Intelligence and IQ

Landmark Issues and Great Debates

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ABSTRACT: Understanding human intelligence and its development has been a major pursuit of psychologists for more than a century. This article describes the status of controversies regarding the definition of intelligence, its measurement, and the relative roles of genes versus environments in the development of individual differences in intelligence. The article concludes with social and educational policy suggestions that emphasize the limitations of intelligence tests alone in drawing conclusions about individual children.

The systematic search to understand the elusive phenomenon of human intelligence and its development has been a major pursuit of psychologists for over a century. Interest in intelligence and its measurement, stemming from the late 19th century, brought psychology into being as a separate discipline (Sattler, 1988). Probably no psychological concept has engendered more controversy than intelligence. In this article, some of the great debates that have contributed to the study of intelligence and its development will be highlighted: (a) the definition of intelligence as a source of controversy, (b) the IQ measurement debate, and (c) the nature–nurture question. Finally, a research and social policy agenda that might guide future attempts to understand intellectual development will be considered, especially as this agenda relates to the needs of children.

What Is Intelligence?

The definition of intelligence itself has been a major source of debate. All cultures acknowledge individual differences in the degree to which people exhibit intelligent behavior, that is, in the ways they approach and solve problems. But what is this quality that societies value so highly? Of course, there seem to be as many definitions of intelligence as there are individuals asked to define the concept.

Often ignored in tackling the definition problem of psychological concepts such as intelligence are the *implicit* theories, the constructions that reside in people's minds. We all imagine a prototype of an intelligent person against which we compare examples in our daily lives (Neisser, 1979). When commuters waiting for a train, shoppers in a supermarket, and university students were asked "What is intelligence?," there was agreement that intelligence has three facets: (a) practical problem-solving ability (reasoning logically, seeing all sides of a problem, keeping an open mind), (b) verbal ability (being a good conversationalist, reading often and well), and (c) social intelligence (being sensitive to social cues, admitting mistakes, and displaying interest in the world at large). Interestingly, academics who do research in the area of intelligence are in strong agreement with the layperson's implicit conceptions of intelligence (Sternberg, Conway, Ketron, & Bernstein, 1981). When adults are asked further to characterize intelligence as it applies to children of different ages, problem solving and reasoning become increasingly important to the prototype of intelligence with increasing age. Perceptual and motor abilities are seen as more characteristic of infants and younger children. Verbal ability is viewed as important from age two through adulthood (Siegler & Richards, 1982).

The importance of these implicit theories of intelligence has been underestimated, especially in light of the frequency of our assessment of others' intellectual abilities in everyday social interactions (cocktail parties, coffee breaks, etc.; Sternberg et al., 1981). Few people realize that more assessments of others' intellectual skills take place in the real world than in the testing room. Moreover, there is a high level of trust in these informal "measurements" based on implicit theories.

Most psychological research, however, is devoted to the construction and testing of *explicit* theories or models of the nature of intelligence. These theories often are based on or tested against psychometric data collected from individuals performing tasks perceived to measure intellectual functioning. Quickly, one sees disagreement among investigators as to the nature of observed intelligent behavior. Generally, theorists can be assigned to one of two camps, "lumpers" or "splitters" (Mayr, 1982). Lumpers define intelligence as a general, unified capacity for acquiring knowledge, reasoning, and solving problems that is demonstrated in different ways (navigating a course without a compass, memorizing the Koran, or programming a computer). Alfred Binet and Theodore Simon, developers of the first useful mental test, saw intelligence as a "fundamental faculty"—judgment, practical sense, initiative, and adapting to circumstances. On the basis of studying the factor structure of intelligence test scores, Charles Spearman also concluded that all people have a *general* intelligence factor, little *g*. He argued that as a rule, people who do well or poorly on some intelligence tests also do well or poorly on a variety of intellectual tasks (vocabulary *and* mathematics *and* spatial abilities). Although Spearman believed that performance on an intellectual task is dependent on *g*, he also acknowledged

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abilities, knowledge, and aptitudes that are specific (*s*) to a particular task. Belief in general intelligence historically has been the primary justification for using a single index of intelligence, the IQ (intelligence quotient), for a variety of assessment purposes.

Other psychologists, the splitters, hold that intelligence is composed of many separate mental abilities that operate more or less independently. Louis Thurstone, J. P. Guilford, and others have opted for distinct mental capabilities. Another splitter, Howard Gardner (1983) has rejected the view of intelligence as a single factor as well as the exclusive use of IQ tests to measure intellectual skills. He has argued for a theory of multiple, independent intelligences, each of which follows somewhat different developmental paths. For example, manual intelligence, one of at least seven intelligences that Gardner has proposed, appears early in development, whereas linguistic intelligence, exemplified by the poet, usually requires a period of apprenticeship and imitation. Gardner has believed further that our understanding of these intelligences will come from studying the interaction of the individual with the everyday environment, not from the IQ-testing room. He has claimed that each kind of intelligence is guided by its own form of perception, learning, and memory. (Note that Gardner is not without critics; one concern is that Gardner's thesis of multiple intelligences seems not to acknowledge the rich history of theorizing about the hierarchical structures of intellectual skills that came before it.)

Between the lumpers and splitters are those who hold intermediate positions in the definition debate (e.g., Horn, 1986; Vernon, 1971), positing a hierarchical organization from one or two general factors to more specific skills.

Explicit theories generally have come from the psychometric tradition, aimed at quantifying intellectual growth and identifying patterns of individual and group ability differences. In contrast to theories that look at the *structure* of intellectual performance, Jean Piaget's landmark theory of intellectual development focused on discovering *qualitative* developmental changes in the ways children perceive, understand, and operate on their environments. Viewing intelligence as a particular instance of biological adaptation, Piagetians have attempted to establish universal regularities in the child's progression through hierarchical stages of intellectual development (Ginsburg & Opper, 1988). According to Piaget, cognitive processes emerge as a result of a developmental reorganization of psychological structures resulting from the individual's interactions with the environment. Generally, psychometric procedures assess *what* we know (the product); Piagetian techniques probe *how* we think (the process). Although there is no comprehensive battery of Piagetian tests of intelligence, a variety of studies have shown that correlations between Piagetian and psychometric scales of intelligence in infant, preschool, and school-age populations are consistently positive, although generally moderate in magnitude (Sattler, 1988). There appears to be, in fact, a general factor common to Piagetian and standard IQ tasks.

Some have argued that the psychometric and Piagetian perspectives do not account for the specific processes involved in intelligent behavior (Siegler & Richards, 1982). The information-processing approach to understanding intelligence is a detailed, step-by-step analysis of cognitive processes. It describes how people gather and use information to solve problems and to acquire knowledge. The recent resurgence of interest in the psychology of intelligence has come in no small part from this complementary approach, which fills in the details about the processes underlying intelligent behavior. Cognitive psychologists (e.g., Brown & Campione, 1982; Campione & Brown, 1978; Carroll, 1981) propose that the mechanisms of information processing are also universal—whatever the tasks, whoever the performer. As an example, Robert Sternberg's (1985) triarchic theory of intelligence is built on three cornerstones: (a) Intelligence cannot be understood outside of a sociocultural context. What is "intelligent" in one environment may be irrelevant in another. Thus, the ability to adapt to one's environment is no small part of intelligence. (b) Intelligence is purposeful, goal-oriented, relevant behavior consisting of two general skills: the ability to deal with novel tasks and the ability to develop expertise, that is, the ability to learn from experience to perform mental tasks effortlessly or automatically. And finally, (c) intelligence depends on acquiring information-processing skills and strategies. One way to study these skills is cognitive component analysis. By considering the kinds of tasks that appear on mental tests, one can identify the underlying cognitive components, strategies, and knowledge stores that determine the solution of these test problems (Embretson, 1986).

Analyses of selected information-processing components of intelligence have helped address a fundamental question in the study of intellectual development: Is such development continuous or discontinuous? For most of this century, the accepted view was that intellectual development is discontinuous—intelligence in infancy seemed to differ in kind from intelligence in subsequent years of life. One source of evidence to support this belief is that correlations of traditional infant intelligence test scores with later scores are usually negligible (Bayley, 1970). But more recent evidence has suggested that such a conclusion might be wrong and that there are possible sources of continuity across the life span (Bornstein & Sigman, 1986; Sternberg, 1988). For example, coping with novelty, a person's ability to adjust to unfamiliar tasks and life situations, appears to be dependent on certain underlying cognitive components, that is, the ability to explore and solve novel kinds of problems as well as motivational attitudes. There appears to be some degree of

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continuity from infancy through later childhood in the development of these skills. Also, there is evidence of continuity in certain information-processing components of intelligence—the need to define problems, set up strategies for coping with these problems, and monitor solutions to the problems persists throughout the life span.

Despite considerable progress in cognitive psychology, the technologies of mental testing have remained virtually unchanged, being largely dominated by the psychometric perspective. However, the efforts of Sternberg and Gardner will likely result in alternative assessment strategies in the next decade (e.g., Sternberg Multidimensional Abilities Test). Whether such measures will replace or supplement standard IQ tests remains to be seen. Most current IQ tests have persisted because of their success at predicting those global criteria for which they were developed—school and job performance. Yet, their dominance in the testing arena has not been without controversy.

The IQ Controversy

The standardized IQ test has become an important part of Americana. Performances on individual and group tests of intellectual abilities—the "magical" numbers—continue to be an important basis for selection, placement, and other decision making in the psychoeducational and employment arenas across the life span. The scores determine who is adopted quickly or accepted in the top-tier preschools, who is labeled retarded or gifted or is tracked to receive special education placement and programming, who is placed in the bluebird learning group or the cardinals, who goes to elite colleges or is offered other educational opportunities, and who serves in the military as an officer or gets into a management-training program. IQ tests have played a pivotal role in allocating society's resources and opportunities. Many would, in fact, offer the intelligence test as the major achievement of psychology in guiding everyday practical affairs.

The heritage of intelligence tests is grounded in the work of Francis Galton, the father of the study of individual differences. Galton transformed his enthusiasm for the study of gifted men and the genetics of intelligence into the development of an early version of the individual intelligence test (Reynolds & Kaufman, 1985). For Galton, measurement of intelligence was to be as direct as possible a measure of Intelligence A, the biological underlay of all cognitive activities responsible for individual differences in the ability to perform cognitive tasks. That is, measurement should be biological and physiological in nature. Galton suggested reaction time as a feasible approach. More contemporary "Galton-like" measures are being pursued by psychologists, such as Arthur Jensen (1985), who assert they are assessing the integrity of the central nervous system—inherent capacities—as opposed to manifestations of intelligence in everyday life. The latter (Intelligence B) is heavily influenced, of course, by educational, cultural, and socioeconomic factors as well as by a range of individual factors that distinguish one person's life from another's (Eysenck & Barrett, 1985).

But it was Alfred Binet and his colleagues who later established the legacy of our current IQ tests when they constructed a measure to sort out Paris school children and predict their school success and then demonstrated its predictive validity. Binet was more concerned with Intelligence B and, therefore, suggested tests that were relevant to ordinary life.

Binet's conception won the day. His psychometric innovations also dovetailed with the social values and needs of Western society (Wigdor & Garner, 1982). The growth of industrial economies with diverse job demands, the increase in formal education among new social groups, the rapid concentration of large populations in cities, and the demands of two world wars contributed to a social milieu in which there was need for a new tool of measurement as a criterion for making selection decisions. Intelligence, or IQ, tests were designed to permit systematic, objective observation of intellectual performance in a controlled situation to reduce subjectivity and other sources of error and to allow comparisons among individuals (Wechsler, 1975).

There is agreement that tests of general ability measure skills that are important to learning in school. Some have even suggested that it is often difficult to distinguish among the constructs of achievement, aptitude, and intellectual abilities (Anastasi, 1988). IQ tests have established their psychometric credibility as our best guides to predicting later academic achievement, but IQ tests do not predict well the life outcomes for many individuals (McClelland, 1973). Thus, major controversy is rooted in the criticism that IQ tests are not a fair sample of a person's entire repertoire of adaptive behavior and are not adequate indicators of the quality and character of human functioning. It is argued, then, that intelligence is not limited to what intelligence tests test.

Furthermore, attacks on IQ tests have pointed to potential sources of unfairness within the tests themselves as well as with the test givers. The testing situation and test-taking skills are seen as foreign to the inexperienced; charges of sociocultural, economic, and racial/ethnic minority biases are repeatedly made against the tests; and in turn, arguments are proposed that the test scores perpetuate social and economic injustices (Kaplan, 1985; Oakland & Parmelee, 1985). Amid such controversy, there is good evidence that intelligence test performance is influenced by a variety of motivational and personality variables that have little to do with formal cognition or achievement (Zigler & Seitz, 1982).

Always the subject of scrutiny (Cronbach, 1975; Gould, 1981; Snyderman & Herrnstein, 1983), IQ tests during the past decade have been placed on trial in the federal courts (*Larry P. v. Wilson Riles,* 1979; *P.A.S.E. v. Hannon,* 1980) and in state legislatures (New York's "truth-in-testing" legislation). For example, in the *Larry P.* case, the California Federal District Court examined the disproportionate number of Black children placed in classes for the educable mentally retarded and banned the use of IQ test scores as the major basis for placement in special education. In light of the effectiveness of current

IQ tests to predict school performance, it is ironic that tests have been outlawed for the very purpose for which they were designed—to prevent subjective judgments and prejudice from being the basis for assigning students to special classes or denying them certain privileges.

In the public policy arena, another sharp criticism of IQ tests has been their misuse as outcome measures in evaluating or accounting for the effectiveness of social intervention programs, such as Head Start (Weinberg, 1979). Intelligence test results have influenced public policies. IQ alone, however, does not capture the full range of human cognition. Some believe that social competence, an index of functional intelligence, should replace IQ as the major barometer of success of social interventions. Such indexes, although not ignoring IQ, would also take into account adaptive, motivational, and emotional attributes of the individual (Scarr, 1981, 1986; Zigler & Seitz, 1982; Zigler & Trickett, 1978).

The Nature–Nurture Question

Some of the opposition to IQ tests as measures of intelligence rests on the fear that IQ is seen as inborn and unchangeable. Underlying much of the IQ debate is the nature–nurture question. Although the social, political, and religious contexts have varied across history, and popular definitions and theories of intelligence have changed, the question has remained about the same: To what extent are genes and environments important variables in accounting for the development of individual differences in intelligence? (For a fuller discussion of genes and environments, see Plomin, this issue, pp. 105–111). The major points of view—Locke versus Descartes, empiricism versus rationalism, a "blank slate" versus a "prepared mind," and behaviorism versus ethology—represent two essentially different approaches to understanding how individuals gain knowledge (Spitz, 1986). The nature–nurture debate flourishes despite an expanded knowledge base, an increased repertoire of methods, and the availability of populations appropriate for studying the problem. Counterbalancing these advances are value and moral issues that thrive in the rich soil of the social, political, and judicial arenas (Weinberg, 1983).

In the past two decades, the writings of Jensen (1969, 1973), Herrnstein (1973), Kamin (1974), and others have generated a strong emotional climate. Public opinion has been sparked by uncontrolled polemics and the discovery of the fraudulent nature of Sir Cyril Burt's data, long considered a cornerstone of hereditarian arguments. Increasingly, vigorous interest in sociobiology and its emphasis on the evolutionary roots and adaptive nature of complex social behavior have added to the public controversy. Charges of racism, genocide, and antifeminism have been made against psychologists and others who have embraced such sociobiological perspectives. At their extreme, hereditarian arguments have been used both to defend notions of racial inferiority and supremacy in the domain of intellectual ability and to attack intervention programs, such as Head Start, as naive, untenable exploitations of federal funds. "Pure" environmentalists have offered a rationale for developing specific intervention and enrichment programs and social policies that would guarantee the permanent "raising of intelligence" (Spitz, 1986).

Undiluted polar positions have characterized discussions of the sources of individual differences in intelligence. This "either–or" philosophy has created confusion for parents, educators, and others whose primary interest is fostering an individual's development by creating optimal learning environments. If intellectual ability, cognitive skills, and school achievement were really predetermined by genetic blueprints, then the question, "What role can educational interventions or child rearing play in the development of the individual's abilities?," would not be meaningful. More specific, to what extent can an educational environment contribute to the development of a child's intelligence? To what extent can the level of an individual's performance be altered as the result of instruction and interventions? What are the limits to the influence of such interventions?

To begin to address these questions, it is important to explore some facts about the roles that genes and environments together play in affecting the development of intellectual skills. Of course, environments can have a major impact on such development, and changes in one's environment can shape changes in behavior—a phenomenon called *malleability.* This phenomenon has been demonstrated in a study of Black and interracial children who were adopted as infants by upper-middle-class families, providing home environments in which the children were taught middle-class, White culture, especially the vocabulary and cognitive skills that IQ and achievement tests reward. The adopted children performed well above average on IQ tests and on school achievement measures and better than Black and interracial children with similar genetic backgrounds not raised in the specific culture of the tests and schools (Scarr & Weinberg, 1976).

Studying a social phenomenon—transracial adoption, Scarr and I (1976) disputed the hypothesis that IQ differences between Blacks and Whites are due to genetic differences; malleability of IQ test performance and school achievement was documented. Indeed, these data confirm the more general contention that plasticity is a pervasive quality of the human organism throughout development (Lerner, 1984). Yet malleability (or plasticity) does not mean that given the same environment, all individuals will behave alike. Individuals bring idiosyncratic responses to the same situations, and these differences are due in part to variations in genetic makeup.

There is a myth that if a behavior or characteristic is genetic, it cannot be changed. Genes do not fix behavior. Rather, they establish a range of possible reactions to the range of possible experiences that environments can provide. Environments also can affect whether the full range of gene reactivity is expressed. Thus, how people behave or what their measured IQs turn out to be or how quickly they learn depends on the nature of their environments *and* on their genetic endowments bestowed at conception.

We should also recognize that environmental effects can become cumulative organic (not genetic) effects. For example, although Down syndrome is a genetic condition that limits intellectual development, prenatal excessive radiation or maternal drug ingestion are environmental effects that inflict organic damage that can result in limitations in intellectual development. In other words, there are genetic, organic, and environmental factors that determine intellectual development and performance on IQ tests (Horowitz, 1987).

The findings of the transracial adoption study do not support the conclusion that genes are totally unrelated to IQ test performance or academic achievement. The origins of differences between groups are not necessarily the origins of variations among individuals. What, then, accounts for persistent differences among individuals raised in similar environmental situations? Differences in intelligence, as measured by traditional tests, are estimated to be about 50% heritable; that is, 50% of the population variance seems to be genetically determined (Plomin, 1986). But the remaining variation is largely due to individual experience, and these experiences play greater or lesser roles at different stages of the individual's development. A heritability index cannot provide answers to questions about the etiology of an individual's handicaps or the anticipated benefits of novel intervention programs (Anastasi, 1971).

What this all means is that the range of reactions of IQ under present environmental conditions is about 20 to 25 points (Zigler & Seitz, 1982). Edward Zigler, a major architect of the Head Start program, and Victoria Seitz have said that "this position has the advantage of generating energetic willingness to attempt interventions without unrealistic expectations about what they can accomplish" (1982, p. 615). Programs that enhance intellectual performance as a result of an optimal intervention can have considerable "functional" impact on the individual, for example, improved school achievement and the acquisition of skills needed for employability. The conclusion that our genetic heritage contributes to the complex accounting of variation in our performance need not be pessimistic nor bode evil for social and educational policy:

> Social policy should be determined by political and ethical values. . . . Once social policy has been determined, however, research can be useful. Governments can do a better job of designing effective intervention programs if people know which variations in the environment make a difference and which do not. The *average level* of a culture's environment determines the average level of achievement: by providing good schools, nutrition, health care, and psychological services, a society can raise the overall level of health and attainment for the whole population. Resources spent in these areas should eliminate conditions that have definite deleterious effects on individual development.
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> But governments will never turn their entire populations into geniuses, or altruists, or entrepreneurs, or whatever their philosophy is. Biological diversity is a fact of life, and respect for individual differences derives from the genetic perspective. (Scarr & Weinberg, 1978, p. 3)

Those who devote professional efforts to educational and child-care enterprises must appreciate individual differences, accepting the challenge to create educational environments that effectively match a child's abilities and talents. As a society, we can raise the average level of children's environments and attempt to provide the necessary range of environments that will facilitate optimal learning outcomes for every child. Although genetic endowment will always influence the acquisition of intellectual skills, the environments and opportunities we create for children do make an important difference.

Looking Forward

With this brief portrayal of landmark issues and major controversies that have marked psychology's study of intelligence and its assessment, I have observed the tensions that emerged historically between the scientific/technological and social policy arenas. Clearly, psychology will continue to contribute to an understanding of variations in intellectual ability, how these skills develop, and the difference that intelligent behavior makes in human adaptation. Let me share some reflections that might help give direction to the continuing explorations, particularly as these efforts relate to serving the psychosocial needs of children.

1. An increasing focus on behavior–brain connections needs to be high on our research agenda. Work on the psychophysiological bases of cognitive activity and on the neurological processes that underlie intelligent behavior—such as the relations between measures of evoked potentials or processing speed on reaction time tasks and standardized IQ measures—holds promise for shedding light on intellectual development (see Eysenck & Barrett, 1985; Vernon, 1987).

2. Intelligence test development generally has lacked theoretical foundations, being driven instead by attention to measurement and statistical requirements. Cognitive theories and neuropsychological perspectives could offer new momentum to the assessment enterprise.

3. The use of an IQ as the primary basis for decisions about a child's educational future must be discouraged. Objective assessment can inform, but cannot replace, judgment (Wigdor & Garner, 1982). Scores must be interpreted within the context of a child's total record, including classroom observations and behavior outside the school milieu, taking into account the instructional options available for the child. IQ test results cannot be translated into instructional designs or prescriptions for remedial programs (Boehm, 1985; Boehm & Weinberg, 1987). Furthermore, as IQ tests are used to guide placement decisions, parents, educators, and others contributing to these judgments should be well informed and should understand the technical characteristics of the testing tools as well as cultural and racial/ethnic background characteristics of the child.

4. Similarly, society cannot continue to abuse intelligence tests by relying on changes in IQs to evaluate prevention, early education, and social intervention programs. IQ tests do not tap the full spectrum of intellectual

competencies, including the child's ability to use environmental and personal resources in adapting to the world. Society must concentrate on developing an array of reliable and valid indexes of social competence that consider motivational history and personality and socioemotional adjustment factors. Studying the child in natural environments and multiple social contexts goes beyond the IQ to offer a more valid assessment of a child's adaptive skills (Christenson, Abery, & Weinberg, 1986).

5. The accumulating evidence suggests that the substandard intellectual skills and "thinking" capacities of mildly mentally retarded populations, most of whom manifest no particular organic or central nervous system pathology (cultural–familial retardation), cannot be substantially or permanently raised by special training (Spitz, 1986; Zigler & Seitz, 1982). But there is good reason to believe that interventions can enhance the functional abilities, learning strategies, adaptive skills, and social competencies of children whose measured IQ is low. Our goal should be to provide optimal environments to facilitate such learning and development. From a social-policy posture, efforts should be coordinated to help children and their families achieve a better quality of life and cope more resourcefully with daily challenges.

6. Finally, a word of caution: The scientific study of intelligence and its development does not proceed in a vacuum. Public policy evolves from and is supported by our knowledge and discoveries. Therefore, it is critical that we, as psychologists, keep our fingers on the sociopolitical and economic pulse, monitor the translations of our work into the policy arena, and even participate in this enterprise.

The evidence loudly proclaims that the construct of human intelligence continues to fascinate contemporary psychologists. New theories and vigorous research agendas hold promise for an increased understanding of the nature of intellectual development across the life span, more effective tools for assessing individual differences in intellectual competence, and an expanded awareness of how society can intervene to enhance the individual's intellectual skills.

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