

The Heritability of Intelligence

ARTHUR R. JENSEN

The question of why people differ in intelligence has been asked for centuries, but a scientifically acceptable answer did not become wholly possible until psychologists devised techniques for measuring intelligence quantitatively and objectively. The first really useful intelligence test was devised in 1905 by the French psychologist Alfred Binet. Binet's early test was later revised and improved by Lewis Terman at Stanford University; the now-famous test that resulted from these efforts is known as the Stanford-Binet Intelligence Scale. It is still the most widely used test of general intelligence.

There are other intelligence tests, and although many of them appear to be quite different from one another, all actually measure much the same general ability. That is to say, if we administer several seemingly quite different intelligence tests to a large number of persons, their scores on all the tests will be in pretty much the same rank order. Those who score high on one test will tend to score high on the others, and those who score low on one test will usually score low on all the others. This fact of correlation among all tests of intelligence led Charles Spearman, the famous English psychologist, to conclude that there is a general factor, "g," which is common to all tests of intelligence. We know that it is practically impossible to make up a mental test having any degree of complexity which does not involve "g." We can perhaps most clearly characterize "g" as an ability for abstract reasoning and problem solving, for seeing relationships, and for grasping concepts.

A person's score on an intelligence test is usually expressed as an I.Q. (for Intelligence Quotient). The test is standardized in the general population in such a way that the average I.Q. at any age is set at 100, and the middle 50 percent of the population falls within the so-called average range

of I.Q.'s going from 90 to 110.

Significance of the I.Q.

Can the I.Q. tell us anything of practical importance? Is it related to our commonsense notions about mental ability as we ordinarily think of it in connection with educational and occupational performance? Yes, indeed, and there is no doubt about it. The massive evidence from psychological, educational and industrial research, and research in the armed forces, is unequivocal. We know, for example, that no other single fact that we are now able to ascertain about a child gives us a better prediction of his future scholastic performance than his I.Q. obtained after age 5 or 6. (Below this age I.Q. tests become less accurate indicators of the child's later mental development, and below 2 or 3 years of age test scores have practically no predictive value.)

The I.Q. obtained after 9 or 10 years of age also predicts final adult occupational status to almost as high a degree as it predicts scholastic performance. When various occupations are ranked for average income and for the general public's average judgment of the occupation's prestige and desirability, this rank order is found to be highly related to the average I.Q. level of the persons in these occupations. There is of course a wide spread of I.Q.'s in nearly every occupation, but the *average* I.Q. of persons within a particular occupation is closely related to that occupation's standing in terms of its average income and the amount of prestige accorded to it by the general public.

One of the most convincing demonstrations that I.Q. is related to "real life" indicators of ability was provided in a classic study by Terman and his associates at Stanford University. In the 1920's they selected a total of 1,528 children with Stanford-Binet I.Q.'s above 140. The average I.Q. of the group was 152. These children were investigated periodically over the years up into their adulthood. (Most of them are now in their fifties.) Terman found that for the most part these high-

I.Q. children in later adulthood markedly excelled the general population on every indicator of achievement that was examined: a higher level of education completed; more scholastic honors and awards; higher occupational status; higher income; production of more articles, books, patents, and other signs of creativity; more entries in *Who's Who*; a lower mortality rate; better physical and mental health; and a lower divorce rate. Also, they have much brighter children than the average; their average I.Q. is 133, a level which is exceeded by only 2 percent of all the children in the general population.

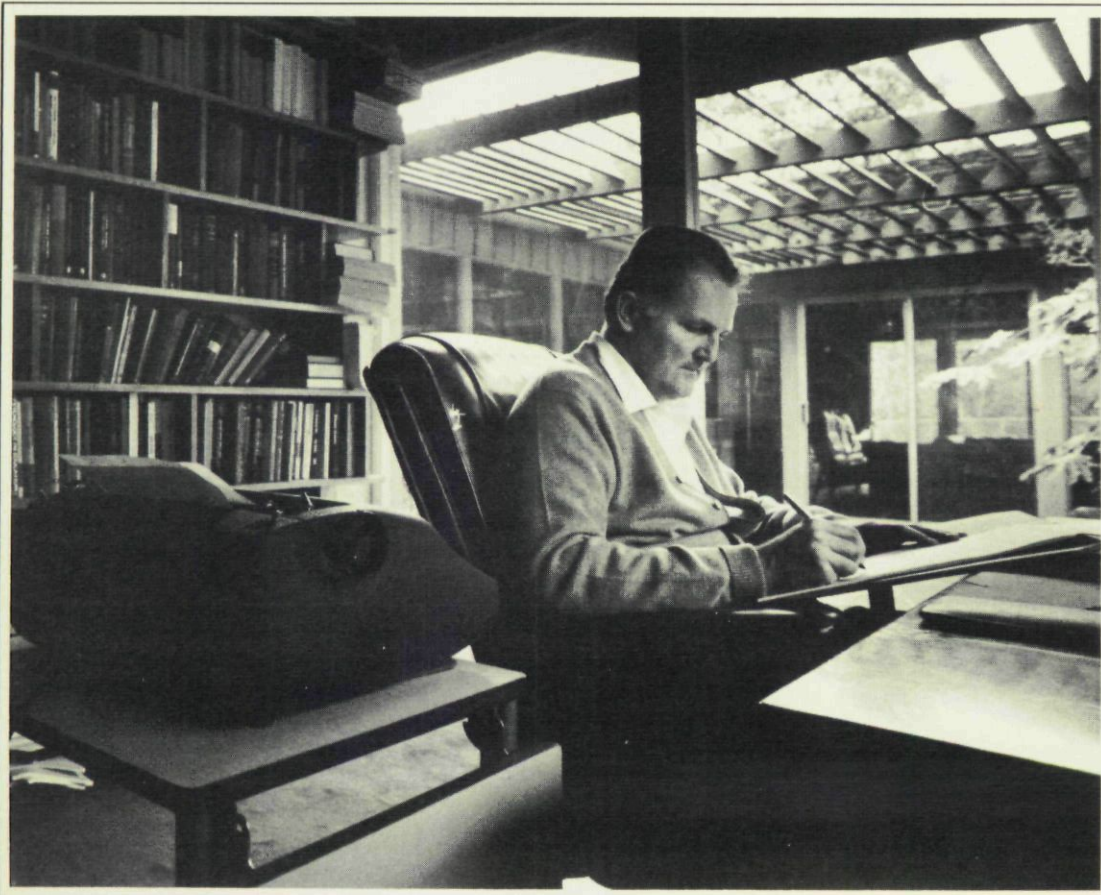
Findings such as these establish beyond a doubt that I.Q. tests measure characteristics that are obviously of considerable importance in our present technological society. To say that the kind of ability measured by intelligence tests is irrelevant or unimportant would be tantamount to repudiating civilization as we know it.

The Causes of I.Q. Differences

The layman usually asks: "Is intelligence due to heredity *or* environment?" The scientist promptly answers: "Both." Without heredity *and* environment there simply is no intelligence. Obviously every person must have had a biological inheritance of genes from his parents and must have grown in an environment, or he wouldn't even be here to take an I.Q. test. So, of course, both heredity and environment are essential for the existence of the individual or any of his physical and mental characteristics.

But when scientists actually study this problem, we find that they do not even ask the layman's question. The question to which scientists have sought an answer can be stated as follows: How much of the *variation* among persons in a given population is attributable to differences in their environments and how much to differences in their genetic endowments?

Numerous studies conducted by psychologists and geneticists over the last 40 or 50 years provide



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an answer to this question. The answer is unambiguous and is generally agreed upon by all scientists who have considered all the evidence. This evidence strongly supports the conclusion that genetic factors are much more important than environmental influences in accounting for *individual differences* in I.Q. How much more important? The evidence indicates that genetic factors account for at least *twice* as much of the variation in I.Q.'s as environmental factors. This conclusion has one main limitation. Since all of the major studies in this field were conducted with samples of Caucasian European and North American populations, we cannot confidently generalize their conclusions to other populations, especially those with very dissimilar environments.

What are the kinds of evidence that lead to the conclusion that genetic differences outweigh environmental differences in accounting for individual differences in I.Q.? Most of this evidence, as it is found in the scientific literature, depends upon quite technical methods of analysis developed in a specialty known as quantitative genetics or population genetics. Some of these methods were devised originally to analyze the roles of heredity and environment in agriculture and animal breeding.

Experiments in Animal Breeding

Experiments in which we explicitly try to breed for some specific trait give us the most certain evidence that variation in the trait has a genetic component. Psychologists have bred rats for speed of learning mazes, which is a good indicator of rat intelligence. By always mating the fast-learning males with fast-learning females, and mating slow-learning males with slow-learning females, it is possible, within 6 to 10 generations, to produce two quite distinct strains of rats in respect to maze-learning ability. The slowest-learning rat of the "bright" strain will learn mazes faster than the fastest rat of the "dull" strain. The two strains will differ markedly in the number of tries they need to learn how to run through a maze efficiently, avoiding the blind alleys. These experiments definitely prove that not only physical characteristics but some behavioral traits as well are largely inherited through the parental genes. Thus we should not be surprised to find in humans that differences in some behavioral characteristics, including intelligence, are a product of genetic inheritance.

Identical Twins Reared Apart

One of the most important lines of evidence for the inheritance of intelligence in humans comes from studies of identical twins who were separated shortly after birth and reared in different homes. Identical twins originate from a single fertilized ovum which splits in the course of early development to form two individuals. Each member of the pair of twins therefore has exactly the same complement of genes. Consequently, any difference between the twins must be due entirely to non-genetic or environmental differences.

Twins separated shortly after birth are often reared in families that differ markedly in social class, and the range of environmental differences observed in their foster homes is fairly typical of the environmental variations seen in the general population.

Four major studies of identical twins reared apart, conducted in England, Denmark, and the United States, and totaling 122 pairs of twins, are in remarkably close agreement in showing that twins reared in different homes are still much more

Continued on page 149

Do I.Q. Tests Measure Intelligence? DAVID C. McCLELLAND

Psychology has one great practical success to its credit in the twentieth century—namely the intelligence testing movement. Many tests have been devised which predict success in school with remarkable regularity. Literally tens of thousands of validity coefficients have been calculated, demonstrating that those who score higher on aptitude or intelligence tests usually do better in their school work. Selecting, at random, a finding which is quite typical for the United States, I recently observed in a longitudinal study to be reported by Costa (1972) that Kuhlman-Anderson I.Q. scores obtained in the sixth grade correlated 0.59 with twelfth-grade rank in class. In other words knowing how a child scores on an intelligence test when he is eleven or twelve years old enables you to predict fairly accurately how well he will be doing in school some six or seven years later. Rank in class at graduation from secondary school in turn predicts whether he can go on to the university and how good a university he will get into. As a con-

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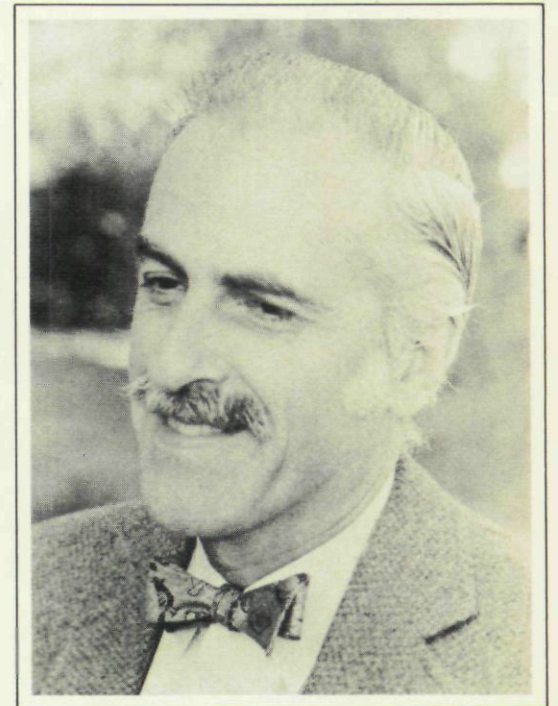
sequence, knowing a person's intelligence-test score or scholastic-aptitude-test score has become a matter of great importance in the United States, not only to admissions officers who use it to pick people for college but also to businesses and civil service commissions who use it to decide who is "bright enough" to be a policeman, a social worker or a fireman.

Testing has therefore become big business. The Educational Testing Service which gives the Scholastic Aptitude Test used by most of the better-known colleges and universities in the United States employs around two thousand people and has a large plant spread over hundreds of acres in Princeton, New Jersey. Thousands of young people pay to take its tests annually to see if they are qualified to get into the college of their choice. The testing technology has been so sold to the American public that only in a few of the more "backward" parts of the society is it not used in the schools or businesses or civil service. And of course it is spreading fast to the rest of the world, which is beginning to discover the utility of tests for picking those who will do well in school.

To be sure, the testers themselves loudly insist

that there are other important human qualities besides the ability to take scholastic aptitude tests, but as Wing and Wallach (1971) have shown, admissions officers may believe they take these other qualities into account but in fact their selection decisions can be almost perfectly predicted by aptitude-test scores alone. The desire to select more "intelligent" people for schooling or for almost any occupation proves overpowering. It quickly reduces other qualifications to insignificance.

While the intelligence-testing movement in the United States has been moving on from one triumph to the next, some questions have been raised about its theoretical underpinnings, both by scholars and by policy makers who wonder if its growing power over people's lives is justified. One difficulty with tests has long been known but little commented on perhaps because its seriousness has not been fully appreciated. It is very simply that if academic achievement tests are taken seriously as measures of real competence, then the *quality* of education does not seem to contribute to improving competence. Back in the 1930's in the United



States, a number of private schools tried to improve the quality of their education as part of what was then known as the "progressive education movement." Standardized scholastic achievement tests were used to evaluate the effects of this supposedly improved education as compared with more traditional teaching.

By and large no effects of the supposedly higher-quality education could be discovered in the test scores. The educators felt they were doing a better job but the test scores did not indicate that they were. The same finding has turned up again and again since that time. Certain colleges in the United States are widely acknowledged to be better than other colleges—in the sense that they have better faculties, more books in the library, higher endowments, better laboratory facilities, and so forth. Yet repeated studies as summarized by Jacob (1957) have failed to show any test-score differences attributable to the better education supposedly obtained in the elite colleges. If the graduates of those colleges perform better on achievement tests, it is because they scored higher on them at entrance to college, not because they received a better education subsequently.

nonsense and order the machinery he needs to carry out the improvements on his property. But he still insisted on waiting until he heard from the Professor.

While waiting, we all checked into the Governor Chittenden Motel. The rest of our group has been seeing the sights of this beautiful city: the parks, the University, the Shelburne Museum, the Lake. And I have been writing this letter, which I will mail tomorrow morning.

I am sorry I cannot as yet report any definite success. But sometime, somehow, something may turn up.

Yours hopefully,
Alexander Botts

P.S. The next morning, Tuesday, January 25, 1972. Something has indeed turned up. When I entered the Post Office this morning to mail this letter, my eagle eye spotted, on a bulletin board, two photographs—one full face and the other profile—of none other than Professor Isaac Newton Norton, Ph. D., alias this and that. He was wanted for grand larceny, fraud, and other crimes. I consulted the local police. They said they were certainly after the man. And they surmised that the mysterious remark, "The fuzz is starting to buzz," was a warning that the cops were after him. I took the news to Monkeyface. We both decided the Professor was on the lam and would not return. Monkeyface then signed a magnificent order for Earthworm equipment—which is enclosed.

All this makes me feel so good that I am repeating the statement I made in an earlier letter: I am not charging anything for my services this time. I am also turning down an offer from Monkeyface, who incidentally is making a generous contribution to Miss Gloriana Smith and the other New York ladies. They are now very good friends with Monkeyface, and they are working on a new slogan for their organization—something like "Convert polluters of the environment by kindness, not merely by kicking them in the pants."

This wraps everything up, except for one nagging doubt: Is this Super-mohole idea really as crazy as it sounds?

Yours,
A.B. ☞

A tree that never had to fight
For sun and sky and air and light
But stood out in the open plain
And always had its share of rain
Never became a forest king,
But lived and died a scrubby thing.

The man who never had to fight
Who never had to win his share
Of sun and sky and light and air
Never became a manly man,
But lived and died as he began.

Good timber does not grow in
ease
The stronger the wind, the
tougher the trees.

—J. Willard Marriott

I.Q.—JENSEN

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alike in I.Q. than are fraternal twins reared together. Fraternal twins are merely siblings who happen to be conceived and born at the same time, and therefore half of them are of the opposite sex. In I.Q. and other traits they resemble one another no more than do ordinary siblings born at different times.

Identical twins reared apart differ, on the average, by only 6 to 7 I.Q. points. But even if we test the very same person on two occasions a week apart, we find that his test score will vary, on the average, by 2 or 3 I.Q. points. This is the test's "measurement error." When we eliminate this error from the twin data, we find that the twins differ only 4 or 5 points in I.Q. Identical twins reared together differ by only 2 or 3 points, not including measurement error. The largest I.Q. difference ever found in a pair of identical twins reared apart is 24 points. More than 17 percent of siblings reared together differ by more than

tween unrelated children brought up in different homes but in the same socioeconomic class. We see that unrelated children brought up together in the same home differ from one another in I.Q. at least 3 or 4 times more than genetically identical twins reared in different homes. And the unrelated children reared together differ almost as much in I.Q. as unrelated children simply picked at random from different homes.

The I.Q.'s of adopted children also show little or no relationship to the I.Q.'s of their adopting parents, but they are almost as closely related to the I.Q.'s of their natural parents as we find in the case of children who are reared by their natural parents.

Children reared in the common environment of an orphanage differ from one another in I.Q. to approximately the same degree as children picked at random from the total population. The I.Q.'s of orphanage children who have never known their own parents show almost the same

between siblings—that is, about 12 I.Q. points. The difference between a child and the average of both of his parents' I.Q.'s is about 10 points.

A parent with a high I.Q. will usually, but by no means always, have children whose I.Q.'s are somewhat lower than his own but are still above the average for the general population. A parent with a low I.Q., on the other hand, will usually, but not always, have children whose I.Q.'s are somewhat higher than his own but are still below the average of the population. This phenomenon, discovered by Sir Francis Galton, is called "regression toward the mean," and it holds true for height and other inherited physical traits as well as for I.Q.

I.Q.'s of Husbands and Wives

It is interesting that in our society husbands and wives are at least as much alike in I.Q. as brothers and sisters. If men and women picked their mates strictly at random, as by a lottery, spouses would differ by an average of 18 I.Q. points. But in fact men and women choose one another partly for intelligence, and so spouses differ by only 10 or 11 points in I.Q.

The Effect of Inbreeding on I.Q.

Every person harbors a number of mutant, recessive genes. Most of these are defective genes. They are passed on from parent to child, but they usually will not produce any harmful effects to the child unless the other parent also contributes exactly the same defective gene. The reason this usually does not occur is that each parent's normal genes are dominant over the other parent's defective, recessive genes. When mating occurs between a man and a woman who are blood relations, however, the chances are much greater that they will both possess many of the same defective genes. When these defective genes are paired together in the related couple's children, they subtract unfavorably from the traits that are controlled by these genes under normal conditions. This depression due to inbreeding is known to occur in inherited physical traits, such as stature, and the same thing has been found for I.Q. It is well established, for example, that cousin marriages produce children who, on the average, have I.Q.'s several points lower than the I.Q.'s of children whose parents are unrelated but are matched with the married cousins on I.Q., age, educational level, and socioeconomic status. More extreme are the cases of children who have resulted from incestuous relationships, such as father-daughter and brother-sister matings. These children show a much higher incidence of severe mental retardation than children born to the same parents when they have mated with unrelated persons. These interesting



"I guess this just wasn't our day."

24 I.Q. points. The same is true of fraternal twins. But siblings (and fraternal twins) have only half of their genes in common, and they differ on the average by 12 I.Q. points (excluding measurement error), even when reared together.

The studies of identical twins show clearly that individuals who are genetically identical are almost as much alike in mental ability as they are alike in physical traits, and this is true even when they have grown up in different environments.

Unrelated Children Reared Together

The opposite situation to identical twins reared apart is that of genetically unrelated children adopted at birth by foster parents and reared together. Such children differ from one another, on the average, by 15 to 16 I.Q. points (excluding measurement error). Compare this with the 17 to 18 I.Q. points difference between unrelated children reared in different homes, or the 15 to 16 points difference be-

degree of correlation with their parents' level of ability as we find in the case of children reared by their own parents.

Resemblance Between Parents and Children

Now and then we notice that very bright parents can have an intellectually mediocre child, or that rather dull parents can have an exceptionally bright child. These observations are often pointed to mistakenly as evidence that intelligence is not inherited. But the fact is that genetic theory predicts precisely that we should find such discrepancies between parents and their offspring. For example, parent-offspring differences in height are of about the same relative magnitude as their differences in I.Q. Children resemble their parents physically and in mental ability to about the same degree that they resemble their own siblings. The average I.Q. difference between a parent and his (or her) child is the same as the difference

findings are entirely predictable from basic principles of genetics that apply to all living beings. Moreover, it is virtually impossible to explain such facts without concluding that I.Q. differences are very strongly influenced by genetic mechanisms.

The Relative Effects of Heredity and Environment

How can we summarize briefly what is now known about the relative importance of heredity and environment in causing individual differences in I.Q.? In the terminology of genetics a summary answer consists of saying that the "heritability" of I.Q. is close to 0.80. This means that 80 percent of the "variance" in I.Q.'s in the general population is attributable to genetic differences and 20 percent is attributable to non-genetic or environmental differences.

"Variance" is essentially a quantitative index of the total amount of differences that exist among all members of some population. So instead of talking about variance, we can more easily describe our conclusions in terms of average differences.

If we should determine the differences in I.Q. between every person in the population and every other person, the average of all these differences would turn out to be 18 I.Q. points. These differences are due both to genetic and to environmental factors. Now we can ask theoretically: What would be the average I.Q. difference among all persons in the population if everyone had grown up in identical environments from the moment of conception, while genetic differences remained as they are? Under this hypothetical condition of completely equal environments for everyone, the average I.Q. difference would be 16 points. Thus, there would be a reduction of 2 points in the average difference that now exists. Let us now ask the reverse: What would be the average difference if everyone had exactly the same genetic endowment, but environmental differences remained unchanged? Under this hypothetical condition of complete genetic equality the average I.Q. difference among persons would be only 8 points, or just half the difference that would exist with equal environments.

So the conclusion we come to—which is certainly valid at least in the white European and North American populations in which the research was conducted—is this: In accounting for the causes of the differences among persons in I.Q., the genes outweigh the effects of environment by 2 to 1. As environmental conditions are improved and made more alike for all persons in the society, the average intelligence level of the population will be somewhat increased, and the I.Q. differences among persons will be slightly reduced. But of course the differences that remain will in-

evitably be due even more to genetic factors.

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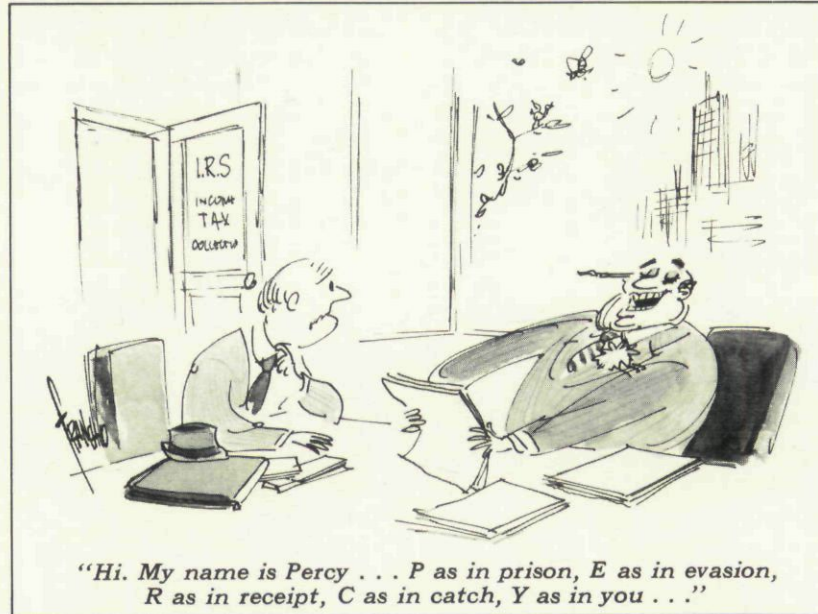
Scholastic Achievement and Intelligence Statement of Arthur R. Jensen to the U.S. Senate Committee on Education

Introduction

Mr. Chairman and members of the Committee, my name is Arthur R. Jensen. I am Professor of Educational Psychology at the University of California at Berkeley, where I have been a member of the faculty for the past 14 years.

First, I want to thank this Committee for inviting me to summarize my position on the topics mentioned in your invitation: "heredity, environment, intelligence, and scholastic achievement." My position on some aspects of these questions, as you know, is a controversial and unpopular one, but it is a position which I have come to through my intensive studies over the past

decade of virtually all the relevant evidence in this field and through my own experimental and statistical investigations. The reporting of these conclusions in scholarly journals, as in my well-known article in the Winter 1969 issue of the *Harvard Educational Review*, has not been without some penalty. At least I have heard of no one taking the contrary position who as a result has had to endure personal threats, prolonged harassment, invasion of his college classes by disruptive demonstrations, or has had his university administration take such precautions as putting two plainclothes police bodyguards on him—in lectures, on the campus, in going to and from classes and to the parking lot. Much of this emotional reaction to my *Harvard Educational Review* article, I believe, is a result of the fact that a generation of social scientists and educators has been assiduously indoctrinated to believe that genetic factors are of little or no importance in human behavior and human differences. My summaries of the relevant evidence contradict the belief. The reactions have often been extreme. In a recent Newsletter of the American Anthropological Association, for example, it was proposed, apparently in all seriousness, that members of the AAA should burn—literally burn—all copies of the *Harvard Educational Review* containing my article! I am therefore grateful for this opportunity to make clear my position on these important matters to the Committee, and also to see that a number of distinguished scientists are concerned with some of the issues I have raised and are here today to express their views. Though I do not expect all their opinions to coincide completely with mine—indeed, they were selected expressly to insure that a variety of views might be expressed before this Committee—I am especially gratified to see that there are prominent scientists who, like myself, are trying to come to grips with these difficult questions now under discussion.



"Hi. My name is Percy . . . P as in prison, E as in evasion, R as in receipt, C as in catch, Y as in you . . ."

decade of virtually all the relevant evidence in this field and through my own experimental and statistical investigations. The reporting of these conclusions in scholarly journals, as in my well-known article in the Winter 1969 issue of the *Harvard Educational Review*, has not been without some penalty. At least I have heard of no one taking the contrary position who as a result has had to endure personal threats, prolonged harassment, invasion of his college classes by disruptive demonstrations, or has had his university administration take such precautions as putting two plainclothes police bodyguards on him—in lectures, on the campus, in going to and from classes and to the parking lot. Much of this emotional reaction to my *Harvard Educational Review* article, I believe, is a result of the fact that a generation of social scientists and educators has been assiduously indoctrinated to believe that genetic factors are of little or no importance in human behavior and human differences. My summaries of the rel-

Scholastic Achievement and Intelligence

Scholastic achievement is what children learn in school—repertoire of knowledge and skills, including the 3 R's. Scholastic achievement can be most reliably measured by means of standardized tests at every stage of schooling from kindergarten to college. When entire school populations are tested on scholastic achievement, there is revealed a wide range of individual and group differences at any given grade level. In one fifth-grade classroom in San Francisco, for example, achievement levels ranged from first to eleventh grade. What most educators, government officials, and writers in the popular press who talk about the present problems of education are in fact referring to is not primarily dissatisfaction with some *absolute* level of achievement, but rather with the large group *differences* in educational attainments that show up so conspicuously in our educational system—the achievement gaps between the affluent and the poor, the

lower class and the middle class, the majority and the minority, the urban and the suburban, and so on. Educational *differences*, not absolute level of performance, are the main cause of concern. Whether we like to admit it or not, the problem of achievement differences today is where the action is, where the billions of dollars of educational funds are being poured in, where the heat is on, and where the schools are being torn apart. We are trying to understand more about the causes of these differences. Massive surveys and statistical analyses such as James Coleman's well-known report on *Equality of Educational Opportunity* (1966) have shown that only a small fraction (about one-tenth to one-fifth) of the total variation in scholastic achievement is attributable to factors in the schools themselves. In other words, differences among schools and school systems nationwide are not sufficiently large to account for more than a small fraction of the total variation in scholastic achievement at any grade level.

The single most powerful predictor of children's scholastic performance is *intelligence* as measured by any one of a variety of standard intelligence tests: group or individual tests, verbal or nonverbal. No other variable has yet been found which makes as large an independent contribution to variance in scholastic achievement as does intelligence. I have found in my own research that a composite of several different measures of intelligence will predict nearly all the true variance in scholastic achievement scores, and the predictive validity of the intelligence tests becomes better with advancing grade level. Furthermore, the validity of intelligence tests for predicting scholastic achievement is not significantly different for white and black children. In this respect, intelligence tests are quite color blind. That is to say, a white child and a black child with the same I.Q. can be expected to perform about equally well in school. In short, if intelligence tests can be said to be good for anything, they are good for predicting scholastic achievement.

Intelligence, in the technical sense that psychologists use this term, is not the same thing as scholastic achievement. Schools do not teach intelligence *per se*. Intelligence is mental brightness; it is a capacity for conceptualization, abstract reasoning and problem solving, for processing information in the form of words and symbols, for integrating and understanding what is learned, and for making broad transfer from past learning to the solution of novel problems. As Harvard psychologist Professor Lawrence Kohlberg recently noted, scholastic achievement merely rides on the back of intelligence: "... bright kids learn the stuff they're taught in school faster, but learning the stuff they're taught in school doesn't make them brighter" (*Education*

Summary, August 6, 1971).

Intelligence can be quite reliably measured by appropriate tests, and these measurements, often called I.Q.'s, show substantial correlations with a number of educationally, occupationally, and socially important criteria. The correlations are not appreciably different for children of the rich than for children of the poor, for whites or for blacks. Although intelligence, as psychologists use this term, is the single most powerful, though by no means perfect, predictor of academic performance, it is surely not the whole of mental ability and human competence. To equate intelligence with all virtue is a ridiculous mistake. But in discussing achievement differences in schools with their present curricula and their present instructional methods, intelligence differences, we know, are of central importance. There are undoubtedly other socially important mental abilities besides intelligence, and on some of these abilities we find little or none of the social class and racial differences that we find for intelligence. Much of my own research has been concerned with identifying such abilities and with trying to determine their relevance to instructional methods that might make better use of these other abilities for scholastic learning.

Both intelligence and scholastic achievement grow or increase in a quite regular manner in most children, and their individual mental growth curves become increasingly stable over the years from infancy to maturity.

The Heritability of Intelligence

A number of genetic studies carried out in Europe and the United States over the past forty years provide evidence which shows quite conclusively that, in the populations studied, a very substantial proportion of the variability among persons in intelligence is attributable to genetic, i.e., inherited, factors. The vast majority of studies have found that the proportion of population variance attributable to genetic differences is something between the extreme limits of about .60 to .90, a figure known as the *heritability* (in the broad sense). (Since heritability, i.e., the proportion of the

total variance which is genetically determined, is a population statistic subject to sampling error and other sources of variation, it has no universal or constant value for all times, all tests, and all populations. But empirically determined values are usu-

ally of the order of .70 to .80.) I believe it is safe to say that in European and North American Caucasian populations at the present time, genetic or hereditary factors are roughly twice as important as environmental variation as a cause of

individual differences in intelligence as assessed by standard tests.

Educational Implications

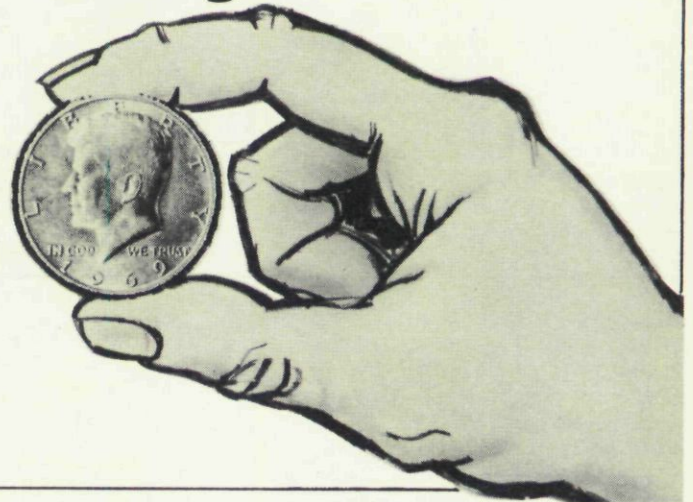
At present, neither I nor anyone else, I'm afraid, has any more than rather general notions concerning

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The future here is unlimited. The San Luis Valley Ranches are located in the heart of the beautiful San Luis Valley, surrounded by ranges of the Rocky Mountains. This is beautiful land, level to rolling. The air is clean; the climate healthy. All Ranches are accessible by graded roads. This is a perfect place for raising children, retirement or as a vacation paradise.

RECREATION

Every outdoor recreation is here. Hunting for duck, elk, deer and bear. Camping and exploring in the Rio Grande National Forest. You'll find great fishing, boating and water skiing within 3 miles of your property. Wolf Creek Pass, only 60 miles away, offers wonderful skiing and winter sports. Yes, the San Luis Valley is truly a scenic and recreation wonderland.

ALL THIS AND MODERN CONVENIENCES TOO!

The cities of Alamosa and Blanca are friendly neighbors, with stores, supermarkets, schools, churches and a hospital. Blanca is less than 3 miles and Alamosa 14 miles from San Luis Valley Ranches. Alamosa is the home of Adams

State College, one of Colorado's fastest growing Institutions of higher learning.

YOU CAN BUY WHERE THE GIANTS INVEST!

You can feel a lot better about buying land where you know large corporations are investing. In the San Luis Valley, Forbes, Inc., publishers of the world's most respected financial magazine, recently bought a giant 168,000 acre ranch nearby San Luis Valley Ranches. Malcolm Forbes, their president, publicly stated that he will turn the ranch into the largest and best known game preserve in the country, leaving the natural beauty untouched

THE PRICE IS STILL LOW — NO DOWN PAYMENT!

*Just \$395.00 per acre in 5 acre parcels. Your total monthly payment is \$15.00, LESS THAN 50c A DAY. There is no down payment, no interest, no salesman commissions, no carrying charges of any kind. Every cent you pay is applied to the purchase price of your land.

WATCH YOUR DOLLARS GROW...

Remember, this is acreage, not just a little plot of ground. Your 5 acre ranch will be equal in size to 20 city lots. We all know about the fortunes made by original investors in Denver. So...

ACT NOW — RANCHES ARE GOING FAST

As you might imagine, property at this price and these terms is going fast. Return the Reservation Form and a 5 acre parcel will be reserved in your name. No obligation, ACT NOW!



GUARANTEED INVESTMENT PLAN

BUYER MAY AT ANY TIME, WITHIN ONE YEAR FROM DATE OF THE CONTRACT, COMPLETE A COMPANY GUIDED TOUR OF THE SAN LUIS VALLEY RANCHES AREA, AND, IF NOT SATISFIED, REQUEST IN WRITING A REFUND OF ALL MONIES PAID ON THE CONTRACT. THIS REQUEST MUST BE EXECUTED IMMEDIATELY UPON COMPLETION OF SAID TOUR.

SEP-6-72

SAN LUIS VALLEY RANCHES / BOX 836 / ALAMOSA, COLORADO 81101

YES, RESERVE a 5 acre Ranch for me. I understand the price is \$395 per acre (total price \$1,975) and my total monthly payment for the 5 acres will be \$15... no down payment... no interest nor carry charges. Please rush complete details, FEDERAL LAND REGISTRATION REPORT, purchase contract and map showing the exact location of my property. Enclosed is my \$1 reservation deposit which will be credited to my account or fully refunded at my request within 30 days. Reservations subject to prior sale.

THIS OFFER IS SUBJECT TO ALL LOCAL, STATE AND FEDERAL REGULATIONS.

Name _____

Address _____

City _____ State & Zip _____

the educational implications of the wide range of apparent differences in educability in our population.

There is fundamentally, in my opinion, no difference, psychologically and genetically, between individual differences and group differences. Individual differences often simply get tabulated so as to show up as group differences—between schools in different neighborhoods, between different racial groups, between cities and regions. They then become a political and ideological, not just a psychological, matter. To reduce the social tensions that arise therefrom, we see proposals to abolish aptitude and achievement testing, grading, grade placement, special classes for the educationally retarded and the academically gifted, neighborhood schools, the classroom as the instructional unit, the academic curriculum, and even our whole system of education. There may be merit in some of these proposals. But I think they are too often aimed at covering up problems rather than coming to grips with them.

Greater Attention to Learning Readiness. The concept of developmental readiness for various kinds of school learning has been too neglected in recent educational trends, which have been dominated by the unproved notion that the earlier something can be taught to a child, the better. Forced early learning, prior to some satisfactory level of readiness (which will differ markedly from one child to another), could cause learning blocks which later on practically defy remediation. The more or less uniform lockstep sequencing of educational experiences may have to be drastically modified for the benefit of many children, but the recent massive insistence on "earliness" and equality of educational treatment of all children has militated against large-scale research on the implications of readiness for children with below-average educability within the traditional school system.

Greater Diversity of Curricula and Goals. Public schools, which aim to serve the entire population, must move beyond narrow conceptions of scholastic achievement to find a greater diversity of ways for children over the entire range of abilities to benefit from their schooling—to benefit especially in ways that will be to their advantage when they are out of school. The academic goals of schooling are so ingrained in our thinking and our values that it will probably call for radical efforts to modify public education in ways such that it will maximally benefit large numbers of children with very limited aptitude for academic achievement. I believe that a well-intentioned but misconceived social egalitarian ideology has prevented public education in the United States from facing up to this challenge.

The belief that equality of edu-

ational opportunity should necessarily lead to equality of performance, I believe, is proving to be a false hope. It is the responsibility of scientific research in genetics, psychology, and education to determine the basis for realistic solutions to the problems of universal public education. Though it may be premature to prescribe at present, I venture the prediction that future solutions will take the form not so much of attempting to minimize differences in scholastic aptitudes and motivation, but of creating a greater diversity of curricula, instructional methods, and educational goals and values that will make it possible for children ranging over a wider spectrum of abilities and proclivities genuinely to benefit from their years in school. The current *Zeitgeist* of environmentalist equalitarianism has all but completely stifled our thinking along these lines. And I believe the magnitude and urgency of the problem are such as to call for quite radical thinking if the educational

eliminate human differences. Rather than making over a large segment of the school population so they will not be doomed to failure in a largely antiquated, elitist-oriented, educational system which originally evolved to serve only a relatively small segment of society, the educational system will have to be revamped in order to benefit everyone who is required by the society to attend school. It seems incredible that a system can still survive which virtually guarantees frustration and failure for a large proportion of the children it should intend to serve.

But we should not fail to recognize that to propose radical diversity in accord with individual differences in abilities and interests, as contrasted with uniformity of educational treatment, puts society between Scylla and Charybdis in terms of insuring for all individuals equality of opportunity for the diversity of educational paths. The surest way to maximize the benefits of schooling to all individuals and at the same

them, if not in the usual academic sense, then in ways that can better their chances for socially useful and self-fulfilling roles as adults. ☛

California Institute of Technology *Engineering and Science* magazine, Pasadena, California, April, 1970.

I.Q.— McCLELLAND

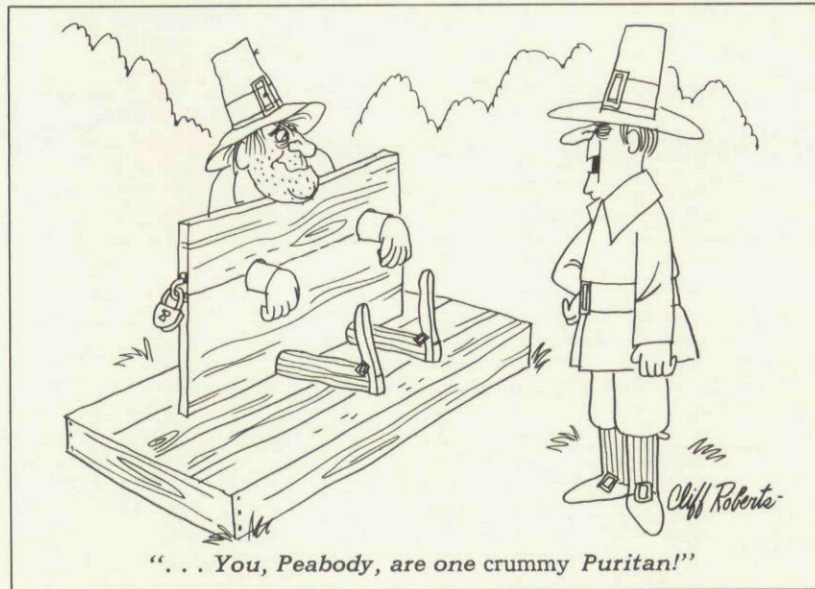
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too far from familiar territory. Yet if he says he would go home he is judged by the testers to be less intelligent. It is also easy to see from these examples why there is a correlation between test performance and later performance in school because the teacher, as a representative of standard middle-class culture, will expect the same language and types of behavior as the person who made up the so-called intelligence test. The teacher will either not understand the dialect that is used in class or will give the child a lower mark for using "bad" language and the ghetto child will before long go through life stigmatized as being less intelligent and a poor student.

Looking at the problem this way forced psychologists to consider seriously another possible explanation for many of the existing correlations between intelligence test scores, doing well in school, and holding down higher-status jobs later in life. Those who control not only economic and social opportunities but also what language and values are the standards by which others will be judged, may in fact be able to use test scores to maintain their power. All one needs to assume is that more powerful families are in a much better position to help their children get higher-status jobs: they know the right people; they can send their children to the right schools; they can use their influence to get them jobs directly. So it turns out that people in higher-status jobs score higher on so-called intelligence tests.

But where is the direct evidence that the higher score on the test in fact indicated that the person was better able to do the higher-status job? As every psychologist knows, correlation does not mean causation. It doesn't follow that because professionals score higher than laborers on certain tests that it is the ability to perform those particular tests which enabled them to be professionals rather than laborers. The reason why people have assumed that causation was involved is that the test scores were supposed to indicate how intelligent the person was, and it seems reasonable to assume that being a professional requires more of something called intelligence than being a laborer does. However it is by no means as self-evident as it once was that these test scores measure the kind of intelligence implied by the logic of this

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system is truly to serve the whole of society. We have invested so much for so long in trying to equalize scholastic performance that we have given little or no thought to finding ways of diversifying schools to make them rewarding to everyone while not attempting to equalize everyone's performance in a common curriculum. Recommendations have almost always taken the form of asking what next we might try to make children who in the present school system do not flourish academically become more like those who do. The emphasis has been more on changing children than on revamping the system. A philosophy of equalization, however laudable its ideals, cannot work if it is based on false premises, and no amount of propaganda can make it appear to work. Its failures will be forced upon everyone. Educational pluralism of some sort, encompassing a variety of very different educational curricula and goals, I think, will be the inevitable outcome of the growing realization that the schools are not going to

time to make the most of a society's human resources is to insure equality of educational opportunity for all its members. Monolithic educational goals and uniformity of approaches guarantee unnecessary frustration and defeat for many. On the other hand, educational pluralism runs the risk that social, economic, ethnic background or geographic origin, rather than each child's own characteristics, might determine the educational paths available to him. The individual characteristics appropriate for any one of a variety of educational paths and goals are to be found everywhere, in every social stratum, ethnic group, and neighborhood. Academic aptitudes and special talents should be cultivated wherever they are found, and a wise society will take all possible measures to insure this to the greatest possible extent. At the same time, those who are poor in the traditional academic aptitudes cannot be left by the wayside. Suitable means and goals must be found for making their years of schooling rewarding to

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