

## CONCEPTUAL FOUNDATIONS OF IQ TESTING

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Cognitive neuroscience has not yet arrived at a definition of what human “intelligence” is. Intelligence is a chapter-heading word used in the 19th century to denote some unspecified mental property that increases in evolution. Other words were given speculative evolutionary meanings in the 19th century: genius, degeneracy, retardation. When the Binet–Simon test came along as a test to screen degrees of mental retardation, later as a pupil classification instrument, some (not Binet) associated the test with these 19th-century words and meanings. Descendants of the Binet–Simon instrument, IQ tests, remain useful today, but the old legendry lives on with them, at times supporting speculative social and political arguments. Researchers need to disentangle what is factual about IQ testing from its associated legendry.

The “intelligence” that the IQ test is supposed to test has never been defined in precise scientific terms and there is no evidence from cognitive neuroscience to indicate that it can be. Many words in the English language—e.g., “intelligent,” “courageous,” “hard-working,” “thoughtful”—are useful in denoting differences between people even though the properties suggested by the words cannot be traced back to simple and distinct processes at the physiological level. The belief that there is a unitary human property of intelligence—and that it can be measured—arose at the turn of the 20th century. What brought it to life was not the findings of scientific research but, first, speculative efforts to account for human differences in evolutionary terms and, second, the invention of a practically useful school readiness test. Before the turn of the 20th century, words denoting properties of people—“intelligence,” “genius,” “degeneracy,” “retardation”—were given speculative evolutionary meanings. These interpretations all together formed what one might call a cloud of legendry. When, in the first decade of the 20th century, Binet and Simon put forward a useful “Measuring Scale of Intelligence” for ascertaining children’s readiness for school, the cloud of legendry descended around the test. In the 20th century, IQ test data have been given social and political interpretations that owe much to the legendry and very little to scientific information about what the IQ test is and does. Researchers know enough today to disentangle the scientifically and psychometrically meaningful part of IQ testing from the cloud of legendry, and they should proceed to do just that.

The conceptual foundations of IQ testing, the words and ideas to be embodied in speculations about what the tests might mean in evolutionary terms, were established well before the tests were invented. In the 19th century, scientists often connected their work to everyday life by attaching scientific meanings to ordinary words. C. S. Peirce used to argue it was a mistake to do this. Invent neologisms, he said. Otherwise, words’ traditional meanings contaminate and confuse your thinking about the scientific phenomena. But scientists, including

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psychologists, regularly interpreted everyday words in scientific terms, probably because they wanted to explore the reach and meaningfulness of their science. As they did so, a new set of double-framed words appeared, cross-referenced on the one side to the psychological ideas of everyday life and on the other to scientific conceptions and theories.

Koestler (1967) has such called such double-framing *bisociation*, and has argued that bisociation is a source of creativity in art, science, and humor. There was much cross-referencing of terms associated with IQ testing at the beginning of the 20th century and this reflected a creative process to be sure but at the same time it distorted purely formal and technical understandings of the tests, just as Peirce had argued might happen. Scientific interpretations of a few words in the 19th century—intelligence, genius, degeneracy, retardation—loaded interpretations of the IQ tests that came along in the 20th century. A reasonably well-made and useful personnel selection test was given shadowy, confusing suggestions of political and social meaning.

### Intelligence

Scientific psychology, the “new psychology” of the 1870s, made “intelligence” a target from the very beginning. When William James, instructor in physiology and anatomy, began teaching psychology at Harvard in the 1870s, his textbook was Herbert Spencer’s *Principles of Psychology*. Spencer argued that evolution—in species, humans, and societies—is a cosmic process by which complex systems are led to “hunt” greater intelligence, greater knowledge of the world all around. More intelligent humans are, thus, more evolved humans:

Intellectual evolution, as it goes on in the human race . . . is thus, under all its aspects, a progress in representativeness of thought. By consisting of representations that are more extended, more definite, more varied, more involved, the conceptions of developed intelligence are distinguished from those of undeveloped intelligence. (Spencer, 1897, p. 535)

When James shifted his teaching at Harvard to Philosophy, he changed his textbook to Taine’s (1871) *On Intelligence*. For Taine, the study of intelligence was tantamount to the study of what researchers call cognition:

If I am not mistaken, we mean nowadays by Intelligence, what was formerly called Understanding or Intellect- that is to say, the faculty of knowing; this, at least, is the sense in which I have taken the word. (p. vii)

Early psychologists designated intelligence as a quality of mentation that increases with evolution. Romanes (1883) titled his first book on comparative psychology *Animal Intelligence*. He said that increases in intelligence across species are built upon increases in information-processing capacity, but comparative psychologists after him would suggest other principles of intelligence. Cognitive neuroscientists have treated “intelligence” as a chapter-heading word, like “motivation” or “emotion,” a property of behavioral organization to be explored and defined by future scientific inquiries. The scientific inquiry process continues in the 20th century, coexisting with intelligence testing but neither closely identified with nor constrained by what the intelligence test tests. Werner

(1948) and Piaget (1950) have written theoretical accounts of the development of intelligence in childhood. Neuroscientists today explore species differences in intelligence, identifying that intelligence as a capacity to experience more of the surrounding environment (Jerison, 1973), or to reprogram behavior (Stenhouse, 1974), or as information-processing capacity, the possession of a language-acquisition device, purposive as opposed to stimulus-driven action, the linkage of experiences across times and places, the use of symbols, or the ability to solve social problems. (Weiskrantz, 1985). The variety of such definitions says that for the cognitive neuroscientists of our time the definition of intelligence remains a work in progress.

### Genius

If the 19th century gave “intelligence” a good name, that century’s views about “genius” were divided. Darwin’s cousin, Francis Galton, saw genius as a mark of advanced evolutionary standing. In his book, *Hereditary Genius*, Galton (1869/1887) offered evidence that great human abilities run in families. He began with lists of distinguished lord chancellors, judges, statesmen and premiers, commanders, literary men, men of science, poets, musicians, painters, divines, Senior Classics at Cambridge, oarsmen, and wrestlers, and he looked for eminent family members. Of 977 eminent men, 415 (42%) had eminent relatives. Galton concluded that great human ability “breeds true.” Geniuses, he thought, were people standing at the leading edge of human evolution, people whose breeding should be encouraged.

Unfortunately, there were other 19th century writers who said that geniuses should be understood as pathological human beings. Cesare Lombroso, for example, wrote a book, *The Man of Genius*, that came out in six editions, arguing that genius is “a degenerative psychosis of the epileptoid group” (Lombroso, 1910/1984, p. 359). William James (1895; Taylor, 1983) reviewed the writings of Lombroso and a number of others who argued that genius rests on psychopathology. James’s (1895) assessment was not kind. He said of Lombroso that “his incapacity for exact reasoning is apparently incurable,” of Max Nordau’s *Degeneration* that it was “a pathological book on a pathological subject,” and he characterized most of the work as “farce-comedy writing.” Summing up, James said:

The trouble is that such writers as Nordau use the descriptive names of symptoms merely as an artifice for giving objective authority to their personal dislikes. . . . The real lesson of the genius-books is that we should welcome sensibilities, impulses and obsessions if we have them, so long as by their means the field of our experience grows deeper and we contribute the better to the race’s stores; that we should broaden our notion of health instead of narrowing it; that we should regard no single element of weakness as fatal—in short that we should *not be afraid of life*. (p. 294)

Still, in the end, James did not entirely discount the argument that genius was associated with psychopathology; he simply said that that is not the only thing, or the most important thing, to be taken into account in considering genius. In the 20th century, Lewis Terman pursued Francis Galton’s idea that geniuses were people standing at the vanguard of evolution. By retrospectively assigning IQ

scores to distinguished historical figures, he sought to show that the genius of these people was the stuff that intelligence tests (Cox, 1926; Terman, 1917). His classic longitudinal study of 1000 gifted children (Terman, 1926) was largely motivated by a desire to show that the psychopathological tradition was wrong and that his high-IQ “geniuses” were, if anything, bigger and healthier than most people. Nevertheless, the psychopathological tradition lives on today (Kessel, 1989), regularly surfacing in depictions of characters like Dr. Strangelove and the mad scientists of the media.

### Degeneracy

Degeneracy was a matter of serious public concern in the 19th century, as a condition that was thought to be a major source of social problems of defect, delinquency, and dependency. Gelb (1990) has pointed out that there were two slightly different 19th century views of degeneracy:

Degeneracy theory, which was widely accepted by psychiatrists and neurologists between 1860 and 1910, assumed that living things acquired and modified their characteristics in response to their environments, and that these changes were then passed on to their offspring. . . . Nervous temperament in the first generation evolved into emotional disorders in the second, to pauperism, waywardness, or criminality in the third, and finally, to idiocy and extinction in the fourth and last stage of degeneration. Degeneracy theorists, in contrast to eugenicists, were most concerned with improving social conditions and training persons to live in healthier ways. . . . eugenicists believed that people made slums while degeneracy theorists believed that slums made people. (Gelb, 1990, p. 243)

Jordan (1993) has recently reviewed the statistics through which degeneracy theorists tried to document the decline in British stock during the 19th century. What brought public concern to a head in Britain were published figures on the health and fitness of recruits for the Boer War. Creswell (1948, p. 115), summarizes them in these terms:

Of the 679,703 recruits medically inspected in the ten years from 1893 to 1902 inclusive, 255,022, or considerably more than a third, were found to be physically unfit for service. If to this figure be added the number of those unfit to qualify even for inspection, the number rejected is probably nearer a half than a third. Indeed the Inspector-General for Recruiting put the number of rejections as high as sixty per cent.

Concerns like those arose after the great mobilization of American men for World War I. Public concern about the health and fitness of the recruits would be a significant source of support for the child development movement that grew up in the 1920s and 1930s in the United States. But a deeper, more anxious kind of public concern arose because of “the menace of the feebleminded.”

### Retardation

The 19th century movement of Americans into cities brought retarded children into institutions and training schools and made retardation a scientific and medical issue. With institutionalization and record keeping, people became aware of the familial connections among cases of retardation. While Francis Galton in

England was finding family connections to show that genius breeds true, Richard Dugdale (1877) was publishing his celebrated study of the Jukes to show that crime, pauperism, and disease were all associated in one family tree. A generation of pedigree studies followed (cf. Trent, 1994, pp. 177–178) to suggest that defect, dependency, and delinquency run together in families. They seemed, all of them, to be symptomatic of degeneracy. And so there was a concern about the “menacing and increasingly well-known defective” that Trent describes in these terms:

What made this new image so threatening and ensured acute concerns and shrill warnings was the increasing insistence in the first and second decades of the new century that mental defectives, in their amorality and fecundity, were not only linked with social vices but indeed were the most prominent and persistent cause of those vices. Graduating from being merely associated with social vices to being their fundamental cause, mental defectives became a menace, the control of which was an urgent necessity for existing and future generations. (Trent, 1994, p. 141)

The feebleminded needed to be found and controlled, some thought, and their concern was an important part of what motivated the early development of IQ testing in the United States.

### Intelligence Testing

Mental testing in the United States, at the very first, was associated with the hope of locating the best and the brightest. James McKeen Cattell, at Columbia, had studied with Francis Galton, and he used some of Galton’s procedures for a test of college-level mental functioning (Cattell, 1890). In 1894, he examined every incoming student at Columbia College and the Columbia School of Mines, with limited results. Later, his student, Clark Wissler (1901), obtained mental test scores and academic records for 300 undergraduates at Columbia and Barnard Colleges. Correlations between student grades in college ranged from a low of .30 (between Rhetoric and French) to a high of .75 (between Latin and Greek). The mental tests showed zero-order intercorrelations with academic subjects and with one another. A thesis done by Stella Sharp (1899) in Titchener’s laboratory compared Cattell’s approach to individual differences with some early work being done by Binet and Henri in France, coming out in favor of Binet’s approach. Not long after, Cattell abandoned his efforts to develop Galton’s approach, though the eugenicist ideas associated with Galton’s work lingered on.

A practically useful mental test was developed by Alfred Binet and Theophile Simon and brought to the United States by Henry Goddard of the Vineland State Training School. In 1905, Alfred Binet and Theophile Simon (1905a, 1905b, 1905c), a psychologist and a physician, published a 30-item “Measuring Scale of Intelligence” designed to provide an objective procedure for the differential diagnosis of idiots, imbeciles, morons (*débiles*) and normal individuals. The first item of the test was *Le regard*: “Do the head and eyes follow a moving match?” The second was *Prehension provoked by a tactile stimulus*: “Will the child seize a piece of wood touched to its hand, and bring the wood to its mouth?” The 29th and 30th items, the top of the scale, were a paper-folding task and the question, *Definitions of abstract terms*: “What difference is there between esteem and affection?” “What difference is there between weariness and sadness?”

The 1905 Binet–Simon test was obviously and only a test for the classification of relatively low-functioning retarded children. As the items of the instrument were explored and modified in a careful program of test development, it became clear that the test responses of retarded children resembled the test responses of younger nonretarded children. To perfect their test, Binet and Simon needed a more detailed picture of children’s mental development. Their 1905 test didn’t have enough “top” and so they extended the range of their test, reporting in 1908 on a scale with groups of items at 1-year intervals from ages 3 to 13 years. Finally, Binet (1911) reported on a last revision. There were now 5 items at every age between 6 and 12 years of age, an item group at 15 years of age, and a final item group for adults.

While this patient, thoughtful process of test development was going on in France, an explosion of pursuit got going in the United States. Henry Goddard, Director of Research at the Training School for the Retarded at Vineland, New Jersey, translated the 1908 Binet–Simon instrument and was impressed with the fact that the scores it yielded accorded well with the clinical diagnoses of those who were experienced in dealing with feeble-minded children. By 1915, Goddard had distributed 22,000 copies of his translated test, and 88,000 answer blanks. In 1910, Goddard (1910) reported on the data of 400 feeble-minded children classified by the Binet method; in 1911, he reported (Goddard, 1911) on the use of the scale with 2,000 normal children. In 1913, Kuhlmann (1913) reported on 1,300 feeble-minded children with the Binet–Simon tests. By 1914, there was enough work that Kohs (1914) published a 254-item bibliography of papers reporting on work with the Binet–Simon instrument.

In 1916, Lewis M. Terman published the first Stanford–Binet test of intelligence, an enlarged version of the Binet–Simon, standardized on an American sample of about 2,300 children. At this point in the development of intelligence testing, the identification and control of mentally retarded individuals was clearly a leading issue. In Chapter I of the test manual, discussing the uses of intelligence tests, Terman says they will (a) allow for scientific diagnosis and classification of children to be placed in special classes; (b) bring tens of thousands of high-grade defectives under the surveillance and protection of society. “This will ultimately result in curtailing the reproduction of feeble-mindedness and in the elimination of an enormous amount of crime, pauperism, and industrial inefficiency” (p. 7); (c) reduce delinquency because there is a close association between feeble-mindedness and delinquency; (d) help the schools to recognize and respond appropriately to children of superior intelligence; (e) assist in assigning children to appropriate school grades; (f) help determine vocational fitness; and (g) serve as a standard for research on the factors determining educability and mental development (Terman, 1916).

In his discussion of the Stanford–Binet test’s possible uses, Terman placed first the possibility of the identification and control of the retarded. The diagnosis of retardation was not then circumscribed in the way it is today; retardation was thought to be a visible sign of a complex of degenerate proclivities. The line between diagnosis and invective was sometimes thin. In a Clark University questionnaire sent out on November 30, 1901, Arthur R. T. Wylie asked about “Sub-Normal Children and Youth” in these words:

It is desired by means of this syllabus to gain material for the study of the bad and troublesome children of school and family life, those who have reached their limit in school, and those limited in only one line, the runaways, the vagrants, spend-thrifts, dudes, hoboes, hoodlums, religious fanatics, sensualists, sentimentalists, vicious and impulsive characters, impulsive masturbators, the ne'er-do-wells, the gilded youth and those who gave early promise but dropped into a humble station which they just managed to fill.

This broad-sweeping conception of what a diagnosis of retardation might mean was brought into the first American usage of mental tests. In 1911, Vinnie Hicks established a clinic in the Oakland, California schools and began examining the "abnormal" children with mental tests. She found 365 problem children, ranging from the "unruly" and the "high school subnormal" to the "feebleminded" and "idiots." She argued that isolating the "subnormal" children—"the absent, the tardy, the sickly, the unruly, the liars, thieves and cowards"—would free the teacher to work with the normal children (Chapman, 1988, p. 58).

### Myths and Realities of Early IQ Testing

If we look at the spreading use of IQ tests in the early decades of the 20th century, it is not hard to see the emergence of such tests in straightforward, pragmatic terms, as personnel management instruments brought into play for assistance with issues of pupil classification for a rapidly enlarging American educational system. IQ tests came into use in American schools at the same time that Civil Service examinations came into use in government, and testing associated with personnel selection and classification came into use in industry. The IQ tests worked reasonably well for administrative purposes, as did the other emergent forms of psychological testing. They work reasonably well today, if sensible allowances are made for the biases and limitations they share with any and all psychometric instruments. What has been hard to handle are the magic, science, and religion all mixed together in usages of the tests (White, 1975).

Some of the American use of IQ tests has been premised on arguments that there exists a monolithic evolutionary order of intellectual development, together with associated conceptions about intelligence, genius, and degeneracy and retardation as properties of superior or inferior human beings. Binet lived just long enough to recognize this massive, inflammatory body of foreign ideas being grafted on his instrument and to reject the "brutal pessimism" and "deplorable verdicts" of those who believe that intelligence is a single, hereditarily fixed entity. He began developing a "mental orthopedics," composed of exercises to raise children's intelligence. To gain *motor control and agility*, children competed on tests of grip and speed of tapping. For *attention, willpower, and motor control*, children carried full cups of water from one table to another without spilling a drop. For *prolonged maintenance of an attitude*, the child had to stare straight-faced at another child who grimaced at him, had to remain motionless holding a copybook with a stick of chalk balanced upon it, or had to stand motionless, holding one foot in one hand while the other hand was placed on the back of his neck. To train *attention and memory*, the child was shown cards with a number of objects pictured on them and subsequently had to write their names from memory (Mann, 1979; Fancher, 1985). Unfortunately, Binet would die in 1911, a relatively

young man with his program not done. We try today to complete the disentangling that he could not accomplish in his lifetime.

### Beyond the 19th Century Assumptions

Suppose we set aside some 19th century ideas that people don't believe any more—that intelligence is the summum bonum of evolution; that geniuses are evolutionary trailblazers; that degenerates cause most troubles in civil society; and that the feeble-minded, in particular, represent an active, predatory menace. Some might want to argue that these ideas can't be completely thrown out because there are useful kernels of truth here and there among them. Fine. But those ideas taken all together do not now hold out to most people a coherent, convincing contemporary justification for widespread practices of IQ testing in our society. Let's consider what does.

All the 20th century evidence about IQ testing that I'm aware of is consistent with the following propositions:

- The IQ test is a reasonable test of facility with symbols and, as such, is useful in predicting how well children will do in schools and in occupations depending heavily on symbolic facility—the professions, middle management, the media, and academia.
- The test has proved useful in helping educators to make personally difficult and politically tricky decisions about pupil placement, and it has been useful for a variety of other personnel classification decisions.
- We have tried repeatedly and do not know how to make the test either “culture free” or “culture fair.” Users of the test have to recognize that and put in place procedures to minimize the difficulties such limitations may produce.
- IQ test scores correlate with education, income, and socioeconomic status, but these are anything but independent variables; they are criterial for one another. The people the test favors are important to the management of a complexly organized society; they tend to get paid well and have prestige. The IQ test gets a good press from its constituency, but there are no data to indicate that the not-so-communicative people are in any way secondary or noncontributory as members of society.
- The IQ test is in part an achievement test. Performance on the test is sensitive to those experiences of the child in family, community, and preschool that foster the ability to play games with symbols and, on the negative side, such performance is suppressed by trauma, illness, family disturbance, or other disturbing factors in a child's life. In part, performance on IQ tests reflects skills that tend to run in families. Most skills that we know anything about have some tendency to run in families.
- The Stanford–Binet test has historically been the benchmark for all IQ tests, and so whenever an instrument is called an IQ test one can assume that it participates (by correlation) in whatever it is that the Stanford–Binet test tests. The Stanford–Binet test is, many say, “too verbal.” But efforts to open up IQ testing by proposing multiple intelligences (various schemes ranging from 2 to 300 entities by my count) are double-edged. They transmit the admirable message that there is more than one way to be Chosen and socially useful but they complicate an already confusing situation. If cognitive neuroscientists have not, so far, been able to settle on a physical basis for intelligence, still less are they able to set forth criteria for the determination of just how many “intelligences” it would take to cover the wide-ranging activities of humans.



- Evidence that races, classes, or cultural groups differ on IQ scores is not, with the old legends set aside, neither terribly surprising nor critical in an educational or social sense.
- Sophisticated scientists nowadays reject the older arguments setting forth an exalted view of IQ testing but nevertheless some still get entangled in complicated arguments in which the reality and legends about IQ testing are mingled. Unhappily, some scientists' usages of the IQ tests corresponding to what William James perceived to be the approach of the writers of the genius-books, the use of "descriptive names of symptoms merely as an artifice for giving objective authority to their personal dislikes." Away from the centers for advanced scientific work, there are some who still take the legends as scientific truths.

In view of what we now know about IQ tests, it seems to me we ought to:

1. Reinvent IQ testing. We know a lot about children's development, and what happens in special classes, that Binet and Simon didn't know. Use that information to make a better practical test. Follow Peirce's principle. Throw away the nomenclature that loads the tests with the old evolutionary speculations and, in so doing, allows some to throw scary political and social shadows on the wall. Call the new test something like the "PQRST test."

2. Reconsider carefully the educational and social practices that use IQ tests—as, indeed, legal challenges are compelling us to do in some areas—to determine that the practices depend on the reality rather than the legendry about what IQ tests have to offer.

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