

# Chapter VIII: Intelligence

## 1. Definition

Intelligence is a concept that can be viewed as tying together all of cognitive psychology. Just what is intelligence, beyond the basic definition? In a recent article, researchers identified approximately 70 different definitions of intelligence. It involves:

1. The capacity to learn from experience, and
2. The ability to adapt to the surrounding environment

## 2. Three Cognitive Models of Intelligence

There have been many models of intelligence. Three models are particularly useful when linking human intelligence to cognition: *the three-stratum model, the theory of multiple intelligences, and the triarchic theory of intelligence.*

### 2.1. Carroll Three-Stratum Model of Intelligence

According to the three-stratum model of intelligence, intelligence comprises a hierarchy of cognitive abilities comprising three strata (Carroll, 1993):

- **Stratum I** includes many narrow, specific abilities (e.g., spelling ability, speed of reasoning).
- **Stratum II** includes various broad abilities (e.g., fluid intelligence (speed and accuracy, crystallized intelligence (abundance of knowledge), short-term memory, long-term storage and retrieval, information processing speed).
- **Stratum III** is just a single general intelligence (sometimes called g).

Of these strata, the most interesting is the middle stratum, which is neither too narrow nor too all-encompassing.

In the middle stratum are fluid ability and crystallized ability. Fluid ability is speed and accuracy of abstract reasoning, especially for novel problems. Crystallized ability is accumulated knowledge and vocabulary (Cattell, 1971). In

addition to fluid intelligence and crystallized intelligence, Carroll includes several other abilities in the middle stratum. They are learning and memory processes, visual perception, auditory perception, facile production of ideas (similar to verbal fluency), and speed (which includes both sheer speed of response and speed of accurate responding). Carroll's model is probably the most widely accepted of the measurement-based models of intelligence.

## **2.2. Gardner: Theory of Multiple Intelligences**

Howard Gardner (2006) has proposed a theory of multiple intelligences, in which intelligence comprises multiple independent constructs, not just a single, unitary construct. However, instead of speaking of multiple abilities that together constitute intelligence (e.g., Thurstone, 1938), this theory distinguishes eight distinct intelligences that are relatively independent of each other (Table 1.1).

Each is a separate system of functioning, although these systems can interact to produce what we see as intelligent performance. Looking at Gardner's list of intelligences.

**Table 1.1** Gardner’s Eight Intelligences

On which of Howard Gardner’s eight intelligences do you show the greatest ability? In what contexts can you use your intelligences most effectively? (After Gardner, 1999.)

Type of Intelligence	Tasks Reflecting This Type of Intelligence
Linguistic intelligence	Used in reading a book; writing a paper, a novel, or a poem; and understanding spoken words
Logical-mathematical intelligence	Used in solving math problems, in balancing a check-book, in solving a mathematical proof, and in logical reasoning
Spatial intelligence	Used in getting from one place to another, in reading a map, and in packing suitcases in the trunk of a car so that they all fit into a compact space
Musical intelligence	Used in singing a song, composing a sonata, playing a trumpet, or even appreciating the structure of a piece of music
Bodily-kinesthetic intelligence	Used in dancing, playing basketball, running a mile, or throwing a javelin
Interpersonal intelligence	Used in relating to other people, such as when we try to understand another person’s behavior, motives, or emotions
Intrapersonal intelligence	Used in understanding ourselves—the basis for understanding who we are, what makes us tick, and how we can change ourselves, given our existing constraints on our abilities and our interests
Naturalist intelligence	Used in understanding patterns in nature

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### 2.3. Sternberg: The Triarchic Theory of Intelligence

Whereas Gardner emphasizes the separateness of the various aspects of intelligence, Robert Sternberg tends to emphasize the extent to which they work together in his triarchic theory of human intelligence (Sternberg, 1999). According to the triarchic theory of human intelligence, intelligence comprises three aspects: creative, analytical, and practical.

- **Creative abilities** are used to generate novel ideas.
- **Analytical abilities** ascertain whether your ideas (and those of others) are good ones.

- **Practical abilities** are used to implement the ideas and persuade others of their value.

According to the theory, cognition is at the center of intelligence. Information processing in cognition can be viewed in terms of three different kinds of components.

- ♣ **First** are metacomponents—higher-order executive processes (i.e., metacognition) used to plan, monitor, and evaluate problem solving.
- ♣ **Second** are performance components—lower-order processes used for implementing the commands of the metacomponents. And
- ♣ **Third** are knowledge-acquisition components—the processes used for learning how to solve the problems in the first place. The components are highly interdependent.

Suppose that you were asked to write a term paper. You would use metacomponents for higher-order decisions. Thus, you would use them to decide on a topic, plan the paper, monitor the writing, and evaluate how well your finished product succeeds in accomplishing your goals for it. You would use knowledge-acquisition components for research to learn about the topic. You would use performance components for the actual writing.

### **3. Intelligence and Neuroscience**

The human brain is clearly the organ that serves as a biological basis for human intelligence.

#### **3.1. Intelligence and Brain Size**

The evidence suggests that, for humans, there is a modest but significant statistical relationship between brain size and intelligence (Gignac, Vernon, & Wickett, 2003). The amount of gray matter in the brain is strongly correlated with IQ in many areas of the frontal and temporal lobes (Haier, Jung, Yeo, Head, & Alkire, 2004). However, the brain areas that are correlated with IQ appear to differ in men versus women. Frontal areas are of relatively more importance in women, whereas posterior areas are of relatively more importance in men, even if both genders are matched for intelligence (Haier, Jung, Yeo, Head, & Alkire, 2005).

### 3.2. Intelligence and Neurons

The development of electrical recording and imaging techniques offers some appealing possibilities. For example, complex patterns of electrical activity in the brain, which are prompted by specific stimuli, appear to correlate with scores on IQ tests (Barrett & Eysenck, 1992). Surprisingly, neural conduction velocity appears to be a more powerful predictor of IQ scores for men than for women. So gender differences may also account for some of the differences in the data (Wickett & Vernon, 1994).

### 3.3. The P-FIT Theory of Intelligence

The discovered importance of the frontal and parietal regions in intelligence tasks has led to the development of an integrated theory of intelligence that highlights the importance of these areas. This theory, called **the parietal-frontal integration theory (P-FIT)**, stresses the importance of interconnected brain regions in determining differences in intelligence. The regions this theory focuses on are the prefrontal cortex, the inferior and superior parietal lobe, the anterior cingulate cortex, and portions of the temporal and occipital lobes (Colom et al., 2009). **P-FIT theory** describes patterns of brain activity in people with different levels of intelligence; it cannot, however, explain what makes a person intelligent or what intelligence is.