

Key Players in the History & Development of Intelligence & Testing

[Intelligence](#)

Last updated:



1. Francis Galton: The 1st Modern Attempt (late 1800s)

Intelligence tests are grounded in the work of [Francis Galton](#) in the late 19th century. Galton is considered to be the father of the study of individual differences [and, incidentally was the half-cousin of Charles Darwin]. For Galton, measurement of intelligence was to be as direct as possible a measure of underlying intelligence. Hence, Galton suggested reaction time as a feasible approach and pursued various sensori-motor measurements.

Interestingly, more contemporary "Galton-like" approaches are being pursued by psychologists such as Arthur Jensen and Mike Andersen who assert that they are assessing the integrity of the central nervous system - inherent capabilities (Intelligence A) - as opposed to manifestations of intelligence in everyday life (Intelligence B). (Weinberg, 1989).

2. Alfred Binet: The origins of IQ Testing (early 1900s)

[Alfred Binet](#) is celebrated in history as the man who created the first 'intelligence test' in the form as we know them today. He is commonly known as the „father“ of IQ testing.

In 1904, Binet was commissioned by the French Ministry of Public Instruction to develop techniques for identifying primary grade children whose lack of success in normal classrooms suggested the need for some form of special education (Gould, 1981).

In 1905 he produced the Binet-Simon scale [with Theodore Simon] - the first intelligence test. Binet took a pragmatic approach, choosing a series of 30 short tasks related to everyday problems of life (e.g. attend to simple instructions

- name parts of the body
- compare lengths and weights
- counting coins,
- assessing which of several faces is 'prettier',
- naming objects in a picture,
- digit span (the number of digits a person can recall after being shown a long list),
- word definition

- filling in the missing words in sentences, etc.

Supposedly all these tasks involved basic processes of reasoning.

The tests were arranged so as to be of increasing difficulty. Each level of tests matched a specific developmental level - i.e. all tests at a given level were capable of being solved by any normal child in that specific age-group.

This was a turning point in psychology: A new type of test had been produced in which the average level of performance was the criterion. In 1908 the test was revised and then again in 1911. This edition was the model for many future tests. The test results proved to be correlated with other criteria (e.g. results of school examinations, assessments of teachers, etc.)

3 & 4. Terman (1916) and Stern (1912)

[Lewis Terman](#) (1877-1956) of Stanford University in the US decided to use Binet's test. He found that the Paris-developed age norms didn't work very well for Californian school children. So he revised the test: adapted some items, added other items, established new age norms, and extended the upper age limit to "superior adults". This became the Stanford-Binet revision in 1916. In this revision the Intelligence quotient first appeared. The Intelligence Quotient or IQ was a score meant to quantify intellectual functioning to allow comparison among individuals. To arrive at an IQ score, Terman relied on a formula expressing the relation between an individual's mental age and chronological age developed in 1912 in Germany by [Wilhelm Stern](#): 1912 Wilhelm Stern proposed the following formula:

$$\text{IQ} = \frac{\text{mental age}}{\text{chronological age}} \times 100$$

This formula works fairly well for children but not for adults (Thomson, 1968; Weinberg, 1989)

5. Yerkes: Army Tests (WWI)

The US army at the beginning of WWI was faced with the problem of assessing the intelligence of great numbers of recruits in order to screen, classify, and assign them to suitable tasks. The Stanford-Binet test required a highly trained person for individual administration - thus it would prove time consuming and costly for large-scale use.

So, when the US entered WWI in 1917 a committee was appointed by the APA to consider ways that psychology might assist the conduct of the war. Head of this committee was Robert Yerkes. His brief was to develop group intelligence testing.

[Robert Yerkes](#), a psychologist and army major, assembled a staff of 40 psychologists [including Terman] to develop a group intelligence test. This resulted in the Army Alpha and Army Beta tests. The Beta was a version of the Alpha specifically for use with non-English-speaking and illiterate persons. [Instructions to those taking the Beta were given by demonstration or pantomime, rather than orally]

or in writing.]

In the end, over a million people were tested, but not until late in the war. Thus the work actually had little effect on the war, but did a great deal to enhance the status of psychology. After the war, industry, business and education saw potential value of psychological testing

Note that the validity of the Beta test, in particular, has since been questioned rather damningly by Gould (1981).

6. Charles Spearman: „g“ (1920's)

Up to now, the approaches to intelligence had been very pragmatic - i.e. tests were developed for particular needs. However, another approach to understanding intelligence, involved analysing data that was already collected.

[Charles Spearman](#) (1927) analysed the relations among experimental intelligence tests using 'factor analysis'. He argued that, as a rule, people who do well on some intelligence tests also do well on a variety of intellectual tasks [vocabulary and mathematical and spatial abilities]. And if people did poorly on an intelligence test, then they also tended to do poorly on other intellectual tests. That is, he observed correlations among performance on a variety of intellectual tasks.

Thus, he proposed, a 'two-factor' theory of intelligence:

- General Ability (g): which was required for performance of mental tests of all kinds; he called this a kind of 'mental energy' that underlies the specific factors
- Special Abilities: which were required for performance on just one kind of mental test.
- e.g. Scores on a verbal comprehension test are largely determined by one's level of general intelligence but they are also affected by one's specific ability to perform verbal comprehension tasks.

But the main thrust of Spearman's analysis was this idea of a general intellectual capacity. This formed a major theoretical platform for many subsequent approaches to intelligence.

It might be also noted, however, that Spearman was perhaps excessively enthusiastic about g. For example, he advocated restricting voting rights to people whose g exceeded a certain level, and he was a eugenicist (eugenics comes from the Greek "eugenes" meaning well-born) - arguing that only people with a certain level of g should be allowed to have offspring.

"g" was controversial then as now.

7. Weschler: Intelligence Scales for Adults and Children (1939 - present)

Another test designer was [David Wechsler](#). Wechsler felt that the Binet scales were too verbally loaded for use with adults, so he designed an instrument with sub-tests to measure both verbal and nonverbal abilities, largely borrowing from many other tests, such as the US Army Alpha test. He adopted a mean score of 100, since the Stanford-Binet metric had become universally accepted. The original Wechsler-Bellevue test in 1939 proved quite successful in civilian and military applications.

In 1949, Wechsler produced the Wechsler Intelligence Scale for Children (WISC), which competed with the Stanford-Binet test.

In 1955, he produced a revision of the adult scales named the Wechsler Adult Intelligence Scale (WAIS). And later he produced a scale which could be used with pre-primary children.

These scales have all been revised, but still show a distinct resemblance to the original 1939 scale.

8. Thurstone: Primary Mental Abilities (1930's)

Another 'factor analyst', [Thurstone](#) (1938), accepted Spearman's hypothesis of a general factor. But he disputed its importance. He argued that g is in fact a second order factor or phenomenon - one which arises only because the primary or 'first-order' factors are related to one another. Thus, Thurstone identified 7 'primary mental abilities' which he judged to be more important. These were:

1. Verbal Comprehension: vocabulary, reading, comprehension, verbal analogies, etc.
2. Word fluency: the ability to quickly generate and manipulate a large number of words with specific characteristics, as in anagrams or rhyming tests
3. Number: the ability to quickly and accurately carry out mathematical operations
4. Space: spatial visualizations as well as ability to mentally transform spatial figures
5. Associative Memory: rote memory
6. Perceptual Speed: quickness in perceiving visual details, anomalies, similarities, etc.
7. Reasoning: skill in a variety of inductive, deductive, and arithmetic reasoning tasks

So, Thurstone's approach constituted the first multi-factor approach to intelligence.

Thurstone's tests have largely dropped out of use because the hope that they would be able to more accurately predict academic or occupational performance than general intelligence was not fulfilled.

Nevertheless, the main argument and findings are important: that intelligence is better described and measured by considering distinct primary mental abilities, rather than a single factor g which does not provide specific information about specific intelligences.

(see Flanagan, Genshaft & Harrison, 1997; Murphy & Davidshofer, 1998).

9. Raymond Cattell: Fluid & Crystallised

Intelligence (1960's)

[Raymond Cattell](#) (1963) [not to be confused with [James McKeen Cattell](#), a contemporary of Galton's who was also significantly involved in early attempts at psychological measurement] suggested that there are two related but distinct components of g: fluid and crystallised intelligence.

Fluid: ability to see relationships, as in analogies and letter and number series = primary reasoning ability

Crystallised: acquired knowledge and skills = factual knowledge

Fluid intelligence decreases with age and crystallised intelligence increases with age. Thus mathematicians and scientists, who need fluid intelligence, produce their best work in their 20s and 30s; whereas those in the field of history, philosophy and literature produce their best work in their 40s, 50s and beyond as they have accumulated more knowledge. Interestingly, poets, who depend more on fluid than crystallised intelligence, produce their best work earlier than prose authors: this has been observed in all cultures, languages and throughout history.

10. Guilford: many, many factors! (1960's - present)

[Guilford](#) (1967; 1988) parted company from the majority of factorial theorists by refusing to acknowledge the existence of any general factor at all. Instead, he proposed that intelligence comprises 180 elementary abilities. The 180 elementary abilities are made up of a combination of three dimensions which he calls:

- operations: what a person does (6-types)
- contents: the material on which operations are performed (5-types)
- products: the form in which the information is stored and processes (6-types).

Guilford proposed that each combination of a specific operation, a specific type of content and a specific type of product defines a unique type of intelligence ($6 \times 5 \times 6 = 180$). In later versions of his theory he proposed even more types of intelligence.

Due largely to the practical implications of such a model, Guilford's theory has not significantly influenced psychological testing of intelligence.

11 & 12. Vernon & Carroll: Hierarchical Approaches (1960's - present)

Probably the most widely accepted factorial description of intelligence is a hierarchical one, e.g. [Vernon](#) (1960, 1965, 1971) and [Carroll](#) (1993). Vernon accepted, in a sense, that both Spearman (single g factor) and Thurstone (multiple primary mental abilities) were right.

Vernon suggested that intelligence can be described as comprising abilities at varying levels of generality:

- at the highest level of generality (i.e. top of the hierarchy) is g as defined by

Spearman);

- at the next level are 'major group' factors, such as:
 - verbal-educational ability [the kind of ability needed for successful performance in courses such as English, history, and social studies] and
 - practical-mechanical ability [the kind of ability needed successful performance in courses such as draughtsmanship and car mechanics];
- at the next level are 'minor group' factors, which can be obtained by subdividing the major group factors;
- and at the lowest (the bottom of the hierarchy) are specific factors again of the kind identified by Spearman.

So, Vernon inserted 2 further levels between Spearman's g and specific factors relevant to only one test.

Carroll (1993) proposed the three-stratum model of cognitive ability (similar to Vernon's).

These hierarchical descriptions of intelligence may be viewed as filling in the gaps between the extreme approaches of Spearman and Thurstone.

13. Howard Gardner: Multiple intelligences (1980s to the present)

[Howard Gardner](#) (1983; 1993) supports Thurstone's notion that intelligence comes in different packages. The most widely cited version of Gardner's concept of intelligence is that there are seven different types of intelligence. Gardner has played around with this number and suggested a possible one or two more or even (in 1999) the possibility of a smaller number of intelligences. He argues that the seven intelligences are: verbal, mathematical, musical, spatial, kinaesthetic, interpersonal (social skills) and intrapersonal (self-understanding) functioning. He argues that these different intelligences are independent of one another. Critics argue: not all these things are intelligence: More next week.

14. Robert Sternberg (1970s to present)

[Robert Sternberg](#) (1977, 1985) together with his colleague Richard Wagner (1993, 1995) argues that there are three intelligences:

- Academic
- Practical
- Creative

Sternberg and Wagner have designed a test of *practical intelligence*.

Sternberg's Triarchic Theory of Intelligence



[Overview of Sternberg's Triarchic Theory of Intelligence](#)

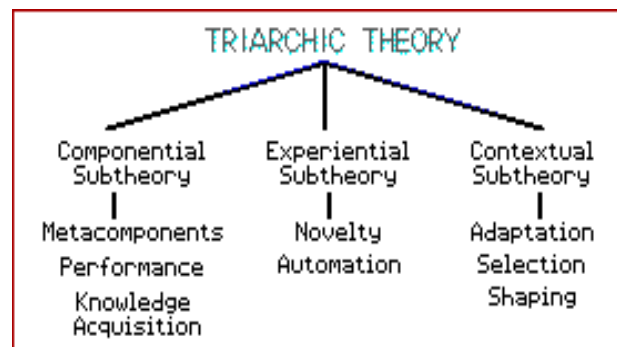
[Analytic \(componential\) Facet or Subtheory](#)

[Creative \(experiential\) Facet or Subtheory](#)

[Practical \(contextual\) Facet or Subtheory](#)

[Sternberg: Why intelligent people fail](#)

Overview of Sternberg's Triarchic Theory of Intelligence



Sternberg's Triarchic Theory of Human Intelligence (1977, 1985, 1995) subsumes both Spearman's g and underlying information processing components. His triarchic theory includes three facets or subtheories:

- Analytical (componential)
- Creative (experiential)
- Practical (contextual)

Sternberg's theory builds on his earlier componential approach to reasoning. His theory is mostly based on observing Yale graduate students. Sternberg believes that if intelligence is properly defined & measured it will translate to real-life success.

Sternberg's Triarchic Theory is an important effort to synthesize the various theories of intelligence.

Analytical (componential) Facet (or Subtheory)

Analytical Intelligence similar to the standard psychometric definition of intelligence e.g. as measured by Academic problem solving: analogies and puzzles, and corresponds to his earlier componential intelligence. Sternberg considers this reflects how an individual relates to his internal world.

Sternberg believes that Analytical Intelligence (Academic problem-solving skills) is based on the joint operations of metacomponents and performance components and knowledge acquisition components of intelligence

Metacomponents: control, monitor and evaluate cognitive processing. These are the *executive* functions to order and organise performance and knowledge

acquisition components. They are the higher-order processes that order and organise the performance components. Used to analyze problems and pick a strategy for solving them. They decide what to do and the performance components actually do it.

Performance Components: execute strategies assembled by the metacomponents. They are the basic operations involved in any cognitive act. They are the cognitive processes that enable us to encode stimuli, hold information in short-term memory, make calculations, perform mental calculations, mentally compare different stimuli, retrieve information from long-term memory.

Knowledge acquisition components: are the processes used in gaining and storing new knowledge - i.e. capacity for learning. The strategies you use to help memorize things exemplify the processes that fall into this category.

Sternberg feels that IDs in intelligence are related to IDs in the use of these cognitive processes. He feels that people with better reasoning ability generally spend more time understanding the problem but reach their solution faster than those who are less skilled at the task.

Creative (experiential) Facet (or Subtheory)

Creative Intelligence: this involves insights, synthesis and the ability to react to novel situations and stimuli. This he considers the Experiential aspect of intelligence and reflects how an individual connects the internal world to external reality.

Sternberg considers the Creative facet to consist of the ability which allows people to think creatively and that which allows people to adjust creatively and effectively to new situations.

Sternberg believes that more intelligent individuals will also move from consciously learning in a novel situation to automating the new learning so that they can attend to other tasks.

Two-Facet Subtheory (Novelty & Automatization)

Basic assumption: That there are two broad classes of abilities associated with intelligence: novelty skills and automatization skills. A task measures intelligence if it requires the ability to deal with novel demands or the ability to automatize information processing (two ends of a continuum).

Novel tasks or situations are good measures of intellectual ability because they assess an individual's ability to apply existing knowledge to new problems.

Practical (contextual) Facet (or Subtheory)

Practical Intelligence: this involves the ability to grasp, understand and deal with everyday tasks. This is the Contextual aspect of intelligence and reflects how the individual relates to the external world about him or her.

Sternberg states that Intelligence is: "Purposive adaptation to, shaping of, and selection of real-world environments relevant to one's life" (Sternberg, 1984,

p.271)

Purposive means that intelligence is directed towards goals, however vague or subconscious they may be. This means that intelligence is indicated by one's attempts to adapt to one's environment.

Practical Intelligence can be said to be intelligence that operates in the real world. People with this type of intelligence can adapt to, or shape their environment. It might also be called ♦Street-smarts♦. In measuring this facet, not only mental skills but attitudes and emotional factors that can influence intelligence are measured.

So this practical intelligence is a combination of:

- (a) adaptation to the environment in order to have goals met
- (b) changing the environment in order to have goals met
- (c) or, if (a) and (b) don't work moving to a new environment in which goals can be met

Sternberg believes that individuals considered intelligent in one culture may be looked on as unintelligent in another.

An important asset of this theory is to avoid defining intelligence in terms of intelligence tests rather than performance in the everyday world (which is, after all, what intelligence tests try to predict!).

Measuring practical intelligence:

- Sternberg Multidimensional Abilities Test measures all 3 intelligences, on separate scales
- Sternberg and Wagner♦s test of Practical Managerial Intelligence measures:
 - ability to write effective memos
 - ability to motivate people
 - knowledge of when to delegate
 - ability to ♦read♦ people

When measuring practical intelligence Sternberg looks at things such as how people decode nonverbal messages e.g. can you tell who are the real couples?

[Individual Differences](#)
[Intelligence](#)

Gardner's Multiple Intelligences

Last updated:



[Overview of Gardner's Multiple Intelligences](#)

[Gardner's Approach to Intelligence](#)

[Gardner's Five Signs of an Intelligence](#)

[Gardner's Seven Intelligences](#)

[Strengths of Gardner's Multiple Intelligence Theory](#)

[Weaknesses of Gardner's Multiple Intelligence Theory](#)

[More about Gardner's Multiple Intelligences...](#)

[References](#)

Overview of Gardner's Multiple Intelligences

Gardner continues in the tradition of Thurstone's proposal that there is no *g* (general intelligence) but rather multiple, distinct intelligences. Gardner proposes seven intelligences (although he does not limit the possible number)

1. Linguistic intelligence
2. Musical intelligence
3. Logical- mathematical intelligence
4. Spatial intelligence
5. Bodily-Kinaesthetic intelligence
6. Interpersonal intelligence
7. Intrapersonal intelligence

Additional 'candidate' intelligences are:

- Naturalistic intelligence (ability to discern patterns in nature - e.g. Darwin)
- Spiritual Intelligence - recognition of the spiritual
- Existential intelligence - concern with 'ultimate issues'

Gardner's approach to intelligence

Howard Gardner (1983, 1993, 1999) believes that we have multiple intelligences, rather than a general intelligence that underlies performance in all tasks (*g*).

In arguing that there are distinct and separate components to intelligence Gardner offers nothing particularly new. However, what is new about Gardner's work is that he does not attempt to support his approach purely through statistical reanalysis of data (e.g. as Thurstone did), but instead he has looked at various "signs" to inform his theory of what constitutes intelligence.

Gardner's multiple intelligence theory is supported by the current anti-*g* Zeitgeist. He also suggests that different cultures highlight certain intelligences & minimize others.

Gardner's Five Signs of an Intelligence

Gardner has examined a variety of sources in order to formulate his theory of intelligence: intelligence tests, cognition experiments, neuropsychological research, child prodigies and idiot savantes.

As a result, Gardner has proposed five "signs" or criteria that he uses to identify whether an intelligence qualifies as being distinct and autonomous from other intelligences:

1. Neuropsychological evidence: isolation by brain damage:

One criterion was whether an intelligence could be isolated neuropsychologically. Gardner argues that people have multiple intelligences because they have multiple neural modules. Each module, he believes, has its own way of operating and its own memory systems. Brain damage may sometimes impair one intellectual skill whilst other skills remain at least partially intact after brain damage. For example, brain-injured musicians may have impaired speech, yet retain the ability to play music (aphasia without amusia (Hodges, 1996; Sergent, 1993).

2. The existence of individuals with exceptional talent:

Selective competence (such as idiot savants, prodigies), like selective deficits, suggests autonomy of that particular competence. In other words, the presence of extraordinary intelligence in one area suggests a distinct form of intelligence. If Mozart could write music before he could even read, then the neural systems involved in musical intelligence must be separate from those involved in language processing.

3. A distinct developmental history:

Another source of evidence for an intelligence is a characteristic developmental trajectory leading from basic and universal manifestations to one or more expert end-states. For example, spoken language develops quickly and to great competence in normal people. In contrast, while all normal individuals can count small quantities, few progress to an understanding of higher mathematics even with formal schooling. (Torff & Gardner, 1999).

4. Experimental evidence:

e.g. individuals performing two different tasks at once indicate that some intelligences (or is it just abilities) operate autonomously.

5. Psychometric support:

e.g. factor analysis shows different factors in intelligence. FA generally supports the existence of two big group factors: verbal and spatial (Torff & Gardner, 1999).

Gardner's Seven Intelligences

Gardner concludes that the cumulative evidence points to seven (or possibly eight) distinct intelligences. The first three are somewhat similar to previous components of intelligence identified by other approaches; whereas the second four/five are more novel. He believes these develop differently in different people due to both heredity and training. He believes that all need to be measured to provide a truly global assessment of intelligence.

1. Linguistic Intelligence: involved in reading, writing, listening and talking
2. Logical-Mathematic Intelligence: involved in solving logical puzzles,

- deriving proofs, performing calculations
3. Spatial Intelligence: involved in moving from one location to another or determining one's orientation in space
 4. Musical Intelligence: involved in playing, composing, singing and conducting. Furthermore, Gardner believes that auto mechanics and cardiologists may have this kind of intelligence in abundance as they make diagnoses on the careful listening to patterns of sounds.
 5. Bodily-Kinaesthetic Intelligence: involved in using one's body (or parts of it) to perform skilful and purposeful movements (dancers, athletes and surgeons)
 6. Intrapersonal Intelligence: involved in understanding oneself and having insight into one's own thoughts, actions and emotions (self-understanding).
 7. Interpersonal functioning: involved in understanding of others and one's relations to others. Being high in social skills (psychologists, teachers and politicians are supposed to be high in this type of intelligence).
 8. The eighth intelligence was proposed by Gardner in 1999 and he calls it Naturalistic Intelligence. This intelligence involves the ability to understand and work effectively in the natural world. This is exemplified by biologists and zoologists.

Strengths of Gardner's Multiple Intelligence Theory

- helps to explain the variety of individual differences in different types of mental performance
- based in developmental, clinical, case study and educational evidence

Criticisms of Gardner's Multiple Intelligence Theory

- narrow intelligences may meet criteria, e.g. 20 to 30 intelligences may also have been convincing
- are these intelligences or just 'abilities'? (and what is the difference?) - musical, bodily-kinaesthetic, intra and interpersonal are a source of some controversy
- doesn't explain why some people are more intelligent than others
- these 'intelligences' are not all essential for successful adaptation (one of the common definitions of intelligence)
- ultimately there is not really much HARD scientific evidence.

References

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic Books.