Intelligence

For other uses, see Intelligence (disambiguation).

Intelligence has been defined in many different ways including as one's capacity for logic, understanding, self-awareness, learning, emotional knowledge, planning, creativity and problem solving. It can be more generally described as the ability to perceive information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context.

Intelligence is most widely studied in humans, but has also been observed in non-human animals and in plants. Artificial intelligence is intelligence in machines. It is commonly implemented in computer systems using program software.

Within the discipline of psychology, various approaches to human intelligence have been adopted. The psychometric approach is especially familiar to the general public, as well as being the most researched and by far the most widely used in practical settings.[1]

1 History of the term

Main article: Nous

Intelligence derives from the Latin verb ability to think *intelligere*, to comprehend or perceive. A form of this verb, *intellectus*, became the medieval technical term for understanding, and a translation for the Greek philosophical term *nous*. This term was however strongly linked to the metaphysical and cosmological theories of teleological scholasticism, including theories of the immortality of the soul, and the concept of the Active Intellect (also known as the Active Intelligence). This entire approach to the study of nature was strongly rejected by the early modern philosophers such as Francis Bacon, Thomas Hobbes, John Locke, and David Hume, all of whom preferred the word "understanding" in their English philosophical works.[2][3] Hobbes for example, in his Latin *De Corpore*, used "*intellectus intelligit*" (translated in the English version as "the understanding understandeth") as a typical example of a logical absurdity.[4] The term "intelligence" has therefore become less common in English language philosophy, but it has later been taken up (with the scholastic theories which it now implies) in more contemporary psychology.[5]

2 Definitions

The definition of intelligence is controversial.[6] Some groups of psychologists have suggested the following definitions:

From "Mainstream Science on Intelligence" (1994), an op-ed statement in the Wall Street Journal signed by fifty-two researchers (out of 131 total invited to sign).[7]

> A very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings—"catching on," "making sense" of things, or "figuring out" what to do.[8]

From "Intelligence: Knowns and Unknowns" (1995), a report published by the Board of Scientific Affairs of the American Psychological Association:

> Individuals differ from one another in their ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by taking thought. Although these individual differences can be substantial, they are never entirely consistent: a given person's intellectual performance will vary on different occasions, in different domains, as judged by different criteria. Concepts of "intelligence" are attempts to clarify and organize this complex set of phenomena. Although considerable clarity has been achieved in some areas, no such conceptualization has yet answered all the important questions, and none commands universal assent. Indeed, when two dozen prominent theorists were recently asked to define intelligence, they gave two dozen, somewhat different, definitions.[9]

Besides those definitions, psychology and learning researchers also have suggested definitions of intelligence such as:

3 Human intelligence

Main article: Human intelligence

Human intelligence is the intellectual prowess of humans, which is marked by high level cognition, motivation, and self-awareness.[21] . Intelligence enables humans to remember descriptions of things and use those descriptions in future behaviors. It is a cognitive process. It gives humans the cognitive abilities to learn, form concepts, understand, and reason, including the capacities to recognize patterns, comprehend ideas, plan, problem solve, and use language to communicate. Intelligence enables humans to experience and think.

Note that much of the above definition applies also to the intelligence of non-human animals.

4 In animals

Main article: Animal cognition

Although humans have been the primary focus of intelligence researchers, scientists have also attempted to investigate animal intelligence, or more broadly, animal cognition. These researchers are interested in studying both mental ability in a particular species, and comparing abilities between species. They study various measures of problem solving, as well as numerical and verbal reasoning abilities. Some challenges in this area are defining intelligence so that it has the same meaning across species (e.g. comparing intelligence between literate humans and illiterate animals), and also operationalizing a measure that accurately compares mental ability across different species and contexts.

The common chimpanzee can use tools. This chimpanzee is using a stick to get food.

Wolfgang Köhler's research on the intelligence of apes is an example of research in this area. Stanley Coren's book, *The Intelligence of Dogs* is a notable book on the topic of dog intelligence.[22] (See also: Dog intelligence.)

Non-human animals particularly noted and studied for their intelligence include chimpanzees, bonobos (notably the language-using Kanzi) and other great apes, dolphins, elephants and to some extent parrots, rats and ravens.

Cephalopod intelligence also provides important comparative study. Cephalopods appear to exhibit characteristics of significant intelligence, yet their nervous systems differ radically from those of backboned animals. Vertebrates such as mammals, birds, reptiles and fish have shown a fairly high degree of intellect that varies according to each species. The same is true with arthropods.

4.1 *g* factor in non-humans

Main article: g Factor in Non-Humans

Evidence of a general factor of intelligence has been observed in non-human animals. The general factor of intelligence, or *g* factor, is a psychometric construct that summarizes the correlations observed between an individual's scores on a wide range of cognitive abilities. First described in humans, the g factor has since been identified in a number of non-human species.[23]

Cognitive ability and intelligence cannot be measured using the same, largely verbally dependent, scales developed for humans. Instead, intelligence is measured using a variety of interactive and observational tools focusing on innovation, habit reversal, social learning, and responses to novelty. Studies have shown that *g* is responsible for 47% of the individual variance in cognitive ability measures in primates[23] and between 55% and 60% of the variance in mice (Locurto, Locurto). These values are similar to the accepted variance in IQ explained by *g* in humans (40-50%).[24]

5 In plants

Main article: Plant intelligence

It has been argued that plants should also be classified as intelligent based on their ability to sense and model external and internal environments and adjust their morphology, physiology and phenotype accordingly to ensure self-preservation and reproduction.[25][26]

A counter argument is that intelligence is commonly understood to involve the creation and use of persistent memories as opposed to computation that does not involve learning. If this is accepted as definitive of intelligence, then it includes the artificial intelligence of robots capable of "machine learning", but excludes those purely autonomic sense-reaction responses that can be observed in many plants. Plants are not limited to automated sensory-motor responses, however, they are capable of discriminating positive and negative experiences

and of 'learning' (registering memories) from their past experiences. They are also capable of communication, accurately computing their circumstances, using sophisticated cost–benefit analysis and taking tightly controlled actions to mitigate and control the diverse environmental stressors.[27][28][29]

6 Artificial intelligence

Main article: Artificial intelligence

Artificial intelligence (or AI) is both the intelligence of machines and the branch of computer science which aims to create it, through "the study and design of intelligent agents"[30] or "rational agents", where an intelligent agent is a system that perceives its environment and takes actions which maximize its chances of success.[31] Achievements in artificial intelligence include constrained and well-defined problems such as games, crossword-solving and optical character recognition and a few more general problems such as autonomous cars.[32] General intelligence or strong AI has not yet been achieved and is a long-term goal of AI research.

Among the traits that researchers hope machines will exhibit are reasoning, knowledge, planning, learning, communication, perception, and the ability to move and to manipulate objects.[30][31] In the field of artificial intelligence there is no consensus on how closely the brain should be simulated.

A theory of hierarchical learning mechanisms, named practopoiesis, may be able to provide a conceptual bridge between biological and artificial intelligence.

7 Culture's influence on intelligence

Intelligence and *culture* are very distinct terms. Intelligence can be defined as a person's cognitive abilities to learn. It is also associated with school performance, IQ, logic, abstract thought, self-awareness, emotional knowledge, memory, planning, creativity, and problem solving. Culture can be defined as a way of life that influences our views, experiences, and engagement with our lives and the world around us. It is shaped by the political, social, and environmental contexts in which we live. Together these form part of the sociocultural theory, coined by Lev Vygotsky. The sociocultural theory investigates "how social factors influence cognition and development, and how social and cultural practices shape and define thought" (Siegler & Abibali, p. 108). More specifically, culture shapes intelligence.

Intelligence and culture is most widely studied in humans. There are not any known studies that exam the culture and intelligence of non-human or plant life in the same way. These are psychological terms that are most easily identified in humans.

The sociocultural theory closely relates to intelligence and culture. Lev Vygotsky was the first researcher to define the sociocultural theory. The theory proposes that children learn a larger part of their cognitive abilities from social interactions with adults or older children and people. He distinctly defines this as the Zone of Proximal Development. Older people provide scaffolding, or tools that help children improve their cognitive abilities. Successful intelligence incorporates the socio-cultural environment and people's ability to be successful in the environment and in their personal standards (Steinberg & Grigorenko, 2004). Different cultures value different things and have different experiences. This will greatly influence what they need to succeed in their world.

Sternberg (2004) discusses a study where they tested children in a village in Kenya on their knowledge of natural herbal medicine. Many in this area of Kenya do not have Westernized schooling or strive for a Westernized education. Therefore, Sternberg (2004) found that they had great knowledge of their herbal medicines, but they scored lower on vocabulary tests. They also discuss how Western children may have knowledge of the herbal medicines, but it would not be as extensive as the Kenyan children's knowledge (Sternberg et al., 2001). This demonstrates different forms of intelligence in different contexts. One is not better than the other, and the type of knowledge that these children have is beneficial for their environment. Intelligence is moldable by culture.

When we combine intelligence and the sociocultural influence, we see that culture has a significant impact on cognitive development and thus school and learning. Siegler and Alibali (2005) gave examples of this from other studies where they found that children of different cultures spend their time participating in different activities. For example, the Korean and American children spent less of their time in formal and informal lessons and work than those in Russia and Estonia (Tudge et al., 1999). In addition, the book continues to discuss cultural norms influence child development and their abilities to perform certain tasks. This can also apply to intelligence in a school and learning context if culture is truly influential. Stevenson and colleagues' (1986) study supports this assumption. They examined Japanese, Taiwanese, and American mothers' different values and beliefs about their children's education. The children took reading and mathematical tests, and the United States children performed worse than the Taiwanese and Japanese children. Researchers found that the mothers' attitudes about school influenced achievement. For example, the Asian mothers were more likely to help them with their homework. Therefore, definitions and the value of intelligence can be different across cultures. Several other studies explore and define the relation between intelligence and

culture. The first study by Greenfield and Quiroz (2013) explored the differences between Latino immigrant parents and European American parents. More specifically, they examined how the different culture valued personal achievement for their children. Their research found that Latino families had more familistic values, family before outsiders, whereas European Americans had more individualistic values. The interviews consisted of conflict scenarios about family reactions school performance and the importance of family. There were 74% of Latino parents that believed the child should be able to leave school to care for his brother at home and only 31% of European American parents believed this. These results imply that there are differences in values of family life and culture that influence children's view on education and thus intelligence.

The second study conducted by Brooks-Gunn and colleagues (1996) looked at IQ score difference among black and white children and their home environment, birth weight, and financial situation. The main point was that maternal education influences this difference. People in poverty are less likely to have a degree from higher education. The children will only learn from their environment and interactions with people in their neighborhood and family members. This creates a cultural difference in the value of intelligence and education. Brooks-Gunn and colleagues (1996) pointed out that the learning experience in the home of the black children was very different or was not as valued as the experience in white children's homes.

The Jose and Bellamy (2011) article examined students in the US, New Zealand, China, and Japan and the different ways that parents influenced their children's persistence. The results indicated that US parents valued incremental theory of intelligence the most, Chinese parents encouraged their kids the most and were most persistent, and New Zealand parents had more significant levels of frustration. The more parents supported incremental learning the more the children were persistent on the task. The main claim that the researchers made was that Asian parents motivate their children to learn in a different way than Western parents do. This study was not so much about levels of intelligence than the way that culture shapes learning and intelligence. It, evidently, varies across cultures. Lastly, Wentzel (1998) conducted a study also assessing how parents shape children's ways of learning and motivation to learn. Parents and culture had an influence on children's value of intelligence and learning and motivation. The main idea was that parents set their expectations for their children through their confidence in them, the nature of children's intelligence, and achievement-related values.

Researchers can not particularly assign intelligence to one culture over another. Additionally, the studies imply that socio-culture plays one of the biggest roles in school achievement, educational motivation, learning abilities, and thus intelligence. That is, these children value what their parents, community, or culture values. This also shapes the way that they learn, the way that they approach problems, and how they value learning and certain educational skills. The main findings are that the way children learn, and thus their intelligence, is shaped by their culture and environment.

8 See also

- Active intellect
- Intelligence (journal)
- Intelligence Quotient
- Knowledge
- Neuroscience and intelligence
- Noogenesis
- Outline of human intelligence
- Passive intellect
- Self-test of Intelligence
- Theory of multiple intelligences

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11 Further reading

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12 External links

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- Intelligence on *In Our Time* at the BBC. (listen now)
- APA Task Force Examines the Knowns and Unknowns of Intelligence - *American Psychologist*, February 1996
- The cognitive-psychology approach vs. psychometric approach to intelligence - *American Scientist* magazine
- History of Influences in the Development of Intelligence Theory and Testing - Developed by Jonathan Plucker at Indiana University
- The Limits of Intelligence: The laws of physics may well prevent the human brain from evolving into an ever more powerful thinking machine by Douglas Fox in *Scientific American*, June 14, 2011.
- A Collection of Definitions of Intelligence

Scholarly journals and societies

- *Intelligence* (journal homepage)
- International Society for Intelligence Research (homepage)

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13.1 Text

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