studies high and low SES groups are carefully matched on IQ. Middle-class children with low IQs are invariably slow learners on these tasks; lower-class children with low IQs, on the other hand, show a wide range of learning ability. The fact that the learning tests correlate substantially with IQ in middle-class groups means to me that they are measuring important psychological functions. The fact that the

learning tests show negligible correlations with IQ in low SES groups means that IQ tests are a poor index of learning ability for these children.

A colleague in Berkeley, William Rohwer, has devised a paired-associate learning test, appropriate over a wide age range and administered as a motion picture. In some of the learning conditions the stimulus and response terms of the pairs, consisting of pictures of common objects, are in motion to more readily arouse attention and mediational processes in the learner. Rohwer has been giving this test to large numbers of children from Head Start and from kindergartens through sixth grades in schools in poor neighborhoods and in affluent neighborhoods. The low SES group has over 90 percent Negroes. The striking finding is the very small average difference between low SES and middle SES children on these tests, as shown in Figure 14. The low and middle SES groups dif-

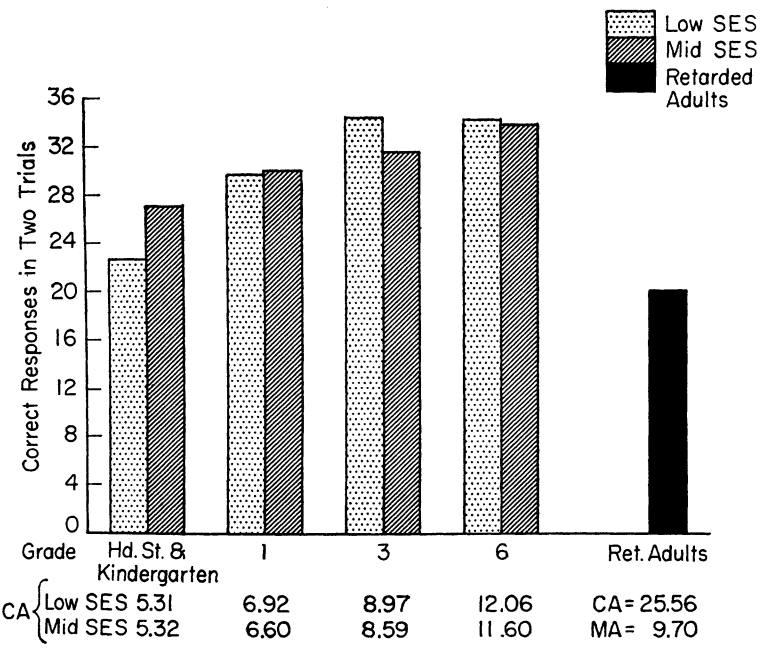

FIG. 14

Comparisons of Low- and Middle-Socioeconomic groups at various ages with retarded adults on a paired-associate task (24 picture pairs presented two times at a rate of 3 sec. per pair). (Permission of Dr. Wm. D. Rohwer.)

fer by an average of 15 to 20 points in IQ, and the discrepancy between their school performances is even greater. In fact, many of the low SES children in these groups are, for all practical purposes, non-learners in the classroom. The mystery is how they are able to learn Rohwer's paired associates as rapidly, on the average, as do middle SES children. Could it be that the paired-associate test is really not measuring an intellectually important function? As one means of getting an answer to this question, Rohwer gave the test to a group of institutionalized, mentally retarded, young adults. The results are shown in Figure 14. Though these adults have an average Stanford-Binet mental age of nearly 10, they are significantly slower learners than low SES Head Start children with an average Stanford-Binet mental age of about 4½.

What are we to conclude from these findings and what implications might they have for education? First, I will summarize the essentials of this picture: tested IQ correlates highly with learning ability in middle-class children. IQ correlates negligibly with learning ability in lower-class children. Also, there is some indication that in the above-average IQ range lower-class and middle-class children matched on IQ are similar in learning ability. It is mainly in the IQ range from 60 to 80 that lower-class children are significantly superior to low IQ middle-class children in learning ability.

Why then do not lower-class children with low IQs perform better in school than middle-class children with low IQs? To state the question in more general terms, why is the IQ more predictive of school achievement than are direct tests of learning ability? My current thinking on this problem can be explained with the aid of Figure 15.

Basic learning abilities are measured by laboratory learning tests which involve little transfer from previous learning. Serial rote learning is a good example. A variety of short-term memory tests, including digit span, may prove to be the best means of measuring these basic abilities. Intelligence as measured by standard IQ tests consists of a reservoir of transferable knowledge and cognitive skills, most of which, I presume, have had to be acquired. The rate of acquisition is a function of the basic learning abilities and the opportunities afforded by the environment. In a good environment we should therefore expect to find a very high correlation

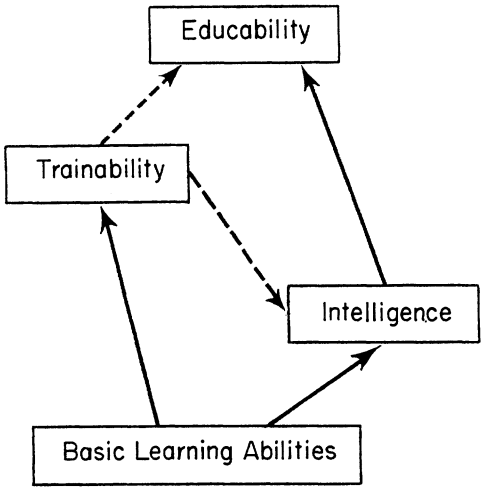

FIG. 15
Schema to illustrate relationships among four educationally important constructs.

between learning ability and intelligence. Educability is the ability to learn school subjects by means of classroom instruction. Note that raw learning ability is not directly converted to educability but serves educability through the agency of intelligence. To profit from ordinary classroom instruction the learner must bring many developed skills to the situation: the voluntary control of attention, the perception of order, self-initiated rehearsal of newly acquired behavior, self reinforcement for successful performance, autonomous symbolic mediation, and a host of other processes I have described in detail elsewhere (Jensen, in press). In short, the learner himself must be able to act on the instructional input in order to master it. An intelligence test score is one indication of the degree to which a child has the equipment to act so as to be educable by ordinary means.

It seems that it is in the lack of these cognitive skills tapped by intelligence tests and required for educability, rather than in basic learning abilities, that culturally disadvantaged children differ most from typical middle-class children.

What we need to know, and what many researchers are now seeking to find out, is how to transmute learning ability into the

kind of intelligence needed for school achievement. There are two major classes of hypotheses concerning the relationship between intelligence and what I call basic learning ability.

One hypothesis states that intelligence and learning ability are highly correlated because there is only one basic process: simple learning ability. According to this view, the processes we recognize as intelligence are entirely learned, given the opportunity, and the rate and thoroughness of learning are direct functions of the basic learning abilities. Thus, learning ability is seen as being one step closer to the genes than is intelligence.

The second hypothesis is that learning ability and intelligence depend upon different processes or structures, which may be more or less independently inherited but which are nevertheless correlated because the basic learning abilities are essential for the use and development of the higher intellectual processes. An analogy would be that the basic learning abilities are like the gasoline in an automobile. Without gasoline the motor will not run, but even the highest grade gasoline will not get the same performance from a four cylinder as from an eight cylinder engine. Experimental investigation of hypotheses such as these has enormous educational implications for dealing with the problems of the culturally disadvantaged.

Returning to Figure 15, we see that another route from basic learning ability to educability is what I call *trainability*. Trainability is the ability to acquire knowledge or skill in a situation in which the learner's behavior is under direct, immediate control of the instructor or instructional medium. It requires much less self-initiated or self-sustained activity on the part of the learner than does educability. Focussing of attention, active engagement of the learner, and immediacy of reinforcement are maximized by the instructional technique. Expert private tutoring will, using operant conditioning techniques, produce similar results. The rate of acquisition in such a training situation will be directly related to the individual's learning ability, but he need not bring as many developed skills to the learning situation. Many of the skills involved in intelligence, however, might be acquired efficiently through direct operant training. The main ingredients of educability might also be acquired through direct training procedures. This may be the most hopeful route to educability for culturally disad-

vantaged children who are already of school age. Its chances for success will naturally depend in the final analysis upon the precise psychological nature of the relationship among the constructs shown in Figure 15. My research in the Institute of Human Learning at Berkeley is currently aimed at finding answers to these questions.

In our efforts to improve education we should not lose sight of the focal point of our concern—the individual child. This means the biological as well as the social individual, for man's intelligence and educability are the products of biological evolution as well as of individual experience. Not to recognize the biological basis of educability is to harmfully restrict our eventual understanding and possible control of the major sources of diversity in human capacities and potentialities. A vigorous renewal of scientific inquiry into the nature-nurture problem will do more to implement the humanitarian goals of a free society than will dogmatic insistence that environment alone is responsible for all educationally or socially important human differences. In the long run, the greatest respect that educational researchers can pay the children in our schools is to take full account of *all* the facts of their nature.

REFERENCES

Bayley, Nancy. "Comparison of Mental and Motor Test Scores for Ages 1-15 Months by Sex, Birth Order, Race, Geographical Location, and Educaion of Parents." *Child Development* 36: 379-411; June 1965.

Blewett, D. B. "An Experimental Study of the Inheritance of Intelligence." *Journal of Mental Science* 100: 922-933; October 1954.

Burt, Cyril. "The Evidence for the Concept of Intelligence." *British Journal of Educational Psychology* 25: 158-177; November 1955.

Burt, Cyril. "The Inheritance of Mental Ability." *American Psychologist* 13: 1-15; January 1958.

Burt, Cyril. "Class Differences in General Intelligence: III." *British Journal of Statistical Psychology* 12: 15-33; May 1959.

Burt, Cyril. "Intelligence and Social Mobility." *British Journal of Statistical Psychology* 14: 3-24; May 1961.

Clark, Kenneth. *Dark Ghetto: Dilemmas of Social Power*. New York: Harper and Row, 1965. 251 pp.

Coleman, James S., et al. *Equality of Educational Opportunity*. U. S. Department of Health, Education, and Welfare, 1966. 737 pp.

Department of Labor. *The Negro Family—The Case for National Action.*

Office of Policy Planning and Research, Department of Labor, March 1965. 78 pp.

Deutsch, Martin. "Some Psychosocial Aspects of Learning in the Disadvantaged." *Teachers College Record* 67:260-265; January 1966.

Eells, Kenneth, Davis, Allison, Havighurst, Robert J., Herrick, Virgil E., and Tyler, Ralph W. *Intelligence and Cultural Differences.* Chicago: University of Chicago Press, 1951. 388 pp.

Erlenmeyer-Kimling, Loise, and Jarvik, Lissy F. "Genetics and Intelligence: A Review." *Science* 142: 1477-1479; December 13, 1963.

Hess, Robert D. and Shipman, Virginia. "Early Experience and the Socialization of Cognitive Modes in Children." *Child Development* 36: 869-886; December 1965.

Hill, A. C., and Jaffe, F. S. "Negro Fertility and Family Size Preferences." In Parsons, T., and Clark, K. B. (Eds.) *The Negro American.* Cambridge: Houghton Mifflin, 1966. Pp. 134-159. 781 pp.

Jensen, Arthur R. "Learning Abilities in Mexican-American and Anglo-American Children." *California Journal of Educational Research* 12: 147-159; Summer 1961.

Jensen, Arthur R. "Learning Abilities in Retarded, Average, and Gifted Children." *Merrill-Palmer Quarterly* 9, 123-140; April 1963. (Reprinted in: John P. DeCecco, Ed., *Educational Technology: Readings in Programmed Instruction.* New York: Holt, Rinehart and Winston, Inc., 1964.)

Jensen, Arthur R. "Rote Learning in Retarded Adults and Normal Children." *American Journal of Mental Deficiency* 69: 828-834; May 1965 (a).

Jensen, Arthur R. *Individual Differences in Learning: Interference Factor.* Cooperative Research Project No. 1867, U. S. Office of Education, 1965. 150 pp. (b).

Jensen, Arthur R. "Verbal Mediation and Educational Potential." *Psychology in the Schools* 3: 99-109; Spring 1966 (a).

Jensen, Arthur R. "Cumulative Deficit in Compensatory Education." *Journal of School Psychology* 4: 37-47; January 1966 (b).

Jensen, Arthur R. "Conceptions and Misconceptions About Verbal Mediation." In Douglas, M. P. (Ed.) *Claremont Reading Conference,* Thirtieth Yearbook, Claremont Graduate School, 1966. 220 pp. (c).

Jensen, Arthur R. "Social Class and Perceptual Learning." *Mental Hygiene* 50: 226-239; April 1966 (d).

Jensen, Arthur R. "Individual Differences in Conceptual Learning." In H. Klausmeier and C. Harris (Eds.), *Analyses of Concept Learning.* New York: Academic Press, 1966. 272 pp. (e).

Jensen, Arthur R. "Varieties of Individual Differences in Learning." In R. M. Gagné (Ed.), *Learning and Individual Differences.* New York: Merrll, 1966. 265 pp. (f).

Jensen, Arthur R. "Estimation of the Limits of Heritability of Traits by

Comparison of Monozygotic and Dizygotic Twins." *Proceedings of the National Academy of Science* 58: 149-157; July 1967.

Jensen, Arthur R. "*Social Class and Verbal Learning.*" In M. Deutsch, A. R. Jensen, and I. Katz (Eds.) *Social Class, Race, and Psychological Development.* New York: Holt, Rinehart and Winston, in press.

Kennedy, Wallace A., Van de Riet, Vernon, and White, James. "A Normative Sample of Intelligence and Achievement of Negro Elementary School Children in the Southeastern United States." *Monographs of the Society for Research in Child Development* 28, No. 6, 1963.

Lawrence, E. M. "An Investigation into the Relation Between Intelligence and Inheritance." *British Journal of Psychology, Monograph Supplement* 16, No. 5, 1931.

Lesser, Gerald S., Fifer, Gordon and Clark, Donald H. "Mental Abilities of Children from Different Social-Class and Cultural Groups." *Monographs of the Society for Research in Child Development* 30, No. 4, 1965.

Ludlow, H. Glenn. "Some Recent Research on the Davis-Eells Games." *School and Society* 84:146-148; October 1956.

Moynihan, David P. "Employment, Income, and the Ordeal of the Negro Family." In Parsons, T., and Clark, K. B. (Eds.) *The Negro American.* Cambridge: Houghton-Mifflin, 1966. Pp. 134-159. 781 pp.

Newman, Horatio H., Freeman, Frank N., and Holzinger, Karl J. *Twins: A Study of Heredity and Environment.* Chicago: University of Chicago Press, 1937. 369 pp.

Nichols, Robert C. "The Inheritance of General and Specific Ability." *National Merit Scholarship Corporation Research Reports* 1965, 1, No. 1. (a)

Nichols, Robert C. "The National Merit Twin Study." In Vandenberg, S. C. (Ed.) *Methods and Goals in Human Behavior Genetics.* New York: Academic Press, 1965. 315 pp. (b).

Pavlov, Ivan P. *Conditioned Reflexes.* (Translated by G. V. Anrep.) London: Oxford University Press, 1927. 430 pp. (Also available in paperback; New York: Dover, 1960.)

Rapier, Jacqueline L. "The Learning Abilities of Normal and Retarded Children as a Function of Social Class." Unpublished Doctoral Dissertation, University of California, Berkeley, 1966. 58 pp.

Rohwer, William D. Jr. "Mental Mnemonics in Early Learning." *Teachers College Record* in press.

Shields, James. *Monozygotic Twins.* London: Oxford University Press, 1962. 264 pp.

Shuey, Audrey M. *The Testing of Negro Intelligence.* (2nd ed.) New York: Social Science Press, 1966. 578 pp.

Skeels, Harold M. "A Study of the Effects of Differential Stimulation on Mentally Retarded Children: A Follow-Up Report." *American Journal of Mental Deficiency* 46:340-350; January 1942.

Skeels, Harold M. "Adult Status of Children with Contrasting Early Life Experiences: A Follow-up Study." *Child Development Monographs* 31, No. 3 Serial No. 105; 1966.

Skeels, Harold M., and Dye, H. B. "A Study of the Effects of Differential Stimulation on Mentally Retarded Children." *Proceedings and Addresses of the American Association on Mental Deficiency* 44: 114-136, 1939.

Terman, Lewis M., and Merrill, Maud A. *Measuring Intelligence.* Boston: Houghton Mifflin, 1937. 461 pp.

Terman, Lewis M., and Merrill, Maud A. *Stanford-Binet Intelligence Scale: Manual for the Third Revision, Form L-M.* Boston: Houghton Mifflin, 1960. 363 pp.

U.S. News and World Report, "Mental Tests for 10 Million Americans—What They Show." October 17, 1966. Pp. 78-80.

U.S. Office of Education. *American Education* October 1966.

Vandenberg, Steven G. "The Nature and Nurture of Intelligence." Louisville, Kentucky, Research Report #20 from the Louisville Twin Study, University of Louisville School of Medicine, 1966. 60 pp.

Wechsler, David *The Measurement and Appraisal of Adult Intelligence.* (4th ed.) Baltimore: William and Wilkins, 1958. 297 pp.

Wilson, Alan B., Jensen, Arthur R., and Elliott, David L. *Education of Disadvantaged Children in California: A Report to the California State Committee on Public Education.* State Department of Education, Sacramento, California. December 1966.

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