



"Race" and IQ

Bem P. Allen
Western Illinois University

This article examines the notions of "race" and IQ. It begins with a history of attempts to tie the brain to the observed black-white difference in average IQ scores. This background is followed by an examination of "race" from genetic and conceptual points of view; consideration of possible additions to the IQ test as they relate to the race-IQ controversy; discussion of the heritability index's implications for a genetic explanation of the black-white, IQ-score difference; exploration of rapid, worldwide gains in IQ as it bears on the IQ-score difference; and a review of neuro-plasticity research as a way to finesse the "race"-IQ debate.

A Brief History of "Brain Size and Intelligence"

During the early 1800s, Franz Gall developed one of the first attempts to relate the brain to human faculties (Boring, 1957). Gall offered "phrenology" as a method of mapping human intellectual and affective faculties. For example, "calculation" was located at the corners of the eyes. Each area was physically represented by a "bump," a protrusion of the skull that presumably was caused by an expansion of the brain at the location of the faculty. It seemed to follow that the greater the number of intellectual "bumps," the larger the brain, and, it was assumed, the greater the intelligence. Phrenology lasted into the early 1900s before a lack of scientific support spelled its demise. However, a related notion, dating to 1839, gave new life to the belief that the bigger the brain the greater the intelligence (Gould, 1981). Its major, modern proponent, J. Philippe Rushton (1995; Rushton and Ankney, 1996), ranks the "races" according to head/brain size and intelligence as follows: Asians, whites, blacks.

During the pre-neuroscience mid-1800s the idea that "the bigger the brain the greater the intelligence" probably seemed intuitively compelling. In fact, physician Samuel G. Morton appeared to produce convincing evidence that whites had larger brains than blacks and, it was assumed, greater intelligence. Gould (1981) performed an in-depth analysis of Morton's measurements and found them deficient in several ways (e.g., his rounding errors favored his biases). Rushton's assumptions and methods have also been criticized (e.g., Cernovsky, 1992; Neisser, et al., 1996). However, a more important issue may be the basic assumption behind 160+ years of race, brain-size and intelligence work. In this era of major neuroscience advances, it may not make

sense to simply assume that the bigger the brain the greater the intelligence.

Einstein's Brain

Witelson's, Kigar's, and Thomas' (1999) examination of Albert's Einstein's brain illustrates that something more complicated than a brain's size relates to its owner's intelligence. They compared Einstein's brain with an average specimen from a sample of 35 intact, control brains. Einstein's brain has about the same dimensions and the same weight as the comparison brain. However, in areas specific to Einstein's unique skills, his brain was quite different. Whereas, in normal brains, the post central sulcus and the Sylvian Fissure do not flow into one another, in Einstein's brain they form a single, continuous rut. The net result is that Einstein's brain lacks the parietal opercula. Extensions of the inferior parietal region that governs spatial-visual, mathematical ability fill the vacated space. It is the structure of the brain that relates to the intelligences, not its size. As considered in the last sections of this article, structure includes the distribution of functions in the brain and actual growth processes in the brain.

Races?

In the course of cataloging human genes around the world, geneticist Cavalli-Sforza and his colleagues (Cavalli-Sforza, Menozzi, Piazza, 1994; and see Cavalli-Sforza, 2000) have failed to find groups that are so genetically unique that they can be called "races." They quote Charles Darwin on the subject of "races": "it is hardly possible to discover clear distinctive character" between races, because they "graduate into one another." (p. 17). They summarized their own findings: "All populations or populations clusters overlap when single genes are considered, and in almost all populations, all alleles [forms of genes] are present but in different frequencies." (p. 19). That is, humans share the same pool of genes and a gene can be found such that, for any two groups, the frequencies are not significantly different (they overlap on that gene). In regard to "races," it is possible to find some alleles (e.g., blood types) for which allelic frequencies are significantly different. However, for most genes on which the "races" can be compared, frequency differences are not significant. In fact, when comparing any two groups, no matter how geographically distant they are from each other, genetically they will be much more similar than they are differ-

ent. Owens and King (1999) estimate that more than 80% of genetic variability is within groups, leaving less (maybe considerably less) than 20% of genetic variability invested in differences between groups.

Findings such as these have led the American Anthropological Association (AAA) to declare the notion of "race" to be "meaningless and unscientific" (Anthropology Newsletter, 1995, p. 7). Similarly, J. Craig Venter of Celera Genomics, the private group that was first to specify the human genome, reported, "We have sequenced the genomes of three females and three males who identified themselves as Hispanic, Asian, Caucasian or African American." Why the variety? "out of respect for the diversity that is America, and to help illustrate that the concept of race has no genetic or scientific basis." (quoted in Recer, 2000 p. A 7). Recent issues of Science contain other similar pronouncements regarding the lack of scientific evidence for "race" (e.g., Owens & King, 1999; Paabo, 2001).

Conceptual Problems With the Notion, "Race"

Especially in the U.S. the overlap between blacks and whites is quite large. The mixture of the "races" began early in what was to become the U.S. By the time of the Revolutionary War, there were several hundred thousand people of mixed African and European heritage (Peoria Journal Star, April, 25, 1995, C10). Obviously this number would greatly increase over the years to the present time. While the great majority of blacks have European heritage (Davis, 1991), the number of people who are labeled "white" by self and others, but have African heritage, has not even been the target of speculation. A population value for this group with an upward boundary of 14,000,000 or 5% of the U.S. population was suggested by sociologist F. James Davis author of *Who is Black?* (1991), the most carefully documented study of the issue (personal communication January 2, 2001).

On a psychological level, "racial" categories have been considered self-evident by those who value differentiating people into "racial" groups. Rather than simply declaring one group "black" and the other "white," or classifying by appearance or by subjects' self-declarations, the following conditions must be satisfied by researchers interested in "racial" differences, if their results are to be meaningful (Allen & Adams, 1992; also see Yee, Fairchild, Weizmann, and Wyatt, 1993). First, consensually accepted criteria for differentiating the "races" must be developed and actually shown to erect clear boundaries between one "race" and another. A consensus on criteria for differentiating people into "racial groups" does not exist, as signified by the observation that most "racial" researchers fail to state criteria (skin color? hair texture? facial bone structure?). Second, variability within "races" on criteria and traits of interest (e.g., IQ) must be adequately reconciled with assumptions of intraracial homogeneity. "Races" vary greatly within themselves on criteria such as skin color as well as on traits such as IQ, but researchers tend to ignore this variability in favor of emphasizing average differences between groups. Third, overlap among races on criteria and traits must be reconciled with the assumption that the

"races" are meaningfully distinct. When comparing any two large groups on just about any psychological trait (and on some classification criteria, such as hair texture) it will almost always be true that the distributions of trait scores for the groups will greatly overlap.

The importance of considering differences among people within groups is well illustrated by comparing the genders on the intellectual trait for which they differ the most (Levy, 2000). The average difference between the genders accounts for only 15% of the variability in spatial-visual scores.¹ The other 85% of variability in spatial-visual ability is accounted for by within group differences. Obviously, if one wants to know whether a person has strong spatial-visual ability, it makes little sense to rely on gender. One would do better by having the person draw a map to guide travel between points in a major metropolitan area.

Beyond IQ: Possible Additions to the IQ Test

Let us assume, for the sake of argument, that meaningfully distinct groups called "races" do exist. If so, would an observed difference between two "races" on IQ test scores signify that one race is more intelligent than the other? An affirmative answer would be relatively reasonable and defensible only if IQ were all there is to intelligence. However, there are a number of candidates for additions to IQ tests. Sternberg (1988; also see Sternberg, 1997; 1999) has proposed three kinds of intelligences: (1) g(general)-like intelligence—the ability to collect information and analyze it (what is measured on the IQ test); (2) "Creativity"—being able to assemble pieces of information into something entirely novel (Einstein's thinking illustrates this category); and (3) "Street smarts"—solving, everyday practical problems, including adapting to one's changing environment.

Gardner (1983) has proposed seven intelligences. Linguistic ability and logical-mathematical ability are essentially what is measured on the IQ test. Spatial ability is a third entry and music ability the fourth. If one defines "intellectual ability" broadly—as any skill that contributes to the survival and prosperity of people—music ability may qualify for inclusion with the other intelligences. While the number of people who make a living directly through musical skill—e.g., pop singers—is probably in the order of a few hundred thousand, adding others, for example music teachers, generates a figure in the millions. However, the number of those directly making a living from music pales by comparison to the multiple millions who make a living indirectly from music. Further, recent genetic research on relative pitch perception illustrates the importance of considering very specific skills in genetic research (Dryna, D. Manichaikul, de Lange, Snieder, and Spector, 2001; Holden, 2001). At the same time it shows that the genes play a role in a music ability that might be related to language skills.

¹While this gender group difference may be important for acquiring rare jobs requiring very high spatial abilities, for most practical purposes it is unimportant. Levy's estimate is one of the highest reported in the literature.

Bodily-kinesthetic ability is, simply put, dexterity and body control. Artistic and athletic skills are included here: ballet and other dance skills as well as ability to play sports and excel in gymnastics. Like music skills, bodily-kinesthetic ability provides a living for millions directly and multiple millions indirectly.

Intrapersonal ability is knowing oneself. Knowing one's abilities and deficiencies allows for the selection of life-circumstances in which one can succeed. Interpersonal ability is knowing others. For example, the ability to decode others' non-verbal, postural and facial communications can lead to the kind of interpersonal success that yields success in general.

Emotional intelligence has captured the fancy of the public (Goldman, 1995; Salovey & Mayer, 1990). Self-awareness—ability to recognize an emotion when it occurs—is among its five components. One cannot control emotions without being aware of them. In fact, sudden acts of self and other destruction (e.g., school shootings) may, in part, result from individuals' inability to monitor their levels of depression and anger.

Mood control—the ability to turn a bad mood into a good one—may be essential for an adequate sense of subjective well-being, a prerequisite for successful living (Diener, 2000; Myers, 2000). While everyone suffers through periods of dysphoria, those who are able to develop the cognitions and behaviors needed to reverse the course of a bad mood will enjoy greater life satisfaction and contribute positively to others' lives.

Self-motivation is the ability to focus on a goal and continue to pursue it even in the face of failures to obtain it. Athletes invariably suffer defeat, but the great ones renew efforts to attain their goals. They show resilience in response to set-backs, just as do accomplished writers and scientists (Bandura, 1994). Success, regardless of the arena in which it is pursued, depends to a significant degree on the ability to maintain motivation whether or not outcomes are favorable.

Impulse control involves the ability to regulate behavior so that a sudden whim does not result in socially embarrassing or destructive behavior. The work of Walter Mischel and colleagues on "delay of gratification" aptly illustrates the social and cognitive benefits of impulse control (Mischel, Shoda, & Rodriguez 1989). Ability to delay gratification during the pre-school years correlates strongly and positively with adolescent academic and social success (Shoda, Mischel, and Peake 1990). Also having important implications for impulse control is Albert Bandura's and colleagues' work on the self-regulatory process, self-efficacy, as it relates to academic achievement, and their research on moral disengagement (Bandura, Barbaranelli, Caprara and Pastorelli, 1996a and 1996b, respectively).

"People skills"—social skills by another name—include the ability to effectively interact with, relate to, and cooperate with other people. Intuitively, people who possess social skills appear to have increased odds of survival and prosperity. For example, a person who obtains a prestigious Ph.D. in physics would almost invariably end

up as a member of a research team at some institution. Under these conditions, lack of social skills could seriously limit success.

Proposals to add intelligences to those already measured on typical IQ tests are relatively new. Thus, it is not surprising that there is, at present, relatively little hard evidence favoring candidates for inclusion on intelligence tests. For example, an investigation of emotional intelligence as a whole generated disappointing results (Davies, Stankov, and Roberts, 1998) and Gardner's candidates have been bolstered by logic and indirect evidence rather than direct, empirical support (Sternberg, 1988; introduction in the 1993 reprint of Gardner's 1983 book). However, Sternberg does provide evidence to support his three kinds of intelligences (e.g., see Sternberg, 1999). Despite the scarcity of evidence, it would be surprising if, fifty years from now, none of the candidates considered here were included on revised intelligence tests.

Measures of spatial ability are currently available (Gardner, 1983), but this crucial skill appears to be given relatively little weight in the intelligence testing process. If so, it provides a good model of how group differences in IQ scores might change if candidate abilities were added to intelligence tests. Kearns (1981; 1986) has shown that Aborigines children possess higher spatial-visual ability than Australian children of European heritage. The gap between Aborigines and European-Australian children in average IQ scores would be narrowed if spatial-visual ability figured more prominently in intelligence testing. More generally, the addition of new abilities to the IQ test might narrow the assumed IQ gap between people of color and others.

Heritability

Again, for the sake of argument, let us assume that there are "races" and that IQ is all there is to intelligence. If such were the case, could it be asserted that an observed difference between blacks and whites in IQ scores is inherited? An affirmative answer would be reasonable only if some measure is available to show that a difference between groups is inherited.

At first blush the heritability index may (and did at one time) appear to be the relevant measure. "Heritability" refers to the proportion of variance in a trait that is accounted for by the genes (McGuire & Hirsch, 1997; Weizmann, Wiener, Wiesenthal and Ziegler, 1990). The heritability index— h^2 (narrow) = additive genetic variance/total phenotypic variance—was developed by geneticists to help predict the outcome of breeding experiments. It was never intended to be used as psychologists have employed it: to divide the total variance in a trait into that which is "determined" by the genes (h^2) and that which is "determined" by the environment ($1-h^2$). Obviously use of the index may be criticized because environments and genes are not manipulated or controlled as they would be in biological, genetic research (Gottlieb, 2000). While there have been other criticisms of the heritability index (e.g., Devlin, Daniels, and Roeder, 1997; Gottlieb, 2000; Schonemann, 1989), a more important point can be made about a misinterpre-

tation of genetic effects associated with h^2 : genes are expressed in environments and expressions may vary as a function of the environments in which they occur (Neisser et al., 1996; Weizmann et al., 1990).

Environmental interventions can change genetic expression. Perhaps the simplest and clearest illustration of this point is in regard to the disorder, phenylketonuria (PKU). If left untreated, PKU can result in retardation and other maladies (NIH, 2000). However, a simple nutritional intervention, avoidance of phenylalanine, can change the harmful expression of this disorder. Other examples abound, although they may not have occurred to the general public or some psychologists. The genes play a role in lack of muscular development, but a person from a long line of frail people can become very muscular through weight lifting. Plastic surgery can change the shape of body parts that undoubtedly are influenced by the genes (e.g., noses and ears). Injection or extraction of fat can change the shape of other bodily features that are influenced by the genes: lips, buttocks, and abdomen. Finally, one of the major goals of medical science is to change the expression of disorders that are heavily influenced by the genes.

In regard to the question, "Can h^2 index the inheritance of a difference between groups on IQ?" the answer is unequivocally, "no." The h^2 statistic is meaningful only for the single population that contributed data to its calculation and only at the time the calculation is made (Weizmann et al., 1990). It cannot be used to make statements about the inheritance of differences between groups. In fact, there appears to be no incontrovertible means to show that an alleged difference between groups is in any sense "inherited."

Implications of Rapid Gains in IQ for the "Race"-IQ Debate

New Zealand, political-scientist James R. Flynn has reported rapid and large IQ gains during the last three quarters of the twentieth century. Maximum gains approximating 20 IQ points occurred in as little as a generation (30 years; Flynn, 1999; 2000; Dickens & Flynn, 2001). Such rapid and large gains cause an immediate problem for genetic determinists. Genetic change requires many, many generations (Cavalli-Sforza, 2000; Cavalli-Sforza et al., 1994). Accordingly, these gains are not "genetic."

Rapid IQ gains also pose a problem for those who believe that intelligence can be characterized as one factor, "g" or general intelligence. For example, it has long been known that heritability (h^2) assumptions rest on the belief that intelligence is general (g) rather than composed of many specific abilities (McGuire & Hirsch, 1977; Yee et al., 1993).

"g" has been broken down into two components. Fluid "g" (g_f) is the "think on your feet," problem solving part of "g" and is thought to be almost entirely inherited (Cattell, 1966). By contrast, crystallized "g" (g_c) depends on "applications of [g_f], and amount and intensity of schooling" (Cattell, 1966, p. 369) and is little affected by the genes. Thus, g_c should show the largest gains. In fact, however, g_f shows the largest gains (Flynn, 1999;

2000), exactly the opposite of what those who endorse "g"-genetic-determinism-link would expect.

As rapid IQ gains cannot be "genetic" they cannot be used to argue that the observed black-white IQ-score difference is "inherited." Actually, these gains may be seen as contradicting expectations derived from the belief that the black-white difference is "inherited." Flynn (1999) reports that blacks are gaining at a slightly higher rate than whites and Neisser et al. (1996) indicate that the black-white IQ gap is closing.

Do the Genes Play a Role in Intelligence?

Directly or indirectly, the genes play a role in almost all human, psychological characteristics (as well as almost all other human traits; Cavalli-Sforza, 2000; Dickens & Flynn, 2001). One does not have to do heritability calculations on identical twin IQ data; the large correlation between the IQs of identical twins strongly implies a genetic contribution to IQ. The problem is that genes and environments are so inextricably tied up that they cannot be separated, as is done when heritability calculations are conducted. One implication of this assertion is that the nature-nurture debate is over: It is not possible to decide between nature and nurture as determinants of human characteristics (Turkheimer, 2000). Environments can change the expression of genes, and genes can, for example, produce behaviors that change environments (Dickens & Flynn, 2001). Another implication is that psychologists need a different approach to studying the influence of the genes on human intelligence and other characteristics. Training in university genetics departments is sorely needed so that more psychologists can do genetics as biologists do it, in the laboratory, not by resorting solely to statistical methods. A third implication is that the dogmatic environmentalists are just as incorrect as the genetic determinists (Gottlieb, 2000).

Major discoveries of genes that influence human intelligence (and other psychological characteristics) await the isolation of very specific intellectual abilities, an eventuality that is unlikely until psychologists abandon "g." It is time to take another hard look at "g." Criticisms of "g" have been offered on mathematical grounds (Guttman, 1992; Schonemann, 1992) and conceptual grounds (McGuire & Hirsch, 1977; Sternberg, 2000).

Because almost every human characteristic is very complex, finding genes that influence a given ability is unlikely if that ability is very broad. For example, finding genes that play a role in alcoholism has been frustrating partly because alcoholism is studied as if it is one unitary entity rather than many, each complex in its own right, and because psychological traits are complex, each probably involving multiple genes (see the debate that followed the report by Crabbe, Wahlsten, and Dudek, 1999, in *Science*, September, 24, 1999, pp. 2067-2069).

Neuro-plasticity: A Way to Finesse the Race and IQ Debate?

Until relatively recently, neuroscientists assumed that the brain was hard-wired at birth and any physical changes that occur thereafter were in modification of

existing neural connections, not in the generation of new connections (Greenough, Black, and Wallace, 1987). Now it is widely known that the brain is plastic, it undergoes actual, physical change in response to experience in environments (Greenough, 1991; Azari and Seitz, 2000). When all abilities are considered, it appears that the brain's capacity to reorganize, reconstruct, and rebuild itself is greatest at birth, and declines thereafter (Azari and Seitz, 2000). However, when specific abilities are considered, such as language learning, sensitive periods during which plasticity is greatest may occur after the first three years (Greenough, 1997). In any case, across abilities, the slope of the plasticity curve reflects a slow, linear decline so that the brain's malleability is maintained into old age. For example, patients of average age 57 who had strokes an average of nearly five years prior to physical therapy and were forced to use their previously paralyzed arms, regained use of their arms (Liepert, Bauder, Miltner, Taub, and Weiller, 2000). Further, an electrical stimulation technique that allowed mapping of the stroke-affected motor cortex showed that, during the course of therapy, these areas became as large as corresponding areas in the unaffected, contralateral motor cortex. This kind of brain change may be called redistribution or, in the researchers' words, "reorganization."

Another kind of brain alteration involves actual growth processes. The work of William T. Greenough and his colleagues nicely illustrates this variety of brain change. They have studied changes in the connectiveness of neurons and have focused on the dendrites. The Greenough team have shown that rats exposed to a "superenriched" environment (a cage crammed with different shaped, three dimensional, complex objects), compared to those reared in normal cages, displayed greater dendritic length and more dendritic branching (Camel, Withers, and Greenough, 1997). They also have shown that dendritic change can occur after only a short exposure to enrichment (4 days in Wallace, Kilman, Withers, and Greenough, 1992). In other research, this team reported that rats forced to perform complex motor activity, compared to rats that were forced to traverse an empty runway, displayed greater synaptic proliferation that showed up early and persisted even after training had ended (Kleim, Vij, Ballard, and Greenough, 1997). Finally, Comery, Shah and Greenough (1995) have shown that spines on dendrites—sprouts that serve to increase amount of communication between neurons—grow more densely in the brains of enriched compared to normal cage animals. Greenough and colleagues note that previous research had shown that enrichment enhanced performance on a rat intelligence test (Hebb-Williams maze; Camel et al., 1986) and that the pattern of connections among neurons is crucial, not merely the number (Greenough et al., 1987). Thus, pruning, not just growth of connections, is important (Greenough, 1997).

But does early enrichment reap intellectual benefits for children? It has long been known that intense, enriched experience beginning as early as the first months of life and extending as long as the eighth year has beneficial, intellectual effects (Ramey, Bryant, and Suarez, 1985; Ramey and Ramey, 1992). Thus, there is no doubt that

enrichment effects shown with rats extend to children, at least in terms of intellectual benefits (revelation of brain effects of early enrichment programs for children await further advances in neurological assessment techniques). A follow-up study by Campbell and Ramey (1994) illustrates the effects of early enrichment on children recruited at an average age of 4.4 months. Ninety-eight percent were black. The program was conducted 8 hours a day, five days a week. At age twelve, the experimental group (pre-school plus school-age program and pre-school-only program) scored above the control group (school-age-only program and no enrichment) and 87.2% of the experimental group, compared to 55.8% of the control group, scored within the normal range for IQ. So, remarkably, although there were long periods of no further enrichment, children who experienced early enrichment showed higher IQ scores than controls and maintained normal IQ to age 12, where the research ended.

This study and many others like it, dating back at least to 1968, show that genes are not necessarily intellectual destiny (Ramey et al., 1985; also see Nesser et al., 1996). Even if it is assumed that some "races" are "genetically disadvantaged," it does not follow that they are destined to be intellectually disadvantaged. Enrichment programs can yield intellectual equality.

Conclusions

It is important to note that the logic of this paper is "even if a condition exists, it does not follow that dire consequences will result." Even if there is a correlation between brain size and IQ, even if there are "races," even if IQ is all there is to intelligence, it does not follow that the future of children of color is bleak. Modern neuroscience and early experience research with animals and humans make it clear that there is hope for children who have often been written off.

However, let's assume there is real change regarding the issues raised in this article. Suppose, for example, that the various relevant scientific bodies reached a consensus regarding the notion, "race," declaring in a single voice that the concept is without scientific merit. Given that the American Psychological Association, the American Association for the Advancement of Science, the National Academy of Science and other relevant bodies all come out against "race," would the notion, along with its horrific effects, disappear rather quickly? Much solid research suggests that it would not. "Race" is learned early (Towes-Schwan & Fazio, 2001; Williams & Roberson, 1967) and its mental representation is like the iceberg, the greater part of it is submerged (non-conscious; see Payne, 2001 and his reference list). It would still take many, many generations to erase the notion from the backs of people's minds. Nevertheless, should psychologists cease to make the knee-jerk assumption that "races" exist, they would be taking the first step toward eradicating the notion from the minds of people. Opening the experts' minds could feedback to open the public mind. Further, challenging "race" could lead to re-conceiving ideas related to it, such as the race-IQ gap. Openness about "race" could lead to greater flexibility regarding conceptions of intelligence, which could ren-

der the gap moot. Questioning "race" could direct developmental psychologists' attention to devising new methods based on neuroscience research that would bolster the intellects of children for whom predictions of adult mental ability have been dire. There is much productive work to be done, even if, decades from now, traces of the notion "race" still plague the common psyche.

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