INTELLIGENCE: NATURE & THEORIES

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by

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Intelligence

- Intelligence is cognition comprising sensory, perceptual associative and relational knowledge. It is sum total of all cognitive processes including coding of information, planning, attention and arousal.
Prior to Binet in 1895 intelligence was a philosophical concept and could not be estimated. Binet was interested in studying the way individual differ from each other and suggested testing for differences in their intelligence. Test should be appropriate to their background and occupation.
The aim of the Binet was to determine qualitatively the mental ability at which a child functions rather than to give to child a number such as mental age.
• Intelligence Quotient was devised by William Stern in 1912
• Binet said the I.Q. could not reduce to sensory, motor or perceptual process as Cattle and Galton rather Binet stressed a core of intelligence consist of more complex process as memory, imagery, comprehension and judgment.
Binet’s complex set of qualities includes

• The appreciation of a problem and the direction of the mind towards its execution.
• The capacity for making the necessary adaptation to reach on a definite end.
• The power of self criticism: Judge well, understand well, & reason well, attention and adaptation.
Definition of Intelligence:

Binet and Simon (1905):
The essence of intelligence is to judge well, to comprehend well, and to reason well.
Definition

American Psychologist M.L. Terman (1921)
“A person is intelligent in proportion as he is able to carry on abstract thinking.”
Wechsler:

Intelligence is a global capacity of an individual to think rationally, to act purposefully and to cope effectively with the environment.
Definition

Anstey (1966)

“Capacity to utilize past experiences to solve new problems.”
Mental Operation

A mental operation is concerned with how the mind goes about the task: the style or approach which it adopts. Guilford identified five different types of mental operations:

- Cognition
- Memory
- Divergent production
- Convergent production
- Evaluation
Content

A content concerns the type of mental representation which is involved.
There are five types of contents:
Visual
Auditory
Symbolic
Semantic
Behavioural
Product

A product is concerned with the type of outcome which can result from the mental task. There are six kinds of products:

Units
Classes
Relations
Systems
Transformations
Implications
Multiplying these mental operations, content and product together results in 150 different cognitive factors.
Gardner’s theory of multiple intelligence:

Gardner’s theory is based on the idea that the mind is not a holistic entity, but instead consists of distinct, independent modules. Gardner (1985) has described seven different types of intelligence.
Linguistic intelligence

used when reading, writing or comprehending speech
Musical intelligence

used in musical appreciation, composition and performance
Mathematical-logical intelligence

used in arithmetic, numerical calculation and logical reasoning
Spatial intelligence
used in arranging objects spatially, as well as
in visual art and finding one’s way around
Bodily-kinesthetic intelligence

used in sport, dancing or simple everyday movement and dexterity
Interpersonal intelligence

used in relating to others, interpreting social signals and predicting social outcomes
Intrapersonal intelligence

used in understanding and predicting one’s own behaviour, and in identifying aspects of the self and one’s own personality
Contextual intelligence

centered with intelligence within its socio-cultural setting. Some fundamental elements of intelligence may be found universally, but since their expression, development and social weighting will differ, their practical manifestations will be very different.
Experiential intelligence

how someone’s own past experience influences how they go about a given task or situation
Componential intelligence

cognitive mechanisms which underlie intelligent functioning. It proposes three types of cognitive components which make up componential intelligence:
a. Metacomponents: higher order processes involved in mental actions such as planning and decision making

b. Performance component: involved in actually carrying out a task- like the ability to count or calculate, or reason logically
c. Knowledge-acquisition components: concerned with how we go about acquiring or learning new information; strategies for identifying important features or patterns, curiosity, and so on.
• Sternberg updated his theory of intelligence and advance the idea of successful intelligence which is defined as the “ability to adapt, to shape and to select environment to accomplish of goals and to one’s society and culture.” (Sternberg & Kaufman -1998)
The cluster cognitive abilities made for successful intelligence is made up of analytical creative and practical abilities. These three abilities appear to be related and can be views together as planning.
Factors affecting intelligence

• Intelligence is an ill-defined, difficult to quantify concept. Accordingly, the IQ tests used to measure intelligence provide only approximations of the posited 'real' intelligence.

• In addition, a number of theoretically unrelated properties are known to correlate with IQ such as race, gender etc., but since correlation does not imply causation the true relationship between these factors is uncertain.
Factors affecting IQ

• Factors affecting IQ may be divided into biological and environmental.

Biological

• Evidence suggests that genetic variation has a significant impact on IQ, accounting for three fourths in adults. Despite the high heritability of IQ, few genes have been found to have a substantial effect on IQ, suggesting that IQ is the product of interaction between multiple genes.
Other biological factors correlating with IQ include ratio of brain weight to body weight and the volume and location of gray matter tissue in the brain.

Because intelligence appears to be at least partly dependent on brain structure and the genes shaping brain development, it has been proposed that genetic engineering could be used to enhance the intelligence of animals, a process sometimes called biological uplift in science fiction.
Environmental

- Evidence suggests that family environmental factors may have an effect upon childhood IQ, accounting for up to a quarter of the variance. On the other hand, by late adolescence this correlation disappears, such that adoptive siblings are no more similar in IQ than strangers.

- Moreover, adoption studies indicate that, by adulthood, adoptive siblings are no more similar in IQ than strangers, while twins and full siblings show an IQ correlation.
Consequently, in the context of the nature versus nature debate, the "nature" component appears to be much more important than the "nurture" component in explaining IQ variance in the general population.
Theories of Intelligence

Psychologists have attempted to understand the structure of intelligence for which they have formulated theories. Among the important theories of intelligence, we shall study three of them.

• Spearman’s Two-Factor Theory
• Guilford’s Theory of Structure of Intellect (S. I Model)
• Thurston’s Group Factor Theory
Spearman’s Two-Factor Theory:

The English psychologist, Charles Spearman (1863-1945), in 1904 proposed his theory of intelligence called two-factor theory. According to him intellectual abilities are comprised of two factors, namely; the general ability known as G-factor and specific Abilities known as S-factors. The performance by the individual is determined by the G-factor and the S-factors. The total intelligence of the individual is the sum total of the G-factor and the S-factors. The performance of a particular task depends on the ‘G’ factor or general ability and the particular ‘S’ factor or specific ability.
Characteristics of ‘G’ Factor:

• It is universal inborn ability.
• It is general mental energy.
• It is constant.
• The amount of ‘g’ differs from individual to individual.
• It is used in every activity of life.
• Greater the ‘g’ in an individual, greater is his success in life.

Characteristics of ‘S’ Factor:

• It is learned and acquired in the environment.
• It varies from activity to activity in the same individual.
• Individuals differ in the amount of ‘S’ ability.
‘G’ factor represents Native Intelligence thus when we respond to any situation or perform an intellectual task, our general mental ability or ‘G’ factor is mainly responsible for it and our specific ability in that particular task is responsible for the rest. There are a large number of specific abilities such as ability to draw inferences, ability to complete sentences, ability to code message etc.

Fig: Spearman’s Two-Factor Theory or Eclectic Theor
Different individuals differed both in their ‘G’ as well as ‘S’ factors. For e.g. an individual’s performance in literature is partly due to his general intelligence and partly due some specific aptitude for his language, i.e. G+S1. In mathematics his performance may be the result of G+S2. In drawing, it may be due to G+S3 and in social sciences; it may be due to G+S4 and so on. Thus the factor ‘G’ is present in all specific activities.
Educational Implications and relevance of Spearman’s Two-Factor Theory:
1. The theory gives a better insight to the teacher about the nature of intelligence.
2. The general ability differs from individual to individual.
3. The specific abilities also differ from individual to individual.
4. ‘S’ factor varies in degrees. Therefore, it can be modified by learning or habitual training.
5. A child requires different amounts of ‘G’ and ‘S’ factors for achieving success in different Subjects.
6. We require a high quality of ‘G’ factor for our success in life.
7. Both ‘G’ and ‘S’ have a high correlation.
8. This theory could be used to guide, construction of a set of ability test.

Conclusion: Thus we see that spearman did not believe in the concept that mental power as independent of one another. According to him they are unitary.
2. Guildford’s Structure of Intelligence (SI Model)
J.P. Guilford developed a model of intelligence (1966) using factor analysis. He outlines topography of the structure of intellect, providing an integrated rationale for describing the many dimension of intellectual performance. He suggests that there are three basic parameters along which any intellectual activity takes place. These are:
1. Operations – the act of thinking
2. Contents – the terms in which we think, and
3. Products – the ideas we come up with.
Guilford identified 5 operations, 5 contents and 6 products. Thus the maximum number of factors in terms of the different possible combinations of these dimensions will be $5 \times 5 \times 6 = 150$. 

1. **Operations**: It consists of five major groups of intellectual abilities.

- **Cognition**: It refers to discovery, rediscovery or recognition.
- **Memory**: Simply remembering what was once known.
- **Convergent Thinking**: This type of thinking, by reasoning, results in useful solution to problems.
- **Divergent Thinking**: This is thinking in different directions, seeking and searching for some variety and novelty.
- **Evaluation**: It is reaching decisions or making judgments about information.
2. **Content:** A Second way of classifying the intellectual factor is according to the kind of material or content involved. It involves five factors:

- **Visual Content:** It is concrete material which is perceived through our senses, i.e. size, form, colour, etc.

- **Auditory Content:** It consists of language, speech, sounds, music and words

- **Symbolic Content:** It is composed of letters, digits, and other conventional signs.

- **Semantic Content:** It is in the forms of verbal meanings or ideas which we get from others.

- **Behavioural Content:** It means social behaviour in society.
3. **Products:** When a certain operation is applied to certain kind of content as many as six kinds of products may be involved.

- **Units:** Understanding the meaning of words, visual, auditory and symbolic units.

- **Classes:** It means classification of words and ideas.

- **Relations:** It implies discovering relations of words and ideas.

- **Systems:** The ability to structure objects in space and to structure symbolic elements and to formulate problems.

- **Transformation:** The ability to look into the future lines of development or to suggest changes in the existing situations.

- **Implications:** The ability to utilize present information for future ends.
Educational Implication and relevance of SI Model:
1. This theory about the idea that the brain of a child is like a computer, who acquires, stores and uses information.
2. It provides knowledge about the specific ability of the students to guide them in the right direction.
3. SI Model is useful in finding out the reasons of the unsatisfactory performance of the students in spite of their adequate intelligence.
4. This model points out that for understanding higher mental processes like thinking some drastic modifications could be needed in our curriculum or method of instruction.
5. This model has explored 150 intellectual abilities and this enables us to find out whether we are paying sufficient attention to each one of them or not and if not how to improve.
6. This model guides us to device enrichment programmes for the gifted children.
7. It stresses that learning of specific skills should be our focus of attention.

8. SI Model is very useful in constructing tests of various types for different age groups.

9. This concept of Guildford will prove useful in our future research in the areas of learning, memory, problem-solving etc.

10. This model discovered many abilities which were not known before.

11. It is very useful for vocational training.

Conclusion: Guildford’s theory of Intelligence seems to be the most comprehensive theory as it attempts to take into considerations all possible aspects of intellectual activity.
3. Thurston’s Group Factor Theory

Louis Thurston came out with the group factor theory (1937) saying that Intelligence is a cluster of abilities. These mental operations then constitute a group. A second group of mental operations has its own unifying Primary factor; a third group has a third Primary factor and so on. Each of them has its own primary factor. Each of these primary factors is said to be relatively independent of others. He pointed out that there were Seven Primary Mental Abilities and later on added two more. They are:

• **Verbal comprehension Factor.** This factor involves a person’s ability to understand verbal material. It is measured by tests such as vocabulary and reading comprehension.
• **Verbal fluency Factor.** This ability is involved in rapidly producing words, sentences, and other verbal material. It is measured by tests such as one that requires the examinee to produce as many words as possible beginning with a particular letter in a short amount of time.

• **Numerical Factor.** This ability is involved in rapid arithmetic computation and in solving simple arithmetic word problems.

• **Perceptual speed Factor.** This ability is involved in proofreading and in rapid recognition of letters and numbers. It is measured by tests such as those requiring the crossing out of As in a long string of letters or in tests requiring recognition of which of several pictures at the right is identical to the picture at the left.

• **Inductive reasoning Factor.** This ability requires generalization—reasoning from the specific to the general. It is measured by tests, such as letter series, number series, and word classifications, in which the examinee must indicate which of several words does not belong with the others.
• **Spatial visualization Factor.** This ability is involved in visualizing shapes, rotations of objects, and how pieces of a puzzle fit together. An example of a test would be the presentation of a geometric form followed by several other geometric forms. Each of the forms that follows the first is either the same rotated by some rigid transformation or the mirror image of the first form in rotation. The examinee has to indicate which of the forms at the right is a rotated version of the form at the left, rather than a mirror image.

• **Memory Factor.** It means the ability to recall and associate previously learned items effectively or memorize quickly.

Later on other factors were added on like **Deductive Reasoning (P)** – Ability to use the generalized results correctly and **Problem solving ability factor (PS)** - Ability to solve problem independently
Educational Significance and Implications

• Thurston contributed greatly to the measurement of attitudes. In psychology, the ‘Thurston scale’ developed in 1928 was the first formal techniques for measuring of attitudes.
• Thurston’s theory of intelligence was a major influence on later theories of multiple intelligences, such as those of Guilford, Gardner, and Sternberg.
• Thurston has been noted for developing a comparative judgment scaling technique. The rank scale can be used to rank all possible feelings related to an issue and to categorize people expressing an opinion based on the rank of that opinion. It is used today mainly in basic research.
• Thurston held that if the individual wants to perform any particular activity, one or more of these factors or abilities are involved. Some of them are more important than others.
THANK YOU!!!