

2 INTELLIGENCE

2.1 General characteristics

Whenever one asks academics to define intelligence or to state what it actually is, almost each one of them provides a different definition. Very often, though, one can come across the following ones (adapted from *What is Intelligence*, 2003):

- “the capacity to carry out abstract thinking” (Terman, 1921);
- “the capacity for knowledge, and knowledge possessed” (Henmon, 1921);
- “the capacity to learn or profit by experience” (Dearborn, 1921);
- “the capacity to acquire capacity” (Woodrow, 1921);
- “what is measured by intelligence tests” (Boring, 1923);
- “a global concept that involves an individual’s ability to act purposefully, think rationally, and deal effectively with the environment” (Wechsler, 1958);
- “a general factor that runs through all types of performance (Jensen);
- “adaptation to the environment” (unknown);
- “purposive adaptation to, shaping of, and selection of real-world environments relevant to one’s life” (Sternberg, 1984:271);
- “that faculty of mind by which order is perceived in a situation previously considered disorder” (R.W. Young, cited in Kurzweil, 1999);
- “the ability to use optimally limited resources – including time – to achieve goals” (Kurzweil, 1999);
- “Intelligent activity consists of grasping the essentials in a given situation and responding appropriately to them” (unknown).

According to Microsoft Encarta Encyclopaedia Deluxe (2004), *intelligence* is a “term usually referring to a general mental capability to reason, solve problems, think abstractly, learn and understand new material, and profit from past experience. It draws on a variety of mental processes, including memory, learning, perception, decision-making, thinking, and reasoning.” Mackintosh (1998:200), claims that “intelligence is not just the sum of what people have been taught, but also reflects how efficiently they learn from their experience. And many of the environmental factors that affect IQ, such as health, nutrition, schooling, parental interaction, are sorts of factors we should expect to influence a growing child’s cognitive or intellectual development.” The Oxford learner’s dictionary (2000) gives

the following definition: “Intelligence: the ability to learn, understand and think in a logical way about things; the ability to do this well.”

All the above mentioned definitions (especially when put together) express what the term can embrace. The following statement stands for my personalised definition of the term:

Intelligence is the faculty of mind enabling one to promptly acquire knowledge and skills and make efficient use of them when necessary.

2.1.1 PSYCHOLOGICAL PROCESSES

Psychological process is an elementary part of relatively independent psychological activity of an individual. Together with psychological characteristics and states (phenomena), they form the psychological structure of an individual in the context of inner and outer world reflection. Psychological processes represent inner activities based in the central neural system and, functionally, indivisible from objective reality. Psychological processes have their contents, stages and outcomes. These depend on the level of one’s predispositions, social factors and other stimuli (adapted from Microsoft Encarta Encyclopaedia Deluxe, 2004).

A special group of psychological processes aimed at acquiring knowledge is called **cognitive processes**. As they are an important part in the research carried out in this treatise, a more detailed overview is provided in the following sub-chapter.

2.1.2 COGNITIVE PROCESSES

“Cognitive psychology postulates a variety of different processes or operations involved in the performance of cognitive tasks, [...] including **sensory analysis, transformation of input, formation of representations, memory (iconic, working, etc.)** and so on” (Mackintosh, 1998:227).

Spearman believed that there is a set of intellectual operations involved in inductive or deductive reasoning and problem solving (after Mackintosh, 1998). Spearman (1927) argued that specific factors are vital characteristics of cognition, the particular processes needed for solution of a particular type of problem, while the general factor was the mental energy that powered these specific engines.

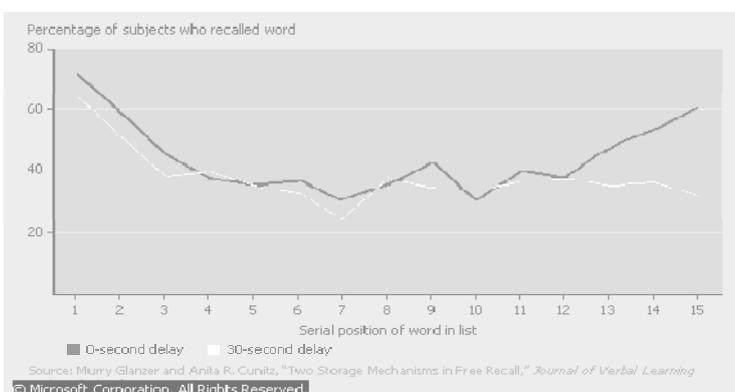
According to Anderson (1992), a cognitive architecture of human intelligence consists of a basic processing mechanism supplemented by a number of specific processors and modules. He adds that variations in the speed and efficiency of this processing mechanism are responsible for variations in *g* or general intelligence, because they set limits to the performance of the specific processors operating on particular types of information (including verbal).

Cognitive processes and **mental functions** are often used interchangeably covering those processes (functions) which we perform with our minds:

- 1 **Perception** – the process of acquiring, interpreting, selecting and organising *sensory information*¹⁰;
- 2 **Introspection** – contemplation on one's self; reviewing one's own thoughts;
- 3 **Memory** – an ability to store, retain, and recall information
 - a *Sensory memory* – corresponds approximately to the initial 200 - 500 ms (milliseconds) after an item is perceived. (Some of the information in sensory memory is then transferred to short-term memory.)
 - b *Short-term memory* – allows one to recall something from several seconds to as long as a minute without rehearsal. Its capacity is 7 ± 2 items;
 - c *Working memory* – a term used to refer to a broader system that both stores information briefly and allows manipulation and use of the stored information.

21

Figure 1: *Working memory*



(after Microsoft Encarta Encyclopaedia Deluxe, 2004)

- d *Long-term memory* – can store much larger quantities of information for potentially unlimited duration (sometimes a whole lifespan);
- 4 **Creativity** (or **creativity**) – a mental process involving generation of new ideas or concepts, or new associations between existing ideas or concepts;
- 5 **Imagination** – the innate ability to invent partial or complete personal dimensions within the mind from elements derived from sense perceptions of the shared world. Imagined images are seen with the *mind's eye*;
- 6 **Conception** – the ability to understand how ideas are formed in the mind; the power of recalling a past sensation or perception; the ability to form mental abstractions;
- 7 **Belief** – the psychological state of being convinced of the truth of a proposition;
- 8 **Reasoning**
 - a the mental process which provides the imagination, perceptions, thoughts, and feelings with the relative level of comprehension needed;
 - b the act of using reason to reach a conclusion from certain given information, via relevant processes.
- 9 **Generalisation** – the process of general concepts formulation from specific instances by abstracting common properties;
- 10 **Analogy** – the use of a similar example or model to explain or extrapolate from;
- 11 **Association** – the process of connecting one thing with another;
- 12 **Volition** – the process governing one's will, choice and decision;
- 13 **Emotion** – an intense mental state arising in the nervous system rather than through conscious effort, and evokes either a positive or negative psychological response.

(after Microsoft Encarta Encyclopaedia 2004)

According to some sources (Microsoft Encarta Encyclopaedia 2004), intelligence is also considered a mental process, although in my opinion, it is rather a group of

interconnected processes rather than an isolated one and it includes those processes mentioned above.

Psychologists, for various reasons, have tried to measure intelligence and psychological processes occurring in the human mind. They have tried to define what they considered intelligence to be and which are the most important processes involved.

What follows is a brief history of what techniques have been applied to find out how developed these processes are in individual people or specific groups.

2.2 History of intelligence testing

“There are a number of different methods which purport to measure intelligence, the most famous of which is perhaps the IQ, or ‘Intelligence Quotient’ test” (Intelligence, 2002: 2). Because of IQ’s supposed ability to objectively measure ‘intelligence’, IQ tests have been used by a variety of people and institutions over the years. Presented below is a brief overview of how psychologists have tested intelligence and how their methods and strategies have changed over time.

- **Francis Galton** is considered the ‘father’ of the study of individual differences. In the late 1800s, he suggested reaction time as a feasible approach and pursued various sensor-motor measurements. He also tried to find correlations between head-size and reaction time of the tested individuals.
- **Alfred Binet** is celebrated in history as the man who created the first ‘intelligence test’ in the form we know them today. He is commonly known as the ‘father of IQ testing’. In 1904, he 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. In 1905 he produced the ***Binet-Simon scale*** (with Theodore Simon) – the first intelligence test comprising 30 short tasks related to everyday problems of life. The tests were arranged in order of increasing difficulty; each level matching a specific developmental level. The 1911 revision was the model for many future tests. “The test results proved to correlate with other criteria (e.g. results of school examinations, assessments of teachers, etc.)” (14 Key Players in the History and Development of Intelligence and Testing, 2003: 2).

- **Lewis Terman** decided to use Binet's test in the US and found out that the Paris-developed age norms did not work well for Californian school children. So he revised the test by adapting some items, adding other ones and establishing new age norms. This became the **Stanford-Binet revision** (1916), in which the Intelligence Quotient (IQ) first appeared. To determine IQ, he used the following formula developed in Germany by **Wilhelm Stern**:

$$IQ = \frac{\text{Mental Age} \times 100}{\text{Chronological Age}}$$

- When the US entered WWI in 1917, a committee was appointed to consider ways that psychology might assist the war effort by assessing the intelligence of recruits in order to screen, classify, and assign them to suitable tasks. **Robert Yerkes**, a psychologist and army major, was appointed the head of the committee with a brief to develop group intelligence testing. This resulted in the **Army Alpha** and **Army Beta tests**. (The Beta being a version of the Alpha specially for use with non-English-speaking and illiterate persons.) The tests did a great deal to enhance the status of psychology.
- **Charles Spearman** analysed the relationship 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)" (14 Key Players in the History and Development of Intelligence and Testing, 2003:3).

In the 1920s, he proposed a '**two-factor theory of intelligence**':

- **General Ability (g)**: required for performance on mental tests of all kinds, (he called this a kind of 'mental energy' that underlies the specific factors)
- **Specific Abilities (s)** : required for performance in just one kind of mental test

Spearman's idea of a general intellectual capacity formed "a major theoretical platform for many subsequent approaches to intelligence" (14 Key Players in the History and Development of Intelligence and Testing, 2003:3).

David Wechsler designed an instrument with subtests to measure both verbal and nonverbal abilities. In 1949, he produced the **Wechsler Intelligence Scale for Children (WISC)** and in 1955 he revised the latter version to be used with adults and named it the **Wechsler Adult Intelligence Scale (WAIS)**. Later on, he produced a scale which could be used with pre-primary children.

- **Louis Thurstone** was a 'factor analyst' who accepted Spearman's hypothesis of a general factor. He argued that 'g' is a second order factor or phenomenon and that it arises only because the primary or 'first-order' factors are related to one another. He identified 7 **primary mental abilities** (adapted from 14 Key Players in the History and Development of Intelligence and Testing, 2003).

- 1 *Verbal comprehension* (vocabulary, reading, verbal analogies, etc.)
- 2 *Word fluency* (the ability to quickly generate and manipulate a large number of words with specific characteristics)
- 3 *Number* (mathematical operations)
- 4 *Space* (spatial visualization, the ability to mentally transform spatial figures)
- 5 *Associative memory* (rote memory)
- 6 *Perceptual speed* (perceiving visual details, anomalies, similarities)
- 7 *Reasoning* (inductive, deductive and arithmetic reasoning tasks)

Thurstone was the first to present a **multi-factor approach** to intelligence.

- **Raymond Cattell** (in the 1960s) suggested there are two related but distinct components of 'g':

- 1 *Fluid intelligence*: ability to see relationships = primary reasoning ability
- 2 *Crystallised intelligence*: acquired knowledge and skills = factual knowledge

Fluid intelligence decreases with age and crystallised intelligence increases with age.

- **J. P. Guilford** (1960s – present) refused to acknowledge the existence of any general factor at all. He proposed that intelligence comprises 180 elementary abilities that are made up of a combination of the three following dimensions:

- 1 *Operations*: what a person does (6 types);
- 2 *Contents*: the material on which operations are performed (5 types);
- 3 *Products*: the forms in which the information is stored and processed (6 types).

6 x 5 x 6 = 180

In later versions of his theory he proposed even more types of intelligence.

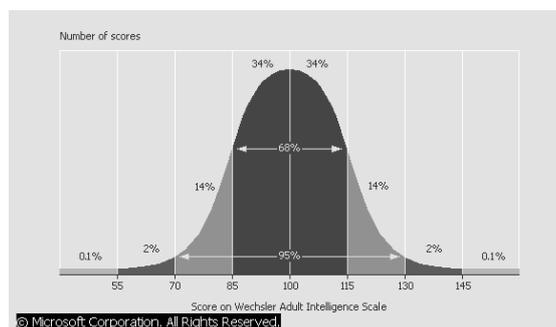
- **Vernon** (1960s – present) suggested that intelligence can be described as comprising abilities at varying levels of generality:
 - 1 'g' as defined by Spearman (the highest level of generality)
 - 2 *major group factors*:
 - a verbal-educational ability (needed in English, history, social studies),
 - b practical-mechanical ability (needed in draughtsmanship and car mechanics);
 - 3 *minor group factors* (obtained by subdividing the major group factors),
 - 4 *specific factors* of the kind identified by Spearman (the bottom of the hierarchy).

- **Arthur Jensen** is another theorist who supports Spearman's 'g' factor, which he considers a 'source' of individual differences in scores, which is common to a number of different tests. He believed that 'g' cannot be excluded regardless of the number of other factors.

- **Howard Gardner** (1980s to present), similarly to Thurstone, presented a model of seven different types 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 possess this kind of intelligence as they make diagnoses based on 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 (adapted from Gardner's Multiple Intelligence, 2003).
- **Robert Sternberg** (1970s – present) is a psychologist of great influence throughout the field. According to his *triarchic* (three-part) **theory of intelligence**, intelligence consists of the three following aspects:
 - 1 *Analytic intelligence* most closely resembles the traditional conception of general intelligence. It is skill in reasoning, processing information and solving problems and it involves the ability to analyse, evaluate, judge, and compare. Analytic intelligence draws on basic cognitive processes or components.
 - 2 *Creative intelligence* is skill in using past experiences to achieve insight and deal with new situations. People high in creative intelligence are good at combining seemingly unrelated facts to form new ideas. According to Sternberg, traditional intelligence tests do not measure creative intelligence, because it is possible to score high on an IQ test, and yet have trouble dealing with new situations.
 - 3 *Practical intelligence* relates to people's ability to adapt to, select, and shape their real-world environment. It involves skill in everyday living ("street smarts") and in adapting to life's demands, and reflects a person's ability to succeed in real-world settings. People with high practical intelligence may or may not perform well on standard IQ tests (after Microsoft Encarta Encyclopaedia Deluxe, 2004).

Measuring IQ is still wide-spread and considered one of the most important indicators of a person's intelligence. IQ scores, like many other biological and psychological characteristics, are distributed according to a normal distribution, which forms a normal curve, or bell curve, when plotted on a graph. In a normal distribution, most values fall near the average, and few values fall far above or far below the average.

Figure 2: *Distribution of IQ scores*

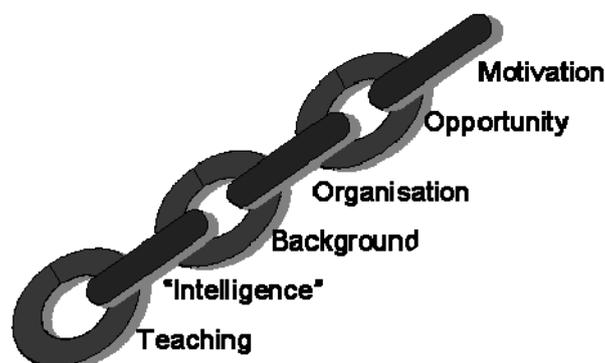
The distribution of scores (commonly called IQ scores) on the Wechsler Adult Intelligence Scale follows an approximately normal curve, an average distribution of values. The test is regularly adjusted so that the median score is 100—that is, so that half of the scores fall above 100, and half fall below.

(After Microsoft Encarta Encyclopaedia Deluxe, 2004.)

2.3 Influence of intelligence on academic achievement

28

Intelligence plays an important role in the successes of everyday life; thus, it should stand to reason that the same is true for academic success. As the process of education becomes more and more student centred, researchers and teachers have been trying to explore a possible link between the level of intelligence in foreign language learners and the relative ease with which they can be taught a foreign language. Acquisition of foreign languages is closely connected to the educational process, where students are provided with formal instruction and, based on their results, they are assessed by educators. According to the grades they get for their performance in class, they are ranked with regard to the rest of the class. “The primary aim of education is to prepare students for active, creative, and autonomous life. All educators who exert their influence upon this process should stimulate the development of the student’s abilities. This is, however, a difficult task since each student is unique with respect to their personality, intelligence, motivation, etc., which means that the teacher would have to personalize his/her approach toward each individual student” (Dobzhansky, 1962:9).

Figure 3: *Factors influencing educational achievement*

(after Atherton, 2005)

“Achievement encompasses student ability and performance; it is multidimensional; it is intricately related to human growth and cognitive, emotional, social, and physical development; it reflects the whole child; it is not related to a single instance, but occurs across time and levels, through a student’s life in [...] school and on into post secondary years and working life“ (Steinberger, 1993). Many academics believe that there is a connection between intelligence and academic achievement, be it general (good level of performance in all school subjects) or in foreign language acquisition specifically. “We believe that more intelligent children are likely to do better at school than less intelligent children, and that more intelligent adults are likely to be more successful in a variety of spheres than the less intelligent – although in both cases we also believe that other factors certainly play an equally important role” (Mackintosh, 1998:200). Ellis (1985:111) proclaims that “intelligence may be a powerful predictor of success in classroom SLA, particularly when this consists of formal teaching methods.” Dobzhansky (1962:25) states that “although the correlation between intelligence and academic achievement in foreign language appears to be there, the conducted tests have produced ambiguous results that not necessarily support this view.” However, later in the same work he claims that, undoubtedly, a correlation between intelligence, language aptitude, and academic achievements in foreign language learners exists and that the right diagnosis arising from psychological testing can lead to using the appropriate teaching methods and, in this way, assisting students to achieve greater success in foreign language

acquisition. Moreover, he introduces the term **academic intelligence**, which he understands to be a good overall logical thinking indicator, which may be characterized as analytical and goal-oriented. The same author claims that “high intelligence will always help people in their intellectual pursuits as well it may positively affect their learning and life in general. One may infer from the conducted research that students intellectually endowed will do much better in their foreign language learning than those less blessed but also that intelligence alone might not be the greatest factor in their success. Low intelligence might never hinder the student in becoming a proficient foreign language user, but it may never help them either” (Dobzhansky, 1962: 26). Atkinson (1993) supports his claims by providing research results on correlations observed between intelligence and educational achievement. “Clearly, high intelligence may be expected to correlate significantly with educational achievement. The correlation is positive, but declines substantially as students proceed through the system:”

Figure 4: *Correlations between intelligence and academic achievement with regard to the stage of education*

Stage of education	Correlation
Primary school	0.6-0.7
Secondary school	0.5-0.6
College	0.4-0.5
Post-graduate	0.3-0.4

(after Atkinson et al, 1993)

From the above opinions and research it can be assumed that intelligence is interrelated to academic achievement in general as well as in foreign language acquisition and that the relationship can be partly responsible for successes or failures of students in the process of acquisition of English as a foreign language. As has been explored above, there are many processes which combine to make up various definitions of intelligence (ability to generalise, make analogies, form judgements, use working memory, and so on), which is why they were focused on in the psychological test applied in the research and why the levels of these processes in the research subjects were observed.