

Intelligence Theory and Brain Properties

General intelligence was the idea that dominated most of the intelligence theories. Psychometrics experts believe in the existence of a *general intelligence factor*, “*G factor*”, that relates to abstract thinking and that includes the abilities to acquire knowledge, to reason abstractly, to adapt to novel situations, and to benefit from instruction and experience. People with higher general intelligence factor learn faster.

Conversely, the **theory of multiple intelligences** differentiates intelligence into specific modalities, rather than seeing intelligence as dominated by a single general ability. Gardner proposed this model in his 1983 book *Frames of Mind: The Theory of Multiple Intelligences*. Nowadays, human and animal intelligence is considered as the biopsychological potential to process information that can be activated to solve problems and interact with the environment. Gardner proposed eight intelligence modalities – table 1.

Sternberg’s **tri-archic theory of intelligence** also attempts to understand the human intelligence in terms of distinct components rather than a single ability. Sternberg also argued that intelligent tests were wrong to ignore creativity. The tri-archic theory categorizes intelligence into three different aspects (analytical, creative, and practical), with key functions to each of them – table 2.

Sternberg argued that traditional intelligence tests assess analytical intelligence, the ability to answer problems with a single right answer, but that they do not well assess creativity (the ability to adapt to new situations and create new ideas) or practicality (experiential or contextual intelligence that cannot be gained from books or formal learning). Furthermore, science has shown that the brain areas that are associated with *convergent or analytical thinking*, thinking that is directed toward finding the correct answer to a given problem, are different from those associated with *divergent or creative thinking* which could be considered as the ability to generate many different ideas or solutions to a single problem.

Many attempts have been made to correlate degrees of both animal and human intelligence with brain properties. With respect to mammals, a much-discussed trait concerns absolute and relative brain size. However, the correlation of both with degrees of intelligence yields large inconsistencies, because although they are regarded as the most intelligent mammals, monkeys and apes, including humans, have neither the absolutely nor the relatively largest brains. The best fit between brain properties and degrees of intelligence among mammals is reached by a combination of the number of cortical neurons, neuron packing density, interneuronal distance and axonal conduction velocity – factors that determine general **information processing capacity (IPC)**, as reflected by general intelligence.

The highest IPC is found in humans, followed by the great apes and monkeys. The IPC of cetaceans and elephants is much lower because of a thin cortex, low neuron packing density and low axonal conduction velocity. By contrast, corvid and psittacine birds have very small and densely packed neurons which, despite their small brain volumes, might explain their high intelligence. It was traditionally believed that if the brain is what generates conscious cognition, having more brain should only mean more cognitive abilities. However, equating larger brain size with greater cognitive capabilities presupposes that all brains are made the same way, starting with a similar relationship between brain size and number of neurons.

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Table 1: Gardner’s eight intelligence modalities.

Intelligence	Description
Linguistic	The ability to speak and write well
Logico-mathematical	The ability to use logic and mathematical skills to solve problems
Spatial	The ability to think and reason about objects in three dimensions
Musical	The ability to perform and enjoy music
Kinesthetic (body)	The ability to move the body in sports, dance, or other physical activities
Interpersonal	The ability to understand and interact effectively with others
Intrapersonal	The ability to have insight into the self
Naturalistic	The ability to recognize, identify, and understand animals, plants, and other living things

Table 2: Key functions in Sternberg’s aspects of intelligence.

Modalities	Componential / Analytical	Experiential / Creative	Practical / Contextual
Functions	Analyze	Create / Invent / Discover	Apply
	Observe	Imitate	Use
	Judge	Adapt	Put into practice
	Compare / Contrast	Imagine / Suppose	Employ / Implement
	Evaluate / Assess	Expect / Predict	Try

Section I / Understanding and Learning:

1- Find in the text words that correspond to each of the following definitions:

- a) A concept developed in psychometric investigations of cognitive abilities and intelligence . (1§)
- b) A particular mode in which something exists or is experienced or expressed. (2§)
- c) A supposition or a system of ideas intended to explain something. (2§)
- d) A specialized cell transmitting nerve impulses. (5§)
- e) The speed of something in a given direction. (5§)
- f) The outer layer of the cerebrum. (6§)

2- Are these statements: true, false, or not mentioned? Justify your answer.

- a) Cognitive intelligence theories attempt to understand the human intelligence in terms of a single ability.
- b) According to cognitive scientists, creativity should be omitted when measuring intelligence.
- c) Practical intelligence is the type of intelligence that is developed from life experiences.
- d) The correlation of both absolute and relative brain size with degrees of intelligence has revealed that intelligence is directly impacted by the size of the brain.
- e) Some of the factors that determine our general intelligence are the number of cortical neurons, neuronal density, and axonal conduction velocity.
- f) Equating larger brain size with greater cognitive capabilities contradicts modern scientific discoveries.

Section II / Researching, Thinking and Speaking:

1- Answer the following questions.

- a) What are the main differences between analytical, creative, and contextual aspects of intelligence?
- b) What are the brain properties mentioned in the text?
- c) How do observing and analyzing differ from creating and imitating (analytical vs. creative)?
- d) Are there any other ways to measure intelligence?

2- Read and understand the following text. Are you for or against anatomy-based scientific research?

Keywords: Ethics – Medical ethics – Anatomy – Dissection – Technology - Medical imaging

“ For years, Russian scientists harvested the brains of exceptionally smart people, trying to locate the source of their intelligence. After Lenin died in 1924, for example, the Russians invited the German neuro-anatomist O. Vogt to try to locate the source of genius in the leader of the Russian revolution. Einstein’s brain was also studied in the same way by teams of neurologists and anatomists.

Today, scientists around the world continue to search for the physiological basis of human intelligence, but they also focus on genetic variation, which appears to determine about half of a brain’s cognitive ability on average. And by using modern scanning techniques, they are gaining much more detailed insights into the structure and function of the brain than the Russians could achieve through dissection.

The emerging consensus is that intelligence depends not just of the efficiency or power of various brain regions, but also on the strength of the connections that link them. The early attempts to find the physiological basis of intelligence were limited by a lack of modern technology. With the advent of modern medical imaging, it became possible to look for more subtle differences that might not be found with gross anatomy. ”

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