



BLOCK 2

INTELLIGENCE AND APTITUDE

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UNIT 3 CONCEPT OF INTELLIGENCE AND EMOTIONAL INTELLIGENCE*

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3.1 OBJECTIVES

After going through this Unit, you would be able to:

- Discuss the meaning and definition of intelligence;
- Know the concept of IQ and intelligence testing;
- Explain the influence of both genetic and environmental factors on intelligence;
- Know the different approaches (psychometric and cognitive) to understand the nature of intelligence;
- Explain the concept of emotional intelligence; and
- Recognize the factors contributing to the development of intelligence.

3.2 INTRODUCTION

If we observe our surrounding, we will find diversity in human behaviour with regard to how do people think, learn, reason and perform activities. For example, some people

* Sunanda Pattnaik, Assistant Professor, Department of Psychology, Utkal University, Bhubaneswar, Odisha

are better than others at remembering facts; some can control their attention process and so on. Such individual differences can be noticed in the course of our daily lives. Individual differences in intelligence are one of the psychological attributes which has been of great interest to psychologists. If you observe your friends or classmates, you will find how they differ from each other in their ability to understand concepts, learn from environment, use different forms of reasoning and adapt to the environment.

Intelligence is one of those concepts which is easier to recognize than to define. Different people are likely to agree fairly well in describing intelligent people as sharp, bright, clever, or quick. However, it is very difficult to give a precise definition of intelligence. In the present Unit, we will focus on defining and understanding intelligence. The nature-nurture issue will be highlighted. Different perspectives/approaches to intelligence will also be mentioned. Finally, the concept of emotional intelligence highlighting individual differences in intelligence will be discussed.

3.3 DEFINING INTELLIGENCE

Intelligence is a hypothetical construct, which is usually equated with higher level abstract thought processes. It is generally agreed that those who are good at abstract reasoning, problem solving and decision making are more intelligent than those who are poor at these mental activities. In general, intelligence underlies how well we learn, plan, solve problems and make decisions. In short, it impacts how well we do different things, deal with challenges and manage our everyday life. Not directly observable, intelligence is verified only by the tests used to measure it.

Intelligence has been defined in several ways. Psychologists are yet to agree on a single definition of intelligence. However, a commonly accepted definition of intelligence refers to the ability to learn from one's experiences, acquire knowledge, and use resources effectively in adapting to new situations or solving problems (Sternberg & Kaufman, 1998; Wechsler, 1975). Now, psychologists are of opinion that the definition of intelligence should include skills valued by the culture or society in which one lives. And the above said characteristics are those which the people need to be able to survive in their culture. Culture gives a context for the development of intelligence. Western culture promotes skills of performance, speed, and achievement motivation. In contrast, Indian culture emphasizes self-reflection and connectivity with people.

Let us see some of the important definitions of intelligence.

- *The aggregate or global capacity of an individual to think rationally, to act purposefully and to deal effectively with the environment (David Wechsler, 1944)*
- *The ability to carry on abstract thinking (Lewis Terman, 1921)*
- *The ability to solve problems and to create products, that are valued within one or more cultural settings (Howard Gardner, 1983)*
- *A person's capacity for goal-directed adaptive behaviour (Robert Sternberg & William Salter, 1982)*
- *Intelligence refers to what is measured by tests of intelligence (Boring, 1923)*
- *Intelligence includes sensation, perception, association, memory, imagination, discrimination, judgment and reasoning (Haggerty, 1921)*
- *Ability to adapt oneself adequately to relatively new situations in life (Pentler, 1921).*

Thus intelligence is referred as the ability to perceive information and retain it as knowledge for applying it towards adaptive behaviours in the environment. It is also described as individual's capacity for self-awareness, understanding and problem solving. It is the general mental capability that involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas and learn from experience.

A more comprehensive and widely used definition of intelligence is given by Gottfredson (1997a). It is described as 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.

3.4 MEASURING INTELLIGENCE

The concept of measurement of intelligence started when educators in France attempted to identify children who were unable to learn as quickly or as well as others in school. Alfred Binet and his colleague, Theodore Simon designed a test of intelligence that distinguished fast learners and slow learners as well as between children of different age groups (Binet & Simon, 1916). They gave the concept of mental age (MA).

Mental age is a measure of person's intellectual development relative to people of his/her age group. A mental age of 8 means that a child's performance on an intelligence test equals the average performance level of a group of 8 year olds. Let us imagine that a child who can answer questions that an 8 year old can answer. Can we tell how smart he/she is? No, we cannot say about it, because we have no idea about how old the child is? If he/she is 12 years old, he/she's not that smart. If he/she's 6, then she is regarded as a bright child. So, in order to estimate a child's intelligence we need to have knowledge about his *chronological age* (biological age in years) and mental age. The mental age is calculated on the level of individual's answer to the questions which are ranked according to the age of an individual.

Mental age indicates nothing about whether the intelligence of the individual is high or low in comparison to other people of the same age. We also need to consider a person's biological age, to find out what a particular mental age means. Then only, we can relate the mental age to the actual biological age of the individual. This gives an Intelligent Quotient or IQ. This concept was devised by William Stern in 1912. Terman, in 1916, used this concept with revised Binet scale which was later referred as Stanford – Binet scale.

Intelligent quotient (IQ) refers to mental age (MA) divided by chronological age (CA) and multiplied by 100. Multiplying by 100 helps to avoid the decimal, as it changes the IQ into a whole number.

So $IQ = MA/CA \times 100$

A merit of the IQ as used by intelligence tests was that, it helped to compare the intelligence of individuals with different chronological and mental age. For example, let us calculate a 13 year old person's IQ who has a mental age of 16.

Example 1: $IQ = MA (16)/CA (13) \times 100 = 123$.

Now suppose a 16 year old person also has a mental age of 16. So, his IQ will be 100.

Example 2: $IQ = MA (16)/CA (16) \times 100 = 100$.

An IQ score of 100 is regarded as average intelligence, because in this case a person's mental age and chronological age is equal (example 2). It is the mathematical average or mean for IQ scores. IQ scores will be over 100 when mental age is higher than chronological age (as seen in first example). When a person's chronological age exceeds his mental age, IQ scores are below 100. Let us now discuss an illustration of this situation, in which 14 year old Rajat has a mental age of 11. So Rajat's IQ will be 78, as $IQ = MA(11)/CA(14) \times 100 = 78$.

Modern intelligence tests use deviation IQ instead of a ratio IQ. In deviation IQ, the IQ is obtained statistically from a person's relative standing in his/her group. In simpler words, they tell us how far above or below average the person's score was, relative to others scores. For example, if a person score at 50th per centile, then half of the people of his/her age who take the test score are higher than his/her IQ and half score lower.

Distribution of IQ scores

We all know that individuals differ in the level of intelligence. Some individual may be very dull, some may be average and some other people may be more intelligent. But can we know, how many of them in a group are dull or intelligent or average? We can get the answer to this question by knowing the distribution of intelligence scores in a given population.

The frequency distribution for the IQ scores tends to approximate a normal distribution. This normal distribution is symmetrical in nature around the central value, called the mean. If we plot the IQ scores of large number of people on a graph, it assumes the shape of a normal distribution curve or otherwise called as bell shaped curve. The distribution of IQ scores in the form of a normal distribution is shown in the Figure 3aF.

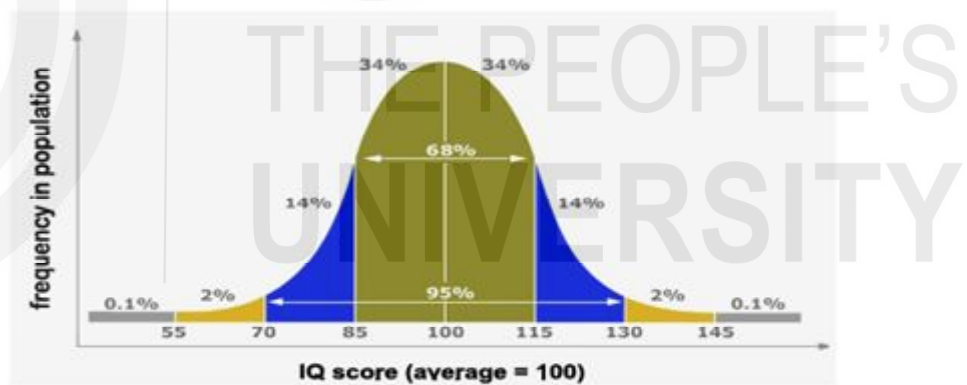


Figure 3aF: Distribution of IQ scores in the population

The IQ scores are distributed in such a manner that the majority of individuals' scores tend to fall in the middle range of the distribution. Only a few people have either very high or very low IQ scores in the population. The average IQ score in the population is 100. The people with IQ scores in the range of 90 – 110 have normal intelligence. Those individuals having an IQ score above 130 are considered as having exceptional talents (intellectually gifted); whereas IQ below 70 may mean that the person may have mental retardation/intellectual disability. These two groups (intellectually gifted and intellectually disabled) deviate from the normal population with respect to their cognitive, emotional and motivational characteristics. The following Table 3aT shows the classification of people on the basis of IQs.

Table 3aT: Classification of people on the basis of IQ

IQ Range	Description of IQ level
Above 130	Very superior
120-130	Superior
110-119	High Average
90-109	Average
80-89	Low average
70-79	Borderline
Below 70	Mentally retarded/ intellectually disabled

Self Assessment Questions I

- 1) State whether each of the following statements is ‘True’ (T) or ‘False’ (F).
- Binet developed the concept of IQ.
 - A person with an IQ of 100 is intellectually superior.
 - A dull child’s chronological age is same as his mental age.
 - When biological age and mental age are same, IQ is 100.

3.5 INFLUENCE OF NATURE AND NURTURE ON INTELLIGENCE

You must have experienced situations in which some individuals find it difficult to solve a simple problem whereas some have the ability to solve complex problems very quickly. There is a wide variety of individual differences in the level of intelligence. Why such differences exist in people’s intellectual ability? At the most general level, two factors could be responsible: heredity and environment. Heredity consists of genetic materials and codes that we inherit from our parents. Environment consists of the socio-cultural conditions and experiences of people in the course of their lives.

There is debate among researchers, whether heredity or environment has the larger role in determining intelligence of an individual. This is known as the *nature - nurture controversy/debate* on intelligence. Here, nature refers to heredity and nurture to environment. At present, researchers agree that individual differences in intelligence are clearly the result of the interplay between genetic factors and the environmental conditions. Now let’s consider some evidence pointing to this standpoint.

Evidence for the Influence of Nature

The research evidence supporting the view that heredity plays an important role in human intelligence comes from family studies majorly involving twin studies and adoption studies.

The Bryan Brothers: Similar Genes or Similar Training?



Figure 3bF: Tennis players Bob Bryan and Mike Bryan

Retrieved from [https://www.tennisworldusa.org/tennis/news/Tennis_Interviews/58388/mike-bryan-bob-will-have-surgery-sixmonth-recovery-for-him-/](https://www.tennisworldusa.org/tennis/news/Tennis_Interviews/58388/mike-bryan-bob-will-have-surgery-sixmonth-recovery-for-him/)

The Bryan Brothers are identical twin brothers Robert Charles “Bob” Bryan and Michael Carl “Mike” Bryan, American professional doubles tennis players, and are the most successful duo of all time. They were born on April 29, 1978, with Mike being the elder by two minutes. The Bryans have won multiple Olympic medals, including the gold in 2012 and have won more professional games, matches, tournaments and Grand Slams than any other men’s pairing. They have held the World No. 1 doubles ranking jointly for 438 weeks (as of October 25, 2015), which is longer than anyone else in doubles history, and have also enjoyed that World No. 1 ranking together for a record 139 consecutive weeks. (Source: Wikipedia)

Twin studies

Various studies have used monozygotic and dizygotic twins to assess the role of heredity in determining the IQ of an individual. Monozygotic or identical twins begin from a single fertilized ovum, and so they have identical genotypes (individual’s genetic potential). In contrast, the dizygotic or fraternal twins are conceived from two separate fertilized ova. They share about 50 per cent of their genetic makeup, with the other 50 per cent being unique to each twin. If heredity influences intelligence, then identical twins would have more similar IQ scores than fraternal twins.

Bouchard and McGue (1981) reviewed many studies, and found that the mean correlation between IQs of identical twins was $+0.86$, and it was $+0.60$ for the fraternal twins raised in the same home. Whereas, it was $+0.72$ for identical twins raised in different homes.

Thus the identical twins have high mean correlation between their IQ scores ($+0.86$). Researchers argue that this result may be due to the fact that, most twins are raised together by the same parent(s) and in the same home, and so they share similar environments as well as similar genes. Yet, even when identical twins are raised separately, they typically tend to have similar IQ scores ($+0.72$) than fraternal twins reared together ($+0.60$). The fact that identical twins are more similar than fraternal twins support for the role of heredity factors in determining the individual differences in intelligence.

Family Studies

Researchers have also measured IQ with respect to family relationships. A number of studies have attempted to assess the similarity of IQ between different groups of relatives. If heredity influences intelligence, then we would expect that the more closely two persons are related, the more similar their IQs will be. Meta-analysis of research findings carried out by Bouchard and McGue (1981) pointed out the following mean correlation in IQ:

Relationship	Mean Correlation
Siblings reared together	+ .47
Siblings reared apart	+ .24
Parent and child living together	+ .42
Parent and child reared apart	+ .22
Adopted parent- child	+ .19

These findings suggests that the closer the biological relationship of the two individuals, the higher the correlation between their IQ scores.

Adoption studies

Another line of support for the impact of heredity on intelligence is provided by research studies involving adopted children. It tries to compare adopted children with both their biological and adoptive parents. Researchers have found out that adopted children's IQ scores are more highly correlated with their biological parents' IQs than with their adoptive parents' IQs. A long term study results revealed that, the correlations between the adopted children's intelligence and their biological parents increased over time, and those between the children and their adoptive parents decreased over time (Plomin, Fulker, Corley, & DeFries, 1997). This suggests that heredity factors have influence on the human intelligence.

Heritability

In order to be more specific about the contribution of heredity in determining intelligence, researchers have used the concept of heritability of intelligence. It refers to the proportion of variance in intelligence within a given population that is attributable to genetic factor. It ranges from about 35 per cent in childhood to around 75 per cent in adulthood (McGue et al., 1993). Plomin & Defries (1998) have determined the estimated heritability for intelligence as 50 per cent. What could be the reason for the increase in the contribution of genetic factors to intelligence with increase in age? One possible explanation could be, as people grow older, individuals can select and control their environment to a great extent, which in turn reduces the impact of environment on intelligence.

Evidence for the Influence of Nurture

Influence of hereditary factors does not give an entire picture of human intelligence. Environmental variables do play an important role in intelligence. Now we will try to analyze the research findings of family studies from an environmental perspective.

Relooking at twin studies and adoption studies

Let us look again at the IQ correlations for identical twins raised in the same home

versus in different homes (as explained earlier). The mean correlation for twins raised in different homes is .72, whereas that for twins raised in the same home is .86. In other words, we can say that twins raised in different homes have less similar IQs than the twins raised in the same home. It can be inferred that, the different environments that the different families provide do have some influence on intelligence of the individuals.

Adoption studies, too, indicate that intelligence is not determined entirely by heredity. For instance, in one study (Scarr & Weinberg, 1976), some children of poor parents (with unknown IQs) were adopted by middle-class parents with IQs averaging 118–121. Other children remained with their biological parents who formed the control group. At later stage, the IQ averages of the adopted children were 105 and that of non-adopted children were 90. Although the adopted children's IQ scores were lower than those of their adoptive parents, they were about 15 points higher than the scores for the control group children, who were raised by their biological parents.

Results of various research studies indicate that environmental factors (nurture) have a significant impact on IQ scores. We will discuss about the research findings pointing out the Flynn effect, effect of nutrition, home environment, and early intervention which provide additional support for the influence of environment on human intelligence.

The Flynn effect

Evidence that environmental factors can have influence on human intelligence was reported by Flynn (1987). His research evidence showed that there is a rapid rise in individuals' average performance on IQ tests in several western countries in the recent decades. This trend is referred as the Flynn effect. It referred to increase in IQ scores over generations. It is also called 'secular rise' in IQ scores. This increase cannot be due to genetic factors as a massive shift in human heredity from one generation to the other is quite unlikely. So, what aspects of the environment account for the Flynn effect? Better nutrition, greater access to television and internet which provides informative stimulations, increase in the number of years of education (for parents as well as children), more cognitively demanding jobs, increased urbanization and higher quality home environment are some likely factors which account for this Flynn effect (Flynn, 1999; Neisser, 1998).

Environmental Deprivation and Enrichment

There is evidence that environmental deprivation lowers intelligence while rich nutrition, quality schooling and good family background increases intelligence. Intelligence can be reduced by absence of different forms of environmental stimulation in early life of children. Social and economic deprivation can adversely affect IQ. Children from households in poverty have lower IQs than do children from households with more resources even when other factors such as education, race, and parenting are controlled (Brooks-Gunn & Duncan, 1997).

In terms of enrichment, placing children in favorable settings seems to enhance intelligence than growing up in a restricted environment. Research studies indicate that stimulating home environments — those in which parents interact frequently with their children, make numerous learning and reading materials available, encourage the development of new skills, and so on — have positive impact on intelligence of the children.

The impact of nurture can prominently be seen in case of children with disadvantaged background. The environmental stimulation can make a difference for such children. Once they have similar environment, biology may have an impact on their intellectual ability.

Right to Education Act (RTE)

On 4th August 2009, Government of India implemented the Right of Children to Free and Compulsory Education Act or Right to Education Act (RTE). It aims to provide free and compulsory elementary education for children between 6 and 14 years of age. The motto of this act is to generate equal opportunity of education to all children irrespective of their economic status, social class and gender.

As a psychologist, what's your stand on this act? Do you think it can make a positive impact on the intelligence level of the children belonging to disadvantaged group?

Research studies support the benefits of schooling, which influences children's intellectual capacities. Schooling improves IQ as it engages the children in cognitive processes of memorizing, rehearsal, organization and so on. School provides an enriched environment that allows their thought processes to deal with the problems effectively.

Unfortunately, as we all know, not all children live in homes which provide stimulation and nurturance for their development. When children live in impoverished or neglectful home environments, enriching early intervention can make an appreciable difference. For instance, early childhood education programs, such as, Head Start can lead to IQ gains and other cognitive and academic benefits which can help them from falling behind in school.

Biological Influences

Additional support for the influence of environmental factors in intelligence is provided by research findings on biological factors. Many biological factors that the individual encounter while growing up can affect their intelligence. The biological influences act on the physical body of the individual. It includes nutrition, exposure to toxic substances like lead, prenatal factors such as mother's use of alcohol and drugs. Nutrition has been shown to affect human intelligence. Prolonged malnutrition during critical early periods of growth (particularly the prenatal period and early years of life) can adversely affect the neurological development and cognitive development of the children. A number of toxic substances in children's prenatal or early postnatal environments, like alcohol, drugs, radiation, lead-based paint dust, can affect neurological development and thus also affect children's later IQ scores. Prenatal environment such as mother's nutrition, emotional state (presence of stress) and use of drugs affects the health of developing fetuses and their intelligence). An example of such effects is *fetal alcohol syndrome (FAS)*, in which children whose mothers have consumed alcohol during pregnancy show retarded physical and mental growth.

There is considerable evidence that both nature and nurture play a role in intelligence. This view is now accepted by most psychologists. So, we can conclude that intelligence is a product of both heredity (nature) and environment (nurture). Heredity sets a range within which an individual's intellectual development is shaped by the environment.

Self Assessment Questions II

1) What do you mean by the "nature- nurture debate on intelligence"?

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2) What is heritability?

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3) Define Flynn effect.

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3.6 APPROACHES TO INTELLIGENCE

Like most scientific theories, the approaches to study intelligence have also evolved through a succession of models. Psychologists have developed different theories of intelligence in order to understand the nature of intelligence. Two of the most influential approaches have been the psychological measurement, also known as psychometrics/structural approach; and cognitive / information processing approach, which focuses on the processes by which the human mind functions. You will learn about the various theories of intelligence in detail in the next Unit 4, but here we will briefly highlight the two main approaches for your understanding.

3.6.1 Psychometric Approach

The question of whether intelligence is a single characteristic, or a collection of specific abilities, is hard to answer. This may be partly due to the fact that it involves intellectual capacities that we cannot see directly. We can only infer it from individual’s observable surface behaviour, such as intellectual tests. The psychometric approach considers intelligence as an aggregate of abilities and expresses the individual’s performance as a single index of cognitive abilities. It tries to understand the structure of intelligence or its underlying dimensions. Factor analysis and related techniques are used to locate a smaller number of dimensions, clusters, or factors from a larger set of independent variables or items on a test.

One of the earliest of the psychometric theories came from the British psychologist **Charles E. Spearman** (1927). He proposed a two factor theory of intelligence. Spearman used a statistical technique called factor analysis and concluded that intelligence consists of two factors that explain the individual differences in test scores: general factor (g factor) and specific factors (s factors). The g factor includes mental operations which are primary and common to all performances requiring intelligence. The second factor (s factor) is specifically related to each particular test.

In contrast to Spearman, several theories have concluded that intelligence has multiple components. One of the multifactor theories grew out of the work of Thurstone. The American psychologist **E.L. Thurstone** (1938) proposed the theory of primary mental ability. He analyzed the inter-correlations of a set of 56 mental tests and identified seven factors, each of which are referred to as the primary mental ability. These seven abilities are:

- i) *Verbal comprehension* (grasping meaning of words, concepts, and ideas)
- ii) *Verbal fluency* (using words fluently and flexibly)
- iii) *Numerical ability* (solving numerical computation and arithmetical reasoning problems with speed and accuracy)
- iv) *Spatial ability* (visualizing and manipulating objects)
- v) *Inductive reasoning* (ability to derive general rules and principles from presented facts)
- vi) *Memory* (ability to recall information)
- vii) *Perceptual speed* (the speed of perceiving the details).

Raymond Cattell (1963) used factor analysis technique to show that general intelligence can be divided into two relatively independent components: crystallized intelligence and fluid intelligence. Crystallized intelligence is the type of intelligence which consists of the knowledge a person has already acquired and the ability to use that knowledge whenever required. In contrast, fluid intelligence is the type of intelligence used when dealing with novel situations and problems. Fluid abilities are the reasoning and problem-solving abilities which are measured by tests such as analogies, classifications, and series completions. Crystallized abilities include vocabulary, general information, and knowledge about specific fields.

Arthur Jensen (1969) proposed a hierarchical model of intelligence, which consists of abilities operating at two levels: Level I and Level II. The level I ability is called as associative learning which consists of rote learning and memory, in which the output is more or less similar to the input. Level II is called as cognitive learning, which involves higher order skills such as abstract thinking and symbolic thought. These skills help to transform the input to produce an effective output.

The above mentioned theories are representations of psychometric approach to understand the nature of intelligence. The psychometric approaches to intelligence, thus basically study the statistical relationships between different measures of mental testing.

3.6.2 Cognitive Approach

The preceding theories attempt to understand intelligence by finding out its component parts. This is one path to an understanding of intelligence. An alternative approach in understanding the concept of intelligence was taken by many theorists, who focused on intellectual processes – that is, the patterns of thinking that individuals use when they reason and solve problems. They are more interested in the cognitive processes which focus on how people go about solving problems and figuring out the answers. The cognitive approaches to intelligence do not focus on the structure of intelligence, but on the processes underlying intelligence of the individual. They apply the information processing approach to understand the nature of intelligence. Now, let us discuss in brief some theories of intelligence which follow this approach.

Robert Sternberg (1985) emphasizes the importance of cognitive processes in problem solving. His model of information processing consisted of three types of components:

- i) *Knowledge Acquisition Components*: It is used for encoding and comparing information as well as for learning new facts.
- ii) *Performance Components*: It is used for problem solving strategies and techniques.
- iii) *Metacognitive Components*: It involves selecting a strategy and monitoring the progress of cognitive processing.

According to this theory, there are three basic types of intelligence:

- i) *Componential or analytic intelligence* involves the abilities to think critically and analytically. It is reflected in IQ scores and college grades.
- ii) *Experiential or creative intelligence* focuses on insight and the ability to formulate new ideas. It is involved in using past experiences creatively to solve new problems.
- iii) *Contextual or practical intelligence* emphasizes on the ability to deal with the environmental demands faced during day-to-day affairs. It is otherwise referred as street smartness.

Howard Gardner (1983) believed that intelligence is not a single entity; rather it consists of numerous abilities, each of which is equally important. He described different types of intelligence concerning the following ability:

- i) Linguistic/verbal ability: skills involved in production and use of language.
- ii) Logical - mathematical ability: skills in scientific thinking and problem solving.
- iii) Spatial ability: skills involved in forming visual images and patterns.
- iv) Musical ability: skills in tasks involving musical rhythms and patterns.
- v) Bodily – kinesthetic ability: skills used for using whole or portions of the body flexibly and creatively.
- vi) Interpersonal ability: skills in interacting and understanding people by being sensitive to their emotions.
- vii) Intrapersonal ability: skills involved in understanding oneself.
- viii) Naturalistic ability: skills for being sensitive to the features of the natural world.
- ix) Existential ability: skills concerning the broader meaning of life.

Planning, Attention-Arousal, Simultaneous and Successive (PASS) model has been developed by **J.P. Das, J. Naglieri, and Kirby** (1994). According to this model, human cognitive processes involve three functional units of brain. These units are responsible for arousal/attention, coding or processing and planning. The three functional units are as follows:

- i) First functional unit is responsible for arousal and attention. This is associated with activities of brain stem and lower part of cerebral cortex.
- ii) Second functional unit is involved in analyzing, coding, and storing information using simultaneous and successive processes. Simultaneous processing is associated with parietal and occipital lobes and successive processing is associated with frontal temporal lobes.

- iii) Third functional unit is used for planning, self-monitoring and structuring of cognitive abilities. It is associated with activities of prefrontal lobes.

Attention-Arousal: This process involves the ability to selectively attend to stimuli while ignoring other distractions. Arousal keeps people awake and alert. An optimal level of arousal focuses our attention to the relevant portion of a problem.

Simultaneous Processing: This involves the ability to integrate separate concepts to our knowledge system as an interrelated whole. Simultaneous processing helps us in finding relationship between the given abstract figures.

Successive Processing: This involves the ability to remember and integrate information into a sequential order. Learning of digits, alphabets and multiplication tables are examples of successive processing.

Planning: This is the ability to make decisions about problem solving and how to carry out the task. It involves setting goals, to think of courses of action to reach the goal and evaluate their effectiveness.

All the above described theories represent the cognitive approach to understand the intelligence of human being.

Self Assessment Questions III

State whether each of the following statements is 'True' or 'False':

- 1) Jensen proposed the concept of fluid and crystalized intelligence.
- 2) Psychometric approach examines the processes underlying intelligence.
- 3) Gardner's theory is an example of psychometric approach.
- 4) Theory of multiple intelligences exemplifies the cognitive approach to intelligence.
- 5) Contextual intelligence is otherwise referred to as practical intelligence.

You will learn more about the theories in Unit 4 which specifically deals with the theories of intelligence. Now let us see how individuals differ in their level of intelligence.

3.7 INDIVIDUAL DIFFERENCES IN INTELLIGENCE

Intelligence has significant implications for our everyday life, and it influences our effective functioning. It is related to various life outcomes such as academic achievement, job performance, health etc, however, it is difficult to establish a causal relationship. There are other individual differences in personality, mood, motivation, leadership, creativity etc. that may affect the outcome in a particular aspect/area. Nevertheless, individual differences in intelligence does matter and we need to know the implications of it.

As we have discussed above in section 3.3, intelligence is assessed in terms of IQ scores and we get a range of IQ in terms of the normal distribution curve. Those who score at the extreme high end of normal curve for intelligence are having extreme high IQ and called as 'gifted'. Individuals who fall at the other extreme of the normal curve and have extreme low IQs come under the 'intellectual disability' group, earlier known as mental retardation.

The *gifted* usually have an IQ of 130 and above. Terman's (1925) longitudinal study of 1528 children having IQ more than 130, demonstrated that they were more successful

in different domains including education, career, social skills and adjustment. However, studies (Torrance, 1993) have also found that other factors such as a high energy level, persistence, a sense of purpose in life etc. do play a role in the various life outcomes of gifted people.

Intellectual disability is marked by an extreme low IQ of 70 or below on a test when the mean IQ score is 100. In addition to it, the child also should have deficit in daily adaptive behaviour such as self-care skills, communicating with others, being able to live on one's own etc. Since intellectual disability is known as a neurodevelopmental disorder, the condition is manifested during the developmental stage, i.e., below 18 years of age. Thus, there are three main clinical features of intellectual disability: (a) significant below average IQ, (b) deficiency in age-appropriate adaptive behaviour, and (c) occurs during the developmental period.

Intelligence as assessed in the psychometric tests is used to define the gifted and the intellectually disabled. It is mostly correlated with the traditional academic achievement or being book smart. However, you may be knowing many cases where despite having academic success, such individuals were not so successful in their social relations and other real life situations (Mehrabian, 2000). Thus, individual differences in being people smart accounts more for success in life. It involves *emotional intelligence*, the ability to recognize emotions in oneself and others, and to manage the emotions in an effective way (Mayer & Salovey, 1997).

Let us now discuss this concept of emotional intelligence in little more detail.

3.8 CONCEPT OF EMOTIONAL INTELLIGENCE

As we mentioned earlier, we may find people who are academically talented, but are quite unsuccessful in their own life. They may experience problems in interpersonal relationships at home as well as workplace. Having a good intelligence level and scholastic record is not enough to be successful in life. So what do they lack? Some psychologists believe that the lack of emotional intelligence may be the source of their difficulty to adjust to the environment. The concept of emotional intelligence was first introduced by Salovey and Mayer (1990). It was later popularized and expanded upon by Daniel Goleman (1995) with the publication of his book "Emotional Intelligence: Why it can matter more than IQ". Goleman proposed that emotional intelligence has a more powerful influence on success in life than the traditional views of intelligence.

Salovey and Mayer (1990) described emotional intelligence as "the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions". It refers to the capacity to reason about emotions and emotional information, and thereby, to enhance thought. As IQ is used to express intelligence, Emotional Quotient (EQ) is used to express emotional intelligence. According to Salovey and Mayer, people with high EQ, could solve a variety of emotion-related problems accurately and quickly. For example, people with high emotional intelligence can accurately perceive emotions in faces. They also understand the meanings that emotions convey.

Emotional intelligence is often described as the capacity to be aware of, control, and express one's emotions, and to handle interpersonal relationships empathetically. It is generally said to include skills like emotional awareness, the ability to make productive use of emotions by applying them in thinking and problem solving tasks, and the ability to manage and regulate emotions. In simpler terms, emotional intelligence refers to the capability of individuals to recognize their own emotions and those of others, discern

between different feelings and label them appropriately, use emotional information to guide thinking and behaviour, and manage and/or adjust emotions to adapt to environments or achieve one's goal(s). All these skills are more important for success in life.

3.8.1 Models of Emotional Intelligence

There are different scientific approaches to emotional intelligence. They can be characterized as the ability model, trait model and mixed models.

The *ability model* views emotional intelligence as a standard intelligence. They argue that the construct of emotional intelligence meets the traditional criteria for intelligence. People using this model measure emotional intelligence as a mental ability with performance assessments that have a criterion of correctness (i.e., there are better and worse answers, which are determined using complex scoring algorithms).

The *trait model* encompasses behavioural dispositions and self-perceived abilities and is measured through self-report questionnaire.

Mixed models are so called because they mix the ability conception with personality traits and competencies such as optimism, self-esteem, and emotional self-efficacy. Researchers using this mixed approach use self-report instruments as opposed to performance assessments to measure emotional intelligence. For example, instead of asking people to demonstrate how they perceive an emotional expression accurately, self-report measures ask people to judge and report how good they are at perceiving others' emotions accurately.

Mayer and Salovey's Model of Emotional Intelligence

This ability-based model views emotions as useful sources of information that help one to make sense of and navigate the social environment. The model claims that emotional intelligence includes four types of abilities:

- i) Perception of emotion: It includes the ability to identify and differentiate emotions in the self and others. A basic aspect of this ability is identifying emotions accurately in physical states (including bodily expressions) and thoughts. This ability also enables one to identify emotions in other people, to detect and decipher emotions in pictures, voices, and cultural artifacts also.
- ii) Use of emotion to facilitate thinking: This refers to using emotions to facilitate cognitive activities such as reasoning, problem solving, and interpersonal communication. It includes skills for generating emotions to aid judgment and memory processes. It also includes the ability for producing emotional states to foster different thinking styles.
- iii) Understanding and analyzing emotions: This includes the ability to comprehend the language and meaning of emotion, as well as an understanding of the antecedents of emotions. Skills in this component include labeling emotions with accurate language as well as recognizing similarities and differences between emotions. Interpreting origins of emotions, recognizing transitions between emotions, and understanding blending of different emotions are also component of this ability.
- iv) Reflective regulation of emotions: It includes the ability to regulate and modify an emotional response in oneself and others. It also includes the ability to experience a range of emotions while making decisions about the appropriateness or usefulness of an emotion in a given situation. Monitoring and reflecting on one's own emotions and those of others represents more complex problem solving ability.

A comprehensive performance test of emotional intelligence is the Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT; Mayer et al., 2003) for adults and the Mayer–Salovey–Caruso Emotional Intelligence Test, Youth Version (MSCEIT-YV; Mayer, Salovey, & Caruso, 2004). These are performance tests as they require individuals to solve tasks pertaining to each of the four abilities as defined by their theory; for example: identifying the facial emotions of people, imagining a person’s feeling when appropriate emotion is experienced, to know how emotions develop and change over time and the process of evaluating the courses of actions in different emotional situations.

Goleman’s Theory of Emotional Intelligence

Goleman broadened Mayer’s and Salovey’s model to incorporate five essential components of emotional intelligence:

- i) *Self-Awareness*: It refers to the ability to recognize and understand one’s moods, emotions, and drives, as well as their effect on other people. People with emotional self-awareness understand their own strengths and weaknesses, as well as how their actions affect others.
- ii) *Self-Regulation*: It involves controlling or redirecting one’s disruptive impulses and emotions. It also includes the skill to think before acting. A person with self-regulation has the ability to exercise control when expressing their emotions.
- iii) *Motivation*: It drives the individual to achieve things. It gives a passion to achieve goals with energy and persistence. People with high emotional intelligence are self-motivated and internally driven rather than being influenced by outside forces, such as money or status.
- iv) *Empathy*: It is the ability to understand the emotions of other people as well as to feel what others are feeling. We need to treat other people according to their emotional reactions. A person with empathetic understanding has the ability to connect with people and genuinely respond to their concerns.
- v) *Social skills*: It helps in managing relationships and building social networks. It is the ability to inspire others and induce desired responses from them in a given situation. It helps the person to build rapport and trust with others.

3.8.2 Factors Contributing to Emotional Intelligence

Are people born with all of the emotional intelligence they will ever have, or does experience affects their development. Researchers have provided empirical support for the concept of emotional intelligence and its relatedness with general intelligence (Mayer et al., 2003). While we acknowledge that genetics is likely to play an important role in the development of emotional intelligence, we need to also note that nurture does influence the nature (as in case of general intelligence). The genetic expression itself appears to be shaped by the social and emotional experiences of the individual. Bar-On (2000) has found out that successively older cohorts tend to score higher on scale of emotional intelligence, suggesting that, to some extent, emotional intelligence may be learned through life experience. However, the development of social and emotional competencies takes commitment and sustained effort of the individuals, and not just improvement in emotional intelligence with maturation.

Goleman (1995) includes a set of emotional competencies within each construct of emotional intelligence. Emotional competencies are not innate talents, but rather learned

capabilities that must be worked on and can be developed to achieve outstanding performance. Goleman views that individuals are born with a general emotional intelligence that determines their potential for learning the emotional competencies.

A wide range of findings from the fields of psychotherapy, training programs and executive education (Barlow, 1985; Marrow, Jarrett, & Rupinski, 1997; Boyatzis, Cowan, & Kolb, 1995) provide evidence for people's ability to improve their social and emotional competence with sustained effort and a systematic program. The findings in the emerging field of affective neuroscience are focusing on researches that demonstrate that the brain circuitry of emotion exhibits a fair degree of plasticity, even in adulthood (Davidson, Jackson, & Kalin 2000). Recent research on "mindfulness" training (emotional self-regulation strategy) has also reported that training can actually alter the brain centers that regulate negative and positive emotions (Davidson et. al., 2003). The mindfulness training basically focuses on helping people to stay focused on the present, thus keeping distressful and distracting thoughts (e.g. worries) away, and to pause before acting on emotional impulse. These results support our notion that emotional intelligence competencies can be developed; in other words the environment plays an important role in the development of emotional intelligence.

In this section we have attempted to understand the concept of emotional intelligence. While the progress of the emotional intelligence paradigm has been impressive, much remains to be discovered. One problem with emotional intelligence tests is that they often do not show a great deal of reliability or construct validity. Researchers have questioned the construct validity of the measures, arguing that emotional intelligence measures knowledge about what emotions are, but not necessarily how to use those emotions, and that emotional intelligence is actually a personality trait, a part of g, or a skill that can be applied in some specific work situations — for instance, academic and work situations. Hopefully, upcoming research will facilitate continued refinement of the theory which will help us to understand the concept of emotional intelligence factors contributing to its development.

Self Assessment Questions IV

Complete the following with suitable words:

- 1) The concept of emotional intelligence was popularized by
- 2) Mayer and Salovey's model of emotional intelligence has used model.
- 3) Goleman's theory of emotional intelligence has components.
- 4) The ability to feel what others are feeling is referred to as
- 5) Name any one test of emotional intelligence

3.9 LET US SUM UP

In the present Unit, we learned about the concept of intelligence and how it has been defined in many ways. It refers to the individual's ability to think rationally, understand complex ideas, learn from experience, and adapt to the environment. It is measured in terms of the Intelligent Quotient (IQ), which is obtained by dividing mental age by chronological age and multiplying by 100. We also learned that intelligence is the product of complex interplay of hereditary factors (nature) and environmental factors (nurture). Evidence for the role of nature is provided by findings on twin studies and adoption studies. Evidence for the role of nurture is provided by studies on Flynn effect, environmental deprivation and enrichment.

Approaches to explain the nature of intelligence can be broadly grouped under (a) psychometric approaches, and (b) cognitive approaches. The psychometric approaches to intelligence give emphasis on studying intelligence as consisting of abilities which can be expressed in quantitative term. The theories representing cognitive approaches, e.g. the PASS model or Gardner’s multiple intelligences describe the processes underlying intelligent behaviour.

Further, the Unit also described individual differences in intelligence in terms of intellectual disability, giftedness and emotional intelligence. The concept of emotional intelligence, models and factors affecting emotional intelligence were discussed.

3.10 KEY WORDS

- Intelligence** : refers to the aggregate or global capacity of an individual to think rationally, to act purposefully and to deal effectively with the environment (David Wechsler, 1944).
- Mental age** : is a measure of person’s intellectual development relative to people of his/her age group.
- Intelligent quotient (IQ)** : refers to mental age (MA) divided by chronological age (CA) and multiplied by 100.
- Flynn effect** : refers to increase in IQ scores over generations. It is also called ‘secular rise’ in IQ scores.
- Crystallized intelligence** : is the type of intelligence which consists of the knowledge a person has already acquired and the ability to use that knowledge whenever required.
- Intellectual disability** : is marked by three main features such as (a) significant below average IQ, (b) deficiency in age-appropriate adaptive behaviour, and (c) occurs during the developmental period.
- Emotional intelligence** : refers to the capacity to be aware of, control, and express one’s emotions, and to handle interpersonal relationships empathetically.

3.11 ANSWERS TO SELF ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) a) False
b) False
c) False
d) True

Self Assessment Questions II

- 1) The question of whether heredity or environment is important in determining intelligence is known as the nature- nurture debate on intelligence.

- 2) The proportion of the variance in any trait (here it is intelligence) within a given population that is attributable to genetic factors is called as heritability.
- 3) Flynn effect is the rapid rise in the average IQ of individuals in several western countries in recent decade.

Self Assessment Questions III

- 1) False
- 2) False
- 3) False
- 4) True
- 5) True

Self Assessment Questions IV

- 1) Goleman
- 2) Ability
- 3) 5
- 4) Empathy
- 5) Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT)

3.12 UNIT END QUESTIONS

- 1) Explain the concept of intelligence.
- 2) Critically examine the psychometric and cognitive approaches to understand the nature of intelligence.
- 3) Examine the role of heredity and environment in the development of intelligence.
- 4) Elaborate the different components of emotional intelligence.

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UNIT 4 THEORIES OF INTELLIGENCE*

Structure

- 4.1 Objectives
- 4.2 Introduction
- 4.3 Spearman's Two Factor Theory of Intelligence
- 4.4 Thurstone's Theory of Intelligence
- 4.5 Guilford's Structure of Intellect Theory
 - 4.5.1 The Contents Dimension
 - 4.5.2 The Operations Dimension
 - 4.5.3 The Products Dimension
- 4.6 Cattell's Theory of Intelligence
- 4.7 Gardner's Theory of Multiple Intelligences
- 4.8 Sternberg's Triarchic Theory of Intelligence
- 4.9 PASS Theory of Intelligence
- 4.10 Cross-cultural Conception of Intelligence
- 4.11 Let Us Sum Up
- 4.12 Key Words
- 4.13 Answers to Self Assessment Questions
- 4.14 Unit End Questions
- 4.15 References
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4.2 OBJECTIVES

After going through the Unit, you would be able to:

- Get an overview of different approaches and theories of intelligence;
- Explain the two factor theory of Charles Spearman;
- Define Thurstone's primary mental abilities (PMA);
- Describe Guilford's structure of intellect model based on factor analysis;
- Elucidate Cattell's two types of intelligences;
- Describe Gardner's theory of multiple intelligences;
- Discuss triarchic theory of Robert Sternberg;
- Explain the PASS model of intelligence; and
- Elaborate the cross-cultural conception of intelligence.

* Mousumi Sethy, Assistant Professor, Department of Psychology, Utkal University, Bhubaneswar, Odisha

4.1 INTRODUCTION

In Unit 3 you learned about the concept of intelligence and how it has been defined in various ways. It also discussed the influence of nature and nurture on intelligence, that is, to what extent our intelligence is determined by hereditary and environmental factors. Various theories have been advocated to explain the nature of intelligence. You have got a brief overview of some of these theories in the previous Unit. In the present Unit, we will learn about the various theories of intelligence in detail, starting from the psychometric approach to intelligence to the recent brain-based model of intelligence.

Considerable attention and effort has been devoted to find out whether intelligence is a single ability or it consists of multiple abilities, whether there is only one type of intelligence or there are several types of intelligences. These issues led to the development of different theories of intelligence. There are mainly three approaches or theories of studying intelligence, namely, (a) psychometric approach, (b) information processing approach, and (c) cognitive developmental approach. Psychometric approach describes intelligence as an ability or aggregate of multiple abilities. The two factor theory of Charles Spearman, fluid and crystallized intelligence of Cattell (gf-gc model), Thurstone's primary mental abilities (PMA), Guilford's structure of intellect model based on factor analysis and Gardner's theory of multiple intelligence are examples of psychometric approach. The information processing approach emphasizes on the processes that we use in problem solving and other intellectual tasks. It includes the triarchic theory of Robert Sternberg and the PASS model of J.P. Das. Cognitive approach emphasises the functional significance and development of intelligence. Jean Piaget's theory of intelligence is the most dominant cognitive-developmental approach to study intelligence. Let us now discuss all these theories of intelligence.

4.3 SPEARMAN'S TWO FACTOR THEORY OF INTELLIGENCE

Charles Spearman (1863-1945), an English psychologist and the originator of factor analysis was the first to claim that intelligence consists of general 'g' factor and specific 's' factors. His theory is known as 'Two Factor Theory' (1904). One of his major contributions to the history of psychology is the development and use of 'factor analysis'. He used the techniques of factor analysis and correlational analysis to find out the 'g' and 's' factor. Factor analysis involves finding out the correlation of related variables, and then grouping the variables to form clusters and derive the underlying factors. Thus a larger number of variables are reduced to a lesser number of factors.

In his book, 'The Abilities of Man' (1927), Spearman elaborated that all intellectual activities share a single common factor that runs through all the activities a person performs during his life. Spearman called this general factor as 'mental energy' which is determined innately. A person cannot be trained to have a higher 'g' factor. It is a part of who they are. People possess general intelligence or 'g' in varying degrees. On the basis of this general intelligence, we describe a person as either intelligent or dull. This 'g' is the major determinant of one's score in any intelligence test. In addition to this general or 'g' factor, he recognised the specific factors, each called 's', which are specific to different abilities. For example, test of arithmetic, spatial relationships, verbal fluency, each of these specific intelligence measure a separate 's'. An individual's intelligence score reflects the amount of 'g' plus the magnitude of various 's' factors possessed by the individual. For example, one's performance in spatial intelligence test would be a function of a person's general intelligence (g) and his spatial ability (s).

Spearman statistically analysed the interrelation among various scores obtained by different individuals on various tests. A positive correlation between any two test or mental function implies a factor common to both or 'g' and two specific factors 's'. Let us assume that, the two tests are M (mechanical) and N (numerical), the common factor in these tests is 'g' and the specific factors are sM and sN. Similarly, let V (verbal) and S (spatial) be two other tests with 'g' as the common factor and sV and sS are the specific factors as shown in Figure 4aF below (In the Figure 4aF, g refers to 'general ability' and s refers to 'Specific abilities'). Spearman's theory states that the objective of psychological tests should be to measure individual's 'g' as it runs through all the abilities and predicts individual's performance. Individuals differ on the basis of 'g' they possess.

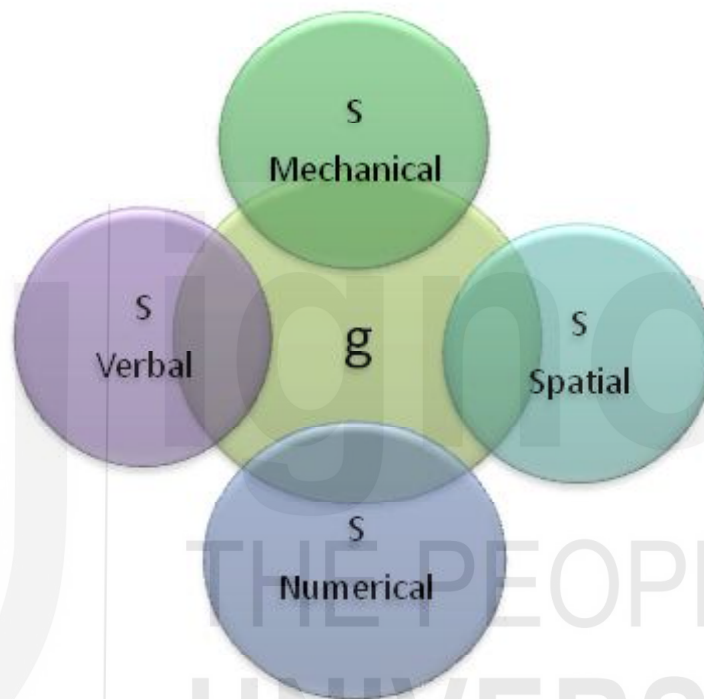


Figure 4aF: 'g' and 's' factors of Spearman's Two Factor Theory

Spearman has often been criticised for his factor analytic approach to intelligence which was purely psychometric and ignored the cognitive basis of intelligence. Louis Thurstone (1935) objected to Spearman's emphasis on general intelligence. He suggested that intelligence can be divided into a number of primary abilities by using factor analysis. However, the contribution of Spearman to the field of psychology remains valuable as his model of two factor theory introduced factor analysis in psychology.

4.4 THURSTONE'S THEORY OF INTELLIGENCE

Louis Leon Thurstone (29 May 1887 – 30 September 1955) suggested that intelligence is a composite of seven distinct primary mental abilities (PMA). His approach was different from Spearman's theory of general intelligence. Rather than focusing on a single factor of general intelligence as suggested by Spearman, Thurstone (1935) pointed out that intelligence consists of a number of primary mental abilities. He recognizes the diversity of human abilities. Using improved statistical techniques he developed a new factor model of intelligence. He analyzed the inter-correlation of the scores of 57 tests on a large group subjects, and identified seven factors. These factors were called primary mental abilities or PMA. These are described as follows:

- **Inductive Reasoning:** The ability to find rules or the logical reasoning ability. It is

the ability to find general rules and principles from the given information.

- **Memory:** The ability to memorize and recall. It is the ability to memorize events, list of words, mathematical formulas, dates, definitions etc.
- **Numerical Ability:** The ability to solve arithmetic problems. It is the ability to use numbers with speed and accuracy, to compute answers to mathematical problems. It measures the speed and accuracy of computational skills.
- **Perceptual Speed:** The ability to visualize details rapidly. It is the ability to perceive or grasp perceptual details quickly and accurately, to see differences and similarities among things.
- **Spatial Relations:** The ability to understand relationship. The ability to visualise and manipulate different geometric patterns, forms and imaginary objects in space.
- **Verbal Comprehension:** The ability of reading comprehension; define and understand words, concepts, ideas; verbal reasoning
- **Word Fluency:** The ability to produce words rapidly, i.e., to use words quickly and fluently in performing tasks like naming word, rhyming, solving cross word puzzles.

Thurstone views each of these mental abilities as independent of each other. Each of them can be assessed separately and there cannot be a single score for intelligence. He suggests a cognitive ability profile for the individual rather than a single IQ score.

Self Assessment Questions I

- 1) According to Spearman, factors specific to different abilities are called as factors.
- 2) Spearman has stated that individuals differ on the basis of they possess.
- 3) Thurstone terms the seven factors as

4.5 GUILFORD'S STRUCTURE OF INTELLECT (SI) THEORY

Joy Paul Guilford, an American psychologist, was born in March 7, 1897 in Marquette, Nebraska. He is best known for his psychometric studies of human intelligence, including the distinction between convergent and divergent production. After completing his graduation from University of Nebraska, he studied under Edward Titchner at Cornell during 1919 to 1921 and conducted intelligence testing on children. He taught in different universities, like University of Kansas, University of Nebraska and University of Southern California till his retirement in 1967.

Unlike Spearman, Guilford believed that intelligence is a combination of multiple activities. Traditional models prior to Guilford proposed intelligence as a monolithic and global attribute. By the 1950's, he tried to develop a system to classify the new mental abilities being discovered and the first version of the Structure of Intellect (SI) model was presented. This model was based on factor analysis. He argued that intelligence consists of numerous intellectual abilities. He first proposed a model with 120, later on revised to 180 independently operating factors in intelligence. In this Structure of Intellect Model, all the mental abilities were organized along three dimensional framework: **Content, Operations, and Product**. This model is represented as a 'cube' with each of the three dimensions occupying one side ($5 \times 6 \times 6 = 180$ specific abilities). Thus, there are

three feature of intellectual task: the content dimension which includes broad areas of information; the operations dimension which includes the operations or general cognitive or mental activities, and the products dimension which contains results of applying particular operations to specific contents. Thus this model is also called 3- dimensional model represented in the form of a cube.

Let us now know about each of these dimensions as given in the Figure 4bF below.

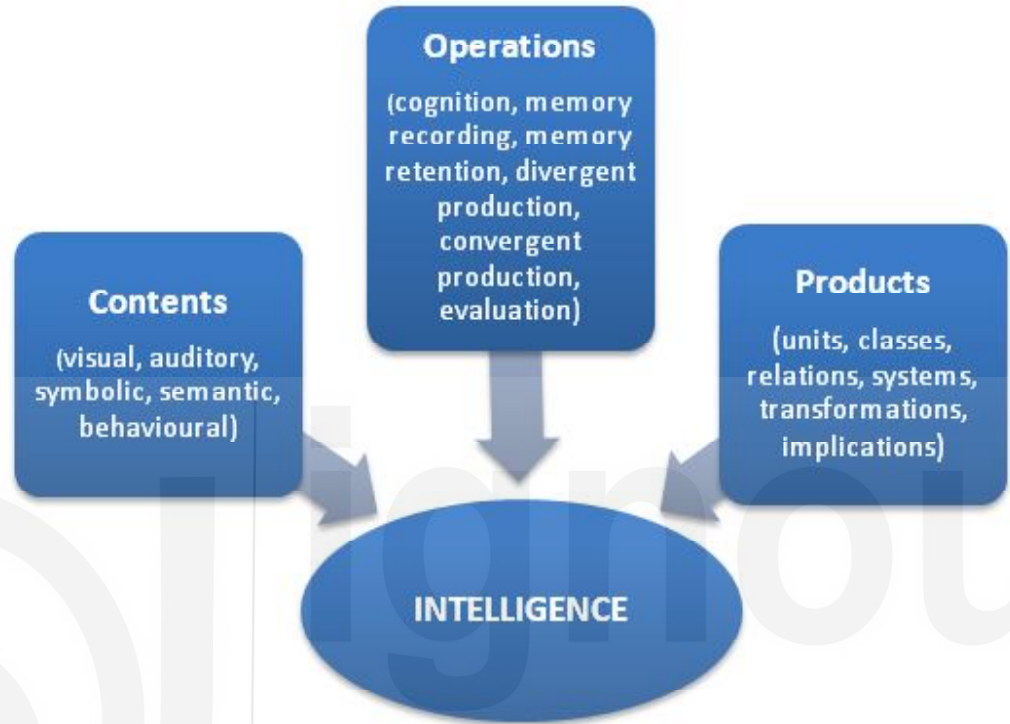


Figure 4bF: J.P. Guilford's Structure of Intellect Model

4.5.1 The Contents Dimension

The contents dimension includes the broad areas of information to which human intellect operations are applied. Initially, these included only four categories, later on auditory and visual were separated making it five content dimensions.

- 1) *Visual* – information perceived through seeing or the information arising from the stimulation of retina in the form of an image.
- 2) *Auditory* – information perceived through hearing or information arising from the stimulation of cochlea of the inner ear as a sound.
(Figural: Information that is non-verbal or pictorial, later divided into Visual and Auditory)
- 3) *Symbolic* – information perceived as symbols or signs that stand for something else, has no meaning by themselves (Arabic numerals, letters of an alphabet, musical and scientific notations).
- 4) *Semantic* – concerned with verbal meaning and ideas.
- 5) *Behavioural* – information perceived as acts or behaviour of people.

4.5.2 The Operations Dimension

As the name suggests, this consists of six operations or general intellectual processes:

- 1) *Cognition* – the ability to understand, comprehend, discover, and become aware of information.

- 2) *Memory recording* – the ability to encode information.
- 3) *Memory retention* – the ability to recall information.
- 4) *Divergent production* – the ability to generate multiple solutions to a problem; creativity.
- 5) *Convergent production* – the ability to deduce a single solution to a problem; rule-following or problem-solving.
- 6) *Evaluation* – the ability to judge whether or not information is accurate, consistent or valid.

4.5.3 The Products Dimension

The products dimension contains results of applying particular operations to specific contents. There are six kinds of products in increasing complexity, they are:

- 1) *Units* – represents a single item of information or knowledge.
- 2) *Classes* – a set of items that share some common attributes.
- 3) *Relations* – represents a connection between items or variables; may be linked as opposites or in associations, sequences, or analogies.
- 4) *Systems* – an organization of items or networks with interacting parts.
- 5) *Transformations* – changes perspectives, conversions, or mutations to knowledge; such as reversing the order of letters in a word.
- 6) *Implications* – predictions, inferences, consequences, or anticipations of knowledge.

Each task accomplished by a person includes a particular type of content, mental operation and a product. For example a test of recall on ‘the movements undertaken by Gandhiji during the freedom struggle’ includes the ‘*semantic*’ aspect of content dimension as it involves information using words or sentences, ‘*memory*’ is the process dimension and ‘*relation*’ of the sequence of events is the product dimension. As there are 5 types of contents, 6 types of operations and 6 types of products, resulting in 180 (5×6×6) types of distinct mental abilities among which more than 100 have been empirically verified.

Guildford’s structure theory of intelligence has been criticised for being too complex. From the practical point of view, Guildford’s factors are so narrow and specialised that they have little value of prediction in vocational and educational guidance. Despite all these criticism, his theory is a significant contribution to the field of research on intelligence.

4.6 CATTELL’S THEORY OF INTELLIGENCE

Raymond Cattell (March 20, 1905 - February 2, 1998) is a British psychologist who proposed that two types of intelligence constitute the *g* (Cattell, 1971). These are fluid intelligence (*gf*) and crystalized intelligence (*gc*). Fluid intelligence refers to the ability for abstract and logical thinking, and does not require any prior knowledge. Thus it involves the ability to think and reason abstractly and solve any new task or problem independent of any past knowledge or experience in it. It helps one to analyze a novel problem, perceive the relationships and patterns that underlie the problem and solve it using logic. Though grows rapidly during the early years of life, fluid intelligence tends to decline during later years of life. It can be measured by tests of puzzle solving, block

designs and spatial visualization. The Cattell Culture Fair IQ tests, The Raven’s Progressive Matrices are the measures of *Gf*.

In contrast to the fluid intelligence (*gf*), which is more hereditary, crystallized intelligence (*gc*) depends on past learning and experience; it is acquired. Thus, *gc* increases with age and experience and *gf* declines gradually.

Crystallized intelligence refers to knowledge that one gains through learning, past experience, acculturation and the ability to use that acquired knowledge. It is one’s life time intellectual achievement and improves with age. More the knowledge and information you gain, more the stronger it becomes. It can be measured through tests of general knowledge, use of language (vocabulary) and a wide variety of acquired skills (Horn & Cattell, 1967). Fluid intelligence grows rapidly during the early years of life but crystallized intelligence grows throughout the life span.

Self Assessment Questions II

- 1) Guilford’s Structure of Intellect consists of three dimensions such as and
- 2) According to Guilford, what are the categories included under the Contents dimension?
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.....
.....
- 3) What is fluid intelligence?
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.....
.....
.....
- 4) Crystallized intelligence increases with age and experience. **True or False**

4.7 GARDNER’S THEORY OF MULTIPLE INTELLIGENCES

Howard Gardner (1983), an American Psychologist, proposed the theory of multiple intelligences. In his book ‘*Frames of Mind*’, he pointed out that he did not believe there was “one form of cognition which cut across all human thinking. There are multiple intelligences with autonomous intelligence capacities.” So, intelligence cannot be viewed as a single entity. There are different types of intelligences which are independent of each other. Further, people may have varied combinations of these intelligences.

According to Gardner (1999), intelligence is much more than IQ as high IQ in the absence of productivity does not equate to intelligence. Gardner initially proposed eight

types of intelligence which later on he increased to nine. Thus Gardner views each individual as a unique combination of various intelligences, hence we cannot say that one is more intelligent and another is less intelligent. Each one of us is talented in unique ways. The utility and value of each type of intelligence is culturally determined in the sense that individual's intelligent performance is determined according to the high desirability, usefulness and demands of society for particular types of intelligence. For instance, one type of intelligence highly valued in a particular society may be of little significance in another.

Let us briefly discuss the nine types of intelligence as given by Gardner.

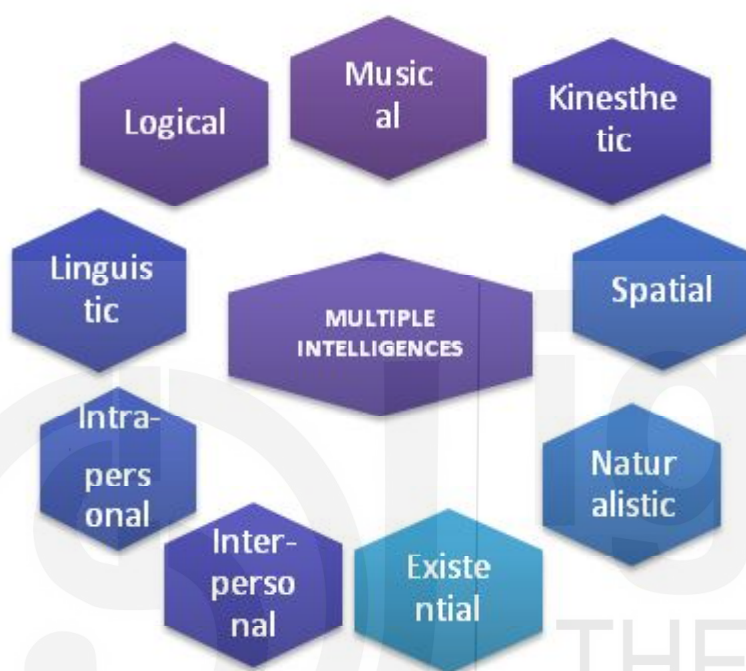


Figure 4cF: Gardner's Theory of Multiple Intelligences

Linguistic Intelligence refers to the ability to use language. It is the capacity to use spoken and written words in a skilled way. Individuals with high verbal/linguistic intelligence are very good in using words and language to express themselves, articulate things and create. They can use language fluently and flexibly and creatively. They can learn various languages easily. Poets, writers, lawyers, journalists, teachers, politicians, philosophers and speakers are very strong in this component of intelligence. Robert Frost, William Wordsworth, William Shakespeare, Gulzar, R.K. Narayan, Chetan Bhagat are some people high on linguistic intelligence.

Logical-mathematical Intelligence is the ability to use logical reasoning and mathematical ability. Individuals high on this intelligence have good abstract reasoning, critical thinking, and good in dealing with numbers. This type of intelligence correlates well with the traditional notion of intelligence. Scientists, engineers, physicist, economists are people with high logical-mathematical intelligence. They are good in mathematics, calculations, numbers and computer programming. Albert Einstein, Archimedes, C.V. Raman and Amartya Sen are examples of people high in this area of intelligence.

Musical Intelligence is the ability to use rhythms, sounds and patterns to create, compose and perform music. It involves sensitivity to music, and the ability to recognise and manipulate musical patterns. People with high musical intelligence are likely to be singers, music composers, instrumentalists and musicians. Yehudi Menuhin, Ludwig van Beethoven, Michael Jackson, W.A. Mozart, M.S. Subhalaxmi, Lata Mangeshkar, R.D. Burman, Zakir Hussain are some examples of people with high musical intelligence.

Bodily-kinesthetic Intelligence is the ability to use and control one's body movements and actions. Dancers and sports persons are usually high in such intelligence. Further, it is also required in surgery and crafts making as it involves skills and dexterity for fine motor movements. People with high bodily-kinesthetic intelligence can become good athletes, actors, sports persons, acrobats, yoga practitioners, surgeons, police officers and soldiers. Cricketers like Bradman, Tendulkar, dancer Pt. Birju Maharaj, Sonal Mansingh, Sanjukta Panigrahi, Madhuri Dixit, Rekha, acrobat Rosa Maria Ritcher, Olympic medallist P.T. Usha, Vijendra Singh demonstrate high bodily-kinesthetic intelligence.

Spatial Intelligence is the capacity to perceive, understand and use spatial and visual information effectively. Such people are good in spatial orientation, forming visual images and patterns. They can easily visualise the world with the mind's eye, modify the surrounding based upon their perception and recreate aspects of their visual experiences. They are good at remembering images, figures, faces, fine details and visualise things from different angles. People with high visual/spatial intelligence are likely to be architects, painters, interior designers, surgeons, pilots, drivers and sailors. M. F. Husain, Amrita Sher-gil, Michael Angelo, Leonardo da Vinci and I.M. Pei are examples of some people with good spatial intelligence.

Interpersonal Intelligence refers to the ability to understand others and social interactions. They can understand the emotions and the perspectives of others and relate well to others. They are able to establish good interpersonal relationships with others. They have good and effective communication skills. They also show sensitivity and empathic understanding towards others. People with high interpersonal intelligence tend to be social workers, managers, psychologists, nurses, counsellors, politicians, leaders, teachers, reformers and spiritual gurus. Some examples of such people are Mother Teresa, Mahatma Gandhi, Sarvepalli Radhakrishnan, Raja Rammohun Roy, Sri Sri Ravi Shankar and Mata Amritanandamayee.

Intrapersonal Intelligence is the ability to understand oneself and know one's thoughts, emotions, feelings, motives and desires, and how these influence their behaviour. It includes awareness about one's strengths, limitations, goals and ambitions in life. Such intelligence includes one's introspective and self-reflective capacities.

Such people are usually introverted, intuitive type, love to work alone and are least affected by any external events. Various people-oriented careers require intrapersonal intelligence, e.g., psychologists and spiritual leaders like Swami Vivekananda, Ramakrishna Paramahansa and Sri Aurobindo. Philosophers and writers also have strong intrapersonal intelligence.

Naturalistic Intelligence is the ability to recognize and understand the various patterns in nature. It includes sensitivity to the nature with all its features including flora, fauna and all the biodiversity. Gardner has added this eighth type of intelligence to his original seven intelligences.

Such people appreciate the beauty of nature and the subtle aspects of nature. Hunters, farmers, bird watchers, botanists, biologists, tourists and gardener are high in this aspect of intelligence. Charles Darwin, a naturalist and best known for his contribution to the science of evolution with his book 'On The Origin of Species' is an example of a person with high naturalistic intelligence.

Existential Intelligence Gardner (1998) added existential intelligence as the ninth intelligence which refers to the sensitivity and capacity to tackle deep questions beyond sensory data and about human existence such as meaning of one's life, why have we

come to this world, why do we die, where do we go after death etc. It concerns the ‘big picture’ in life and the ultimate truth of life. Cosmologists and philosophers are high on this aspect of intelligence.

According to Gardner, each of these “intelligences” has a specific set of observable and measurable abilities. The first two abilities, i.e., linguistic and logical-mathematical intelligence, strongly contribute to the performance in traditional school system and in the academic achievement; usually promoted more in our societies. The next three intelligences, namely, bodily-kinaesthetic, musical and spatial intelligence are usually associated with arts and is high among people like singers, musicians, dancers, athletes, architects, designers, actors and others who make the world beautiful with these capacities and skills. Our traditional school system usually ignores these intelligences, and thus many children high on these capacities do not get enough scope to pursue their interest. Gardner’s theory suggests that equal focus should be given to other intelligences and for optimal use of one’s potentials.

His theory is applied in an experimental program called project spectrum spanning from 1984 – 1993 by Gardner which aims at developing a comprehensive educational system where the elementary school children get an opportunity to explore their strengths and weaknesses by being assigned into different sections of specific intelligences. You can refer to the following link for further details: www.pz.harvard.edu/projects/project-spectrum

4.8 STERNBERG’S TRIARCHIC THEORY OF INTELLIGENCE

Among other theories of intelligence is a theory proposed by Robert Jeffery Sternberg (born in 8th December, 1949), an American psychologist from Yale university. He is a new generation cognitive psychologist who attempts to understand the cognitive processes involved in solving problems. Sternberg defined human intelligence as the cognitive ability to learn from experience, to reason well, to remember important information, and to cope with the demands of daily living. Thus, it involves reasoning, problem-solving ability, knowledge, memory and successful adaptation to one’s surroundings (Sternberg, 2004). He viewed intelligence as how well an individual deals with environmental changes throughout their life span.

Sternberg (1988a) formulated the ‘triarchic theory of intelligence’ which theorizes that there are three types of intelligence such as (a) *Componential or analytical intelligence*, (b) *Experiential or creative intelligence*, and (c) *Contextual or practical intelligence*.

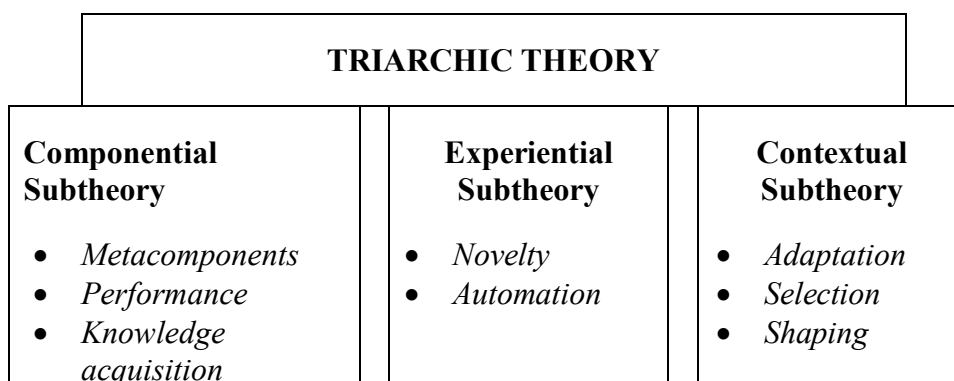


Figure 4dF: Sternberg’s Triarchic Theory

- 1) *Componential or analytical intelligence* refers to the ability to break down the problem into components and analyze things for problem-solving. It refers to the internal mechanisms used in problem solving. It reflects the traditional conceptualization of intelligence and relates more to the academic achievement. It is also called as being ‘book smart’. They are good in problem solving and abstract reasoning.

Analytical intelligence or academic problem solving skills consists of three components such as metacomponents, performance components and knowledge acquisition components. *Metacomponents* are the executive part which controls the other two components. They control and monitor the cognitive processing. They tell the performance components what to do. *Performance components* help in performing a task or solving a problem. Thus it uses attention, coding, memory etc. *Knowledge acquisition components* help in acquiring knowledge and uses different strategies for it.

- 2) *Experiential or creative intelligence* refers to new ways of problem solving by engaging in divergent thinking. It uses prior knowledge and experience to come up with new ideas and solve problems. It includes two components: *Automation* and *novelty*. Automation means some aspects of information processing are automated, they do not require much attention, effort or energy. They can run parallel to other processes. This enables the individual to use cognitive resources for coming up with novel/ new ideas.

- 3) *Contextual or practical intelligence* refers to the ability to use information to function effectively in life. It is also known as ‘street smart’ or being high on ‘common sense’. It is the ability to understand and deal with everyday situation and events successfully. It is the ability to adapt, adjust and change depending on the contextual requirements. Thus they can handle real life problems.

It includes the components/subtheories of *adaptation, shaping* and *selection*. As Sternberg states, “Intelligence is purposive adaptation to, shaping of, and selection of real-world environments relevant to one’s life” (Sternberg, 1984, p.271).

Adaptation takes place when one makes changes within oneself to adjust to a new environment. For example, an intelligent person upgrades himself by learning new technologies to improve his employability.

Shaping occurs when one changes one’s environment according to his requirement. For example, the person may try to change the attitude of the employer or impress the selection committee.

Selection is done when a completely new environment is replaced with the older ineffective one. For example, the person may do a new course and try for another field or migrate to a place where there is better job opportunity.

An important asset of this theory is to avoid defining intelligence in terms of intelligence tests as in the case of analytical intelligence. Rather, contextual/practical intelligence focuses on performance in the everyday world.

<p>Self Assessment Questions III</p> <p>1) Singers, music composers are high on which intelligence?</p>
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2) Which professions best suits the persons high on bodily kinaesthetic intelligence?

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3) What is linguistic intelligence?

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4) What is logical mathematical intelligence?

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5) Define componential or analytical Intelligence.

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6) Explain contextual or practical intelligence.

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4.9 PASS THEORY OF INTELLIGENCE

The PASS theory of intelligence developed by J P Das et. al. (Das, Naglieri & Kirby, 1994) follows an information processing approach. The PASS stands for Planning, Arousal-Attention, Simultaneous and Successive processing. The theory is based on Luria's (1973) conception of three functional units of brain. The first unit is concerned with cortical arousal and attention, and is located in the brain stem and the reticular activating system. The second unit involves coding of information, either simultaneous or successive coding/processing. Thus it deals with how we receive, store and analyze the information. Simultaneous processing of information is represented by a holistic or comprehensive approach to processing of information. It is associated with the occipetal and parietal lobe of the brain. Successive processing refers to processing of information in a sequential way and is carried out by frontal-temporal part of the brain. The third unit deals with planning which includes decision making, self monitoring, self regulation and problem solving. It is broadly located in the prefrontal area of the brain.

As you see in the Figure 4eF below, the individual first receives the input from the sensory organs, and the external environment; the central processing mechanisms (the attention-arousal, simultaneous-successive processing, and planning) are activated then and process the inputs; finally, after the information is processed, it results in output. According to J P Das, all the four processing mechanisms operate in a knowledge base which consists of the past experiences, learning, emotion, motivation of the individual and the socio-cultural background of the individual.

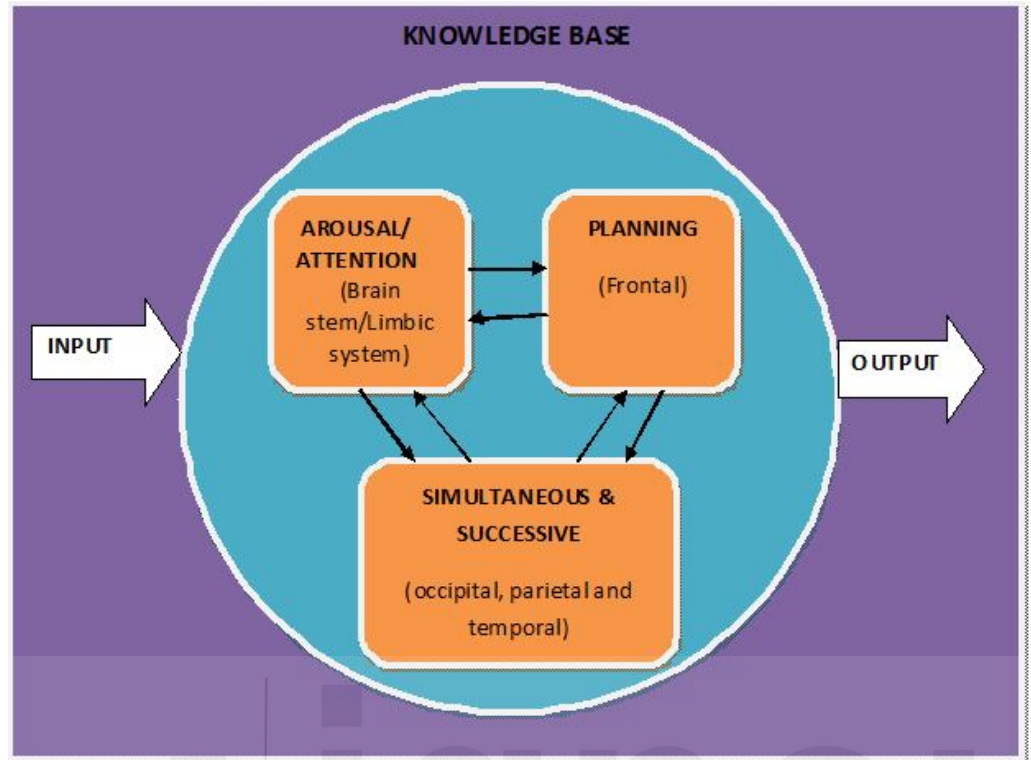


Figure 4eF: PASS Theory of J P Das

Thus the PASS model presents a comprehensive model of intelligence. It integrates the neuropsychological aspects, cognitive and psychometric approaches to intelligence. Further, it views intelligence in a contextual background through knowledge base. PASS theory has identified processes involved in intellectual ability and provided various tests to measure intelligence. The Das-Naglieri cognitive assessment system (CAS) is a comprehensive assessment that includes tests to assess each of the four components of the PASS model. It also provides remedial measures in case of processing difficulties. The PASS theory thus has given rise to evidence-based intervention programmes such as PASS Reading Enhancement Programme (PREP) and COGENT programme which aims at enhancing the cognitive processes.

4.10 CROSS CULTURAL CONCEPTION OF INTELLIGENCE

Intelligence has been viewed and theorized in various ways, starting from unitary notion to multiple intelligences. Majorly, it has been viewed as a decontextualized entity involving logical thinking, abstract reasoning and problem solving. Cross-cultural studies have pointed out cultural differences in the way intellectual abilities are reflected. You must have seen your local grocery shop owner doing mathematics calculation so easily even if he has not gone to school. Similarly, the rural and tribal cultures may not be very proficient in using paper and pencil as their urban counterparts, and may exhibit expertise in oral or other medium of expression. Thus there are cultural differences in the conceptualization and expression of intelligence. The western culture views intelligence more in terms of abstraction and generalization; whereas the non-western cultures relate intelligence more to the social context (e.g. Srivastava, 2013).

As Srivastava and Misra (1996) have pointed out, intelligence in the Indian context, is viewed in terms of relations or sensitivity to the context rather than the context-free western notion of intelligence. In their study, they reported that Indian notion of intelligence is multifaceted which includes not only the cognitive competence, but also the emotional,

social and entrepreneurial competence (Srivastava & Misra, 2007). Cognitive competence includes aspects such as planning, decision-making, sensitivity to context, reflection and communication. Emotional competence includes features such as control of emotions, expressing kindness, patience, adjustment, empathy, and honesty. Social competence involves attributes like obedience, helping the needy, adherence to norms, respecting parents and elders etc. Finally, intellectual behaviour also reflects entrepreneurial competence such as ability to do hard work, commitment, efficiency, patience and discipline.

Self Assessment Questions IV

- 1) Simultaneous processing is associated with which area of the brain?
- 2) Provide the full form of PASS:
- 3) PASS theory views intelligence in a contextual background known as
- 4) The western culture views intelligence more in terms of; whereas the non-western cultures relate intelligence more to

4.11 LET US SUM UP

Now we have learned about various theories of intelligence. Let us list the salient points in each of the theories discussed.

- Charles Spearman proposed the ‘Two Factor Theory of Intelligence’. He used factor analysis to find out the two important factors of intelligence i.e., the general ‘g’ factor and specific ‘s’ factor.
- Thurstone suggested that intelligence is a composite of seven distinct primary mental abilities (PMA).
- Unlike Spearman, Guilford believed that intelligence is a combination of multiple intellectual abilities. These are organized along three dimensions: operations, content, and products.
- Cattell (1971) proposed that two types of intelligence, fluid intelligence (gf) and crystallized intelligence (gc) constitute the *g*.
- The theory of multiple intelligences proposed by Howard Gardner (1983) views that intelligence consists of different abilities. It cannot be viewed as a single entity. Gardner has proposed nine types of intelligences which are relatively independent of each other.
- Sternberg formulated the ‘triarchic theory of intelligence’ which theorizes that intelligent behaviour consists of three major components or subtheories such as (a) componential or analytical intelligence, (b) contextual intelligence or the practical intelligence and, (c) experiential or creative intelligence.
- The PASS model presents a comprehensive model of intelligence integrating the neuropsychological aspects, cognitive and psychometric approaches to intelligence in a contextual background through knowledge base.
- Indian notion of intelligence is multifaceted which includes not only the cognitive competence, but also the emotional, social and entrepreneurial competence.

4.12 KEY WORDS

- Two Factor Theory** : was proposed by Spearman which states that intelligence consists of a general 'g' factor and specific 's' factors.
- Triarchic Theory of Intelligence** : proposes that intelligent behaviour is a combination of three types of intelligences such as analytical intelligence, practical intelligence, and creative intelligence.
- Multiple Intelligences** : advocates that intelligence is not unitary and it includes different abilities, e.g., Gardner proposes nine types of intelligences.
- Fluid Intelligence** : is more hereditary in nature and grows rapidly during the early years of life.
- PASS Model** : is proposed by J.P. Das et.al. (1994) and refers to Planning, Attention, Simultaneous and Successive Processing.

4.13 ANSWERS TO SELF ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) s factors
- 2) g factor
- 3) primary mental abilities

Self Assessment Questions II

- 1) operation, content, and product
- 2) visual, auditory, symbolic, semantic and behavioural
- 3) Fluid intelligence refers to the ability for abstract and logical thinking, and does not require any prior knowledge.
- 4) True

Self Assessment Questions III

- 1) musical intelligence
- 2) dancer, athlete, surgeon, actor, sports man, acrobat, yoga practitioner, surgeon, police officer and soldier
- 3) Linguistic intelligence is the capacity to use language fluently and flexibly to express one's own thinking and to understand others.
- 4) Logical-mathematical Intelligence involves scientific thinking and problem solving. It deals with abstract reasoning and manipulation of symbols involved in numerical problems.
- 5) Componential or analytical Intelligence is described more in terms with the traditional definitions of IQ and academic achievement and can also be referred to

as being 'book smart'.

- 6) Contextual or practical intelligence is the application of knowledge and information to real world situations, and includes the ability to understand and deal with everyday tasks.

Self Assessment Questions IV

- 1) occipetal and parietal lobe of the brain
- 2) PASS stands for Planning, Arousal-Attention, Simultaneous and Successive processing.
- 3) knowledge base
- 4) abstraction and generalization; social context

4.14 UNIT END QUESTIONS

- 1) Critically appraise Spearman's two factor theory.
- 2) How does Thurstone's theory differs from Spearman's theory of intelligence?
- 3) Differentiate theory of multiple intelligences from the unitary theory of intelligence. Explain the educational implications of Gardner's theory of multiple intelligences.
- 4) Describe the Structure of Intellect theory given by Guilford.
- 5) Critically examine Sternberg's triarchic theory of intelligence.
- 6) Describe the Indian notion of intelligence and contrast it with the western notion.

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*** Credit for the Figures (Figure 4aF, 4bF, 4cF, 4dF and 4eF) in Unit 4: Theories of Intelligence goes to Prof. Swati Patra, Discipline of Psychology, SOSS, IGNOU, New Delhi**

UNIT 5 ASSESSMENT OF INTELLIGENCE*

Structure

- 5.1 Objectives
- 5.2 Introduction
- 5.3 History of Assessment of Intelligence
 - 5.3.1 The Binet-Simon Scale: The First Intelligence Test
 - 5.3.2 The Revised Scales and the Advent of IQ
- 5.4 Individual Tests
 - 5.4.1 Stanford-Binet Scale of Intelligence
 - 5.4.2 The Wechsler Scales
 - 5.4.3 The Kaufman Scales
 - 5.4.4 Das-Naglieri Cognitive Assessment System
- 5.5 Group Tests
 - 5.5.1 Advantages and Disadvantages of Group Testing
 - 5.5.2 Examples of Group Intelligence Tests
- 5.6 Verbal and Nonverbal Tests
- 5.7 Culture-Fair Tests
- 5.8 Issues in Intelligence Testing
- 5.9 Let Us Sum Up
- 5.10 Key Words
- 5.11 Answers to Self Assessment Questions
- 5.12 Unit End Questions
- 5.13 References
- 5.14 Suggested Readings

5.1 OBJECTIVES

After reading this Unit, you will be able to:

- Present an account of the history of intelligence testing;
- Explain the essential properties of a test;
- Know and differentiate between the individual and group intelligence tests;
- Explain the difference between verbal and nonverbal intelligence tests; and
- Discuss the relevance of culture fair tests.

5.2 INTRODUCTION

In the previous Units (Units 3 and 4), you have learned about the definition, nature and theories of intelligence. You must have noted that psychologists are not unanimous regarding the nature of intelligence. Even, there is not a single definition accepted by all the theorists. So, how do we go about assessing intelligence? Assessment of intelligence is one of the most highly researched topics in psychology and consequently, a number of intelligence tests have been developed, most of which are based on a specific theory of intelligence. Assessing intelligence has implications for a wide range of areas, specifically for educational achievement and career recruitment.

In this Unit we will discuss about the history of intelligence testing, the types of tests and then discuss about certain issues concerning it.

* Dr. Manaswini Dash, Assistant Professor, Department of Psychology, Utkal University, Bhubaneswar, Odisha

5.3 HISTORY OF ASSESSMENT OF INTELLIGENCE

If we look back to the history of contemporary testing of intelligence, we can know that it started in the nineteenth century with rise in interest in the care and treatment of mentally retarded (now known as intellectual disability, refer to Unit 3). In 1838, a French Physician, Esquirol pointed out that there are different degrees of mental retardation, varying along a continuum from normality to ‘low-grade idiocy’ (no longer used now). He attempted to classify the different degrees of retardation on the basis of individual’s linguistic ability, as he believed that individual’s use of language is the most dependable measure of his/her intelligence.

Another French physician, Seguin, in 1837, established the first school for the education of mentally retarded children. He was employing physiological method of training, i.e., exercises for sensory discrimination as well as motor control was given. Some of the procedures developed by Seguin were eventually incorporated into performance or nonverbal tests of intelligence. His Seguin Form Board test required the individual to insert blocks of different shapes into the corresponding depressions/spaces on a board as quickly and as perfectly as possible. This test is used even today.

English biologist, Sir Francis Galton (1883) believed that individual’s ability to perceive the difference among stimuli is associated with his judgment and intelligence. He devised a number of tests of sensory discrimination like the Galton bar, the Galton whistle and weights for measuring kinesthetic discrimination. He believed that these tests could be used for measuring intelligence. James McKeen Cattell was also of the same opinion as Galton.

Now let us know about the first scales constructed to assess intelligence.

5.3.1 The Binet-Simon Scale: The First Intelligence Test

In 1904, the French Government appointed Alfred Binet to develop a measure to identify children with notably below average intelligence for their age, so that special education can be given to them. With this objective, in 1905 Binet with the help of Theodore Simon developed the first intelligence test, which is popularly known as the first Binet - Simon scale.



Figure 5aF: Binet and Simon

Source: upload.wikimedia.org (Binet) and en.wikipedia.org (Simon)

This scale consisted of 30 problems measuring a variety of functions, such as judgment, comprehension and reasoning. Binet believed that these functions are the essential components of intelligence. The items were arranged in ascending order of difficulty. The items were administered to 50 normal children of 3 to 11 years of age, some mentally retarded children and some adults in order to determine the difficulty level of the items. In this scale, no precise method to calculate the total score was available.

5.3.2 The Revised Scales and the Advent of IQ

In 1908, Binet and Simon revised their 1905 scale. As the 1905 scale had been designed to diagnose children with significantly below average intelligence, many of the items of the test were very simple. In 1908 version, many of the very simple items were dropped and new items were added.

The major innovation of this later version was the introduction of the concept of mental level. The test was standardized on about 300 children of 3 to 13 years of age. Binet and Simon arranged the items according to age level. All the items typically passed by a particular age group were placed at that particular age level. For example, all the items passed by 80-90 per cent of the 3 year olds were placed in the 3-year level. Similarly all the items were ordered according to age level up to age 13. The scoring system consisted of a basal age (all the items of that age level were passed by the child) and credits for partial years, finally expressing the scores in terms of a “mental level”. Mental level of a child corresponded to the age of normal children with whose performance, he or she was equal. Thus, a child of seven years may perform at the level of nine years old. Soon after, in various translations of the scale, mental level was substituted by “mental age”.

Mental age was being compared with the chronological age to indicate the individual’s intellectual level. For example, if an 8 -year old is functioning at the mental level (or mental age) of a 6-year old, he/she is said to be retarded by 2 years. On the other hand, if an 8-year old child is functioning at the mental level (mental age) of a 10-year old child, he is said to be advanced or ahead by 2 years. William Stern (1912) coined the term IQ or intelligence quotient to denote the ratio of mental age to chronological age.

In 1911, the Binet-Simon scale was revised for the third time. More items were added to extend the scale upto the age group of 16 years. The American version of the Binet-Simon test was developed by Terman and Merrill at Stanford University in 1916. It is known as Stanford-Binet Intelligence scale. Terman suggested for multiplying 100 to intelligence quotient in order to avoid fraction.

$$IQ = (\text{Mental Age} / \text{Chronological Age}) \times 100$$

In fact, intelligence testing is one of the major achievements of psychology in the twentieth century. After the success of Binet- Simon scale, several tests of intelligence were developed and refined. These tests can be grouped under (a) individual and group tests, (b) verbal and non-verbal tests, and (c) performance tests. Thus, tests can be categorized based on administration as well as the nature of test items. Refer to the Figure 5bF below.

TYPES OF INTELLIGENCE TESTS

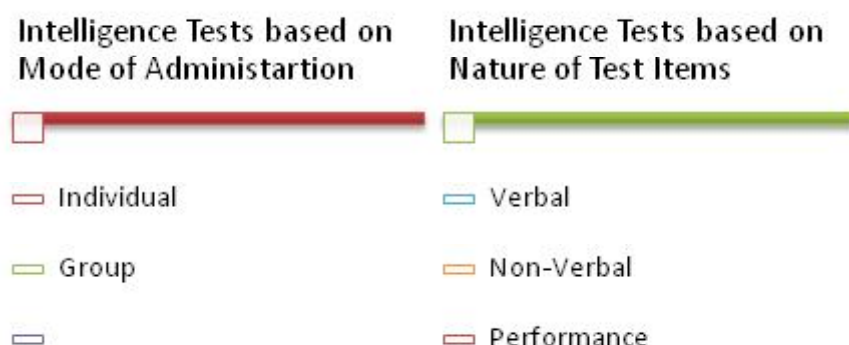


Figure 5bF: Types of Intelligence Tests

Intelligence tests are used in a variety of situations:

- 1) The most common use is in the context of educational setting. Due to their highly significant correlation with academic achievement, intelligence tests are very often used as tests of scholastic aptitude.
- 2) They are also used with normal adolescents and adults for educational and occupational counseling, and personnel selection.
- 3) Further, in clinical setting, they are used for identification and classification of persons with intellectual disability.

Here, let us see what constitutes a good test? When we need to use tests for educational, career or clinical purpose, there are certain considerations one needs to keep in mind. These are called the characteristics or properties of a test.

Properties of a good test

While choosing a particular test in a particular situation, one needs to consider the psychometric properties of the test. Three main properties are: standardization, reliability and validity.

An essential feature of any test is standardization. It implies two things: First, uniformity of procedures in administration and scoring of the test; and second, establishment of norms. Norm is the normal or average performance. Before using a test you should consider the characteristics of the standardization sample on which the norm has been established. Two other psychometric properties of a test are reliability and validity. Reliability is the consistency of scores obtained by a person when retested, be it with the same test, or an equivalent form of test, or by different examiners. Validity says whether the test measures what it intends to measure. You must have already read about properties of a good test in Unit 2 in the context of assessment of personality. You can refer back to it, to further your understanding.

Thus we need to use only such intelligence tests which have good psychometric properties. This is very important because otherwise the findings will not be correct and it may led to wrong information, labeling and stigma with regard to the individual tested.

Self Assessment Questions I

1) What do you mean by ‘mental level’?

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2) What is IQ?

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3) What is the meaning of test standardization?

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5.4 INDIVIDUAL TESTS

Let us now be familiar with some intelligence tests. As we mentioned earlier, intelligence tests can be individual or group tests.

Some individual intelligence tests are described below.

5.4.1 Stanford-Binet Scale of Intelligence

You have already read about the Binet - Simon scale (1905, 1908, 1911) in the earlier section. This test was translated and adapted by Terman (1916) and his associates at Stanford University. This American version of the test included a number of altogether new items and some old items which were revised. The entire scale was re-standardized on an American sample of 1000 children and 400 adults. The fifth version of the Stanford – Binet scale (SB5) was released in 2003. The major changes introduced in each version of the test are given in the Table 5aT below.

Table 5aT: Major Developments in the Binet-Simon and Stanford-Binet Scale

Year	Test/Authors	Comments/ Developments
1905	Binet and Simon	Simple 30 item test
1908	Binet and Simon	Introduced the mental age concept
1911	Binet and Simon	Expanded to include adults
1916	Stanford-Binet (Terman and Merrill)	Used the concept of IQ
1937	Stanford-Binet-2 (Terman and Merrill)	First use of parallel forms (L and M)
1960	Stanford-Binet-3 (Terman and Merrill)	Modern item analysis method used
1972	Stanford-Binet-3 (Thorndike)	SB-3 re-standardized on 2100 persons
1986	Stanford-Binet-4 (Thorndike, Hagen, and Sattler)	Content coverage was broadened by 15 subtests
2003	Stanford-Binet - 5 (Roid)	Five factors of intelligence

(Source: Gregory, R. J. (2004). Psychological Testing)

The SB5 Model of Intelligence

The Stanford-Binet – fifth edition (SB5 model) of intelligence consists of 10 subtests for assessing the intellectual and cognitive abilities. It assesses five cognitive factors such as Fluid reasoning, Knowledge, Quantitative Reasoning, Visual Spatial Processing, and Working Memory. Each cognitive factor is measured by two subtests.

The earlier versions of the Stanford – Binet were yielding a composite IQ. But the SB5 provides three IQ scores (Full score IQ, Verbal IQ, and Nonverbal IQ), as well as five factor scores. The mean and SD of each score (IQ and Factor scores) are set at 100 and 15 respectively.

The SB5 is suitable for use with children from age of two years to adults of 85 years.

The scale was standardized on a sample of 4800 individuals of United States stratified by gender, ethnic, regional and educational levels based on the 2000 census. The reliability and validity are very strong. The reliability of the three IQ scores are in the .90s and that of the subtests range from .70 to .85 (Roid, 2002).

5.4.2 The Wechsler Scales

David Wechsler developed three scales, one designed for adults, one for school-age children, and one for preschool children. These scales are used as measures of general intelligence; at the same time, they are also useful in psychiatric diagnosis. Wechsler observed that brain damage, psychotic deterioration, and emotional difficulties may affect some intellectual functions more than others. Hence, he argued that individual's performance on different subtests should be analyzed in order to diagnose different psychiatric conditions. Therefore, his tests contain several subtests from verbal as well as nonverbal domain.



Figure 5cF: (a) David Wechsler, (b) WAIS - III

Source: (a) ru.wikipedia.org, (b)alchetron.com, Free Social Encyclopedia for the World

Initially Wechsler was interested in developing a scale to measure intelligence in adults. He went through the then available scales. He realized that in these tests, particularly in the Stanford-Binet,

- the test items were not suitable for adults,
- manipulation of words were over-emphasized,
- speed of performance was emphasized at the expense of accuracy,
- mental age norms that were used were not relevant to adult testing.

To overcome these shortcomings, Wechsler developed the 'Wechsler Bellevue Intelligence Scale', which

- was specifically for adults,
- added performance items to balance verbal items,
- reduced the emphasis on speed of performance, and
- replaced mental age with Deviation IQ.

Deviation IQ is the intellectual level of an individual compared to her/his age-mates.

Instead of using the usual formula, $IQ = \text{Mental Age} / \text{Chronological Age}$, he invented a new age-relative formula:

$$IQ = \text{Attained or Actual Score} / \text{Expected Mean score for Age}$$

With this new formula, Wechsler assumed that IQ remains constant in spite of normal aging, even though the intellectual ability might decline. This assumption of IQ constancy is basic to the Wechsler scales.

In 1955, the Wechsler- Bellevue was revised into Wechsler Adult Intelligence Scale (WAIS).

Keeping the basic pattern the same in terms of form and content, Wechsler(1949) prepared the Wechsler Intelligence Scale for Children (WISC), which was meant to measure intelligence of children of 6 to 16 years of age. In WISC, many items were directly taken from the adult scale and easier items of the same type were added to each subtest. Another addition to the Wechsler family in 1967 was the Wechsler Preschool and Primary Scale of Intelligence (WPPSI), a downward extension of WISC, originally meant to make intellectual assessment of 4 to 6 and a half year olds. But now it has been revised to assess the intelligence of children aged 2 years 6 months through 7 years 7 months.

All these scales have undergone several revisions. Now the fifth version of the original Wechsler- Bellevue is available in the name of WAIS-IV (2012). WISC has also been revised for five times. The latest version WISC-V was published in 2014. After three revisions, WPPSI is in its current version, WPPSI-IV (2012).

All the Wechsler scales consist of a number of verbal and performance subtests. Some of the subtests are core tests and others are supplemental. These subtests together can provide a Verbal IQ score, a Performance IQ, and a Full Scale IQ score. In addition to IQ scores, they can yield four Index scores.

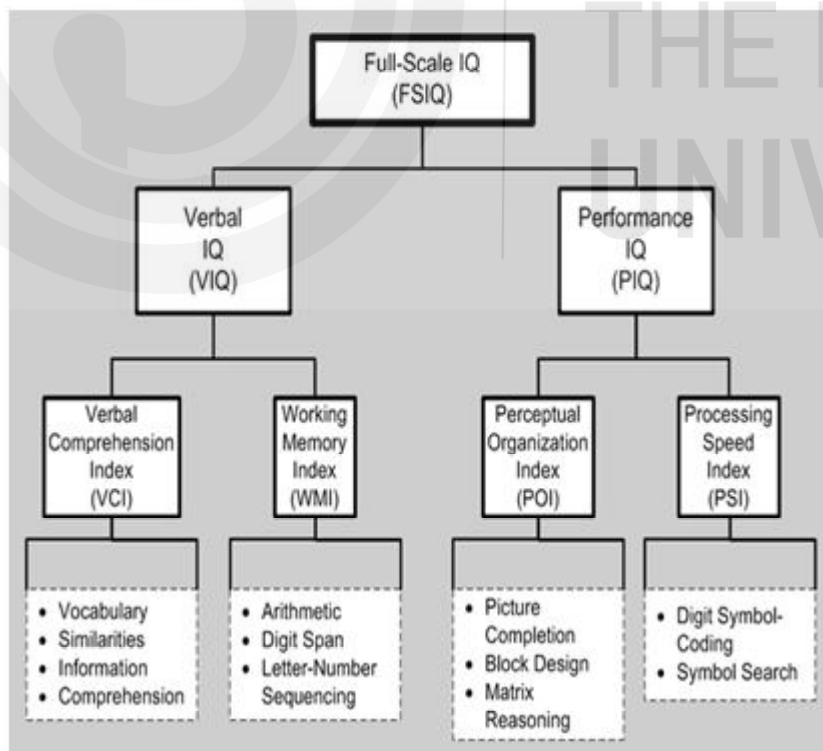


Figure 5dF: Subtests of Wechsler Scales

Source: en.wikipedia.org

General Features of the Wechsler Tests

- 1) Common subtests for different ages. The three scales, WAIS-IV, WISC-V, and WPPSI-IV, all have the same core subtests, such as: Vocabulary, Information, Symbol Search, Block Design, Matrix Reasoning, Picture Completion, and Comprehension. Once the examiner learns to administer any one of the core subtests, (such as information) on any of the Wechsler scale, can easily transfer the skill to the other Wechsler scales.
- 2) Multi-subtest approach enables the examiner to make intraindividual analysis of the strengths and weaknesses of the individual rather than just compute a single global score.
- 3) Verbal and a performance subtests constitute the Verbal and Performance Scales respectively. One can assess verbal comprehension and perceptual organization skills, working memory and processing speed separately with these subtests.
- 4) A common metric for IQ and Index scores, namely Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed. The mean and standard deviation for IQ and Index scores are 100 and 15 respectively. This IQ is known as Deviation IQ. Moreover, the scaled scores on each subtest have a mean of 10 and Standard Deviation of 3. Scaled scores allow the examiner to analyze the relative strengths and weaknesses of the examinee in the skills measured by the subtests.

All the versions of the Wechsler tests have been standardized on large stratified samples. The samples have been carefully stratified on such variables as sex, race/ethnicity, educational level, and geographic region etc. as per the census figures. All the Wechsler scales have high reliability and validity. The respective manuals provide the information regarding reliability and validity of the tests.

5.4.3 The Kaufman Scales

Kaufman and Kaufman, in the 1980s and 1990s, developed three scales which are individually administered. These scales were designed to include developmentally appropriate tasks anchored in theories of intelligence.

The Kaufman Assessment Battery for Children (K-ABC, 1983) is in line with the information processing theory of Das (1984) and Luria (1966). The test comprises seven tests of Simultaneous Processing, three subtests of Sequential Processing and an Achievement Scale consisting of six subtests. The Simultaneous Processing subtests require the synthesis and organization of visuo-spatial information that can be surveyed as a whole. The Successive Processing subtests require serial or temporal arrangement of the separate bits of information as well as short-term memory. These two mental processing scales are similar to those used in neuropsychological examinations. The Achievement subtests tap tasks similar to those included in traditional aptitude and intelligence tests, rather than measuring the factual knowledge taught in school.

The battery gives four global scores: Simultaneous Processing, Successive Processing, Mental Processing Composite and Achievement. The mean and SD of all these scores are set at 100 and 15 respectively.

The second edition of the K-ABC (K-ABC-II) was published in 2004. K-ABC-II incorporates two distinct theoretical models, Luria's and that of Cattell-Horn-Carroll. Before testing, the examiner has to decide which model to follow.

The Kaufman Adolescent and Adult Intelligence Test (KAIT, 1993) is a measure of intelligence for ages 11 through 85 years. This test is based on the theoretical propositions of Horn and Cattell (1966) as well as Luria (1980) and Piaget (1972). The KAIT consists of two batteries: The Core Battery and the Expanded Battery and a brief Mental Status test. The former is composed of a Crystallized Scale and a Fluid Scale, each having three subtests. The Crystallized Scale is related to concepts acquired from schooling and acculturation, while Fluid Scale measures the ability to solve new problems. The Expanded Battery is used with individuals suspected of neurological damage.

Kaufman Brief Intelligence Test (K-BIT, 1990, 2004) is a quick screening measure for estimating the level of intellectual functioning in 4 to 90 year olds. It consists of one verbal and one performance subtest. The test yields three scores, i.e., (verbal, performance and composite). The scores are expressed in terms of deviation IQ units.

The psychometric properties of the Kaufman scales are satisfactory having adequate normative sample, and high reliability and validity.

5.4.4 Das-Naglieri Cognitive Assessment System (D-N CAS)

The D-N CAS was published in the late 1990s. It is an individually administered instrument for assessing the cognitive processing. This test has its theoretical background in the PASS model of intelligence advanced by Das, Naglieri, and Kirby (1994). The CAS comprises several verbal as well as nonverbal subtests to measure four basic cognitive processes, namely Planning, Attention, Simultaneous processing and Successive processing. These processes are believed to be involved in learning, but are independent of schooling.

The CAS is used with children of ages 5.0 to 17.11 years. From the psychometric point of view, the test is sound.

Self Assessment Questions II

1) What are the shortcomings of the Stanford-Binet scale?

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2) Which processes are measured by the D-N CAS?

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3) Name the four index scores measured by the Wechsler scale.

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5.5 GROUP TESTS

As compared to the individual tests of intelligence, a group test is one that can be administered to more than one person at the same time. Thus a group intelligence test allows us for testing the intelligence of several persons, may be hundreds at a time, quickly and efficiently.

When the United States entered World War I in 1917, there was a pressing need for selecting one and half million candidates on the basis of their general intellectual level within very short time for recruitment to military services. The then available tests, since required manipulation of materials or oral responses from the examinee, could not be adapted to group administration. In this setting, under the direction of Robert M. Yerkes the Army Alpha and the Army Beta were developed. While the former was designed for general routine testing, the latter being a nonlanguage scale was used with illiterates and those who did not know English. Thus the Army Alpha and the Army Beta can be considered as models for group testing. They underwent a number of revisions. After the end of World War I, these tests were released for civilian use.

Features of Group Tests as different from Individual Tests

1) *Multiple-choice versus open-ended format*

Although open-ended questions asking for free responses were used in the early group tests, today most group tests employ multiple-choice items. This change in format has ensured uniformity and objectivity in scoring.

2) *Quick and objective machine scoring versus examiner scoring*

Since multiple-choice items are used, scoring takes less time because of the use of scoring templates. Even scoring can be far quicker if it is done by an optical scanning device. Computer scoring eliminates the chances of examiner errors and halo effects that may occur in scoring individual tests.

3) *Group versus individualized administration*

While administering a group test, the examiner only reads the instructions and enforces the time limits. Thus, her/his role is minimal having no scope for one-to-one interaction. In individual test administration, examiner rapport is an important requirement. The examiner needs to be trained and experienced in training.

4) *Control of item difficulty*

In individually administered tests, often there are entry rules and discontinuation rules. The examiner follows these rules to ensure that the test taker takes the items according to her/his ability level. In the group tests, no such starting and discontinuation rules are there.

5) *Application: Screening versus diagnosis and remedial planning*

Group intelligence tests are commonly used for screening the subjects for a particular course or a job. But traditional individual intelligence tests are used as an aid for the diagnosis of and planning remediation for children with learning difficulties.

6) *Very large versus not-so-large standardization sample*

Group tests, in general, are standardized on very large samples compared to individual tests.

5.5.1 Advantages and Disadvantages of Group Testing

Advantages

- 1) Group tests are designed primarily for mass testing. Simultaneously, they can be administered to a number of persons.
- 2) In group testing, examiner's role is simplified. On the other hand, individual tests like Stanford-Binet or Wechsler, the examiner has to have extensive training.
- 3) Scoring is more objective and simpler in comparison to individual tests.
- 4) As it is easier to obtain large amount of data with group tests, they provide better established norms.

Disadvantages

- 1) Since in group testing the examiner has less opportunity to establish rapport with the examinees, some people, particularly those having motivational problems or difficulty in following directions may score far below their true ability.
- 2) Group testing lacks flexibility, as all examinees are required to answer all the items. If there are too many easy or difficult items, the examinee may feel bored or frustrated respectively.
- 3) Invalid scores are difficult to be recognized.

5.5.2 Examples of Group Intelligence Tests

i) Multidimensional Aptitude Battery (MAB)

The Multidimensional Aptitude Battery (MAB; Jackson, 1984) is a paper-pencil equivalent of the WAIS-R. The test consists of 10 subtests, five each from verbal and performance categories. Although the subtests have the same name as the WAIS-R subtests, the test items are not same. The items within each MAB subtests are multiple-choice and are arranged in order of increasing difficulty. Like WAIS-R, this test also provides 10 subtest scores, as well as Verbal, Performance and Full Scale IQs. It is appropriate for people of 16 to 74 years of age. The psychometric properties are comparable with that of WAIS-R.

ii) Cognitive Abilities Test (CogAT)

The Cognitive Abilities Test (Lohman & Hagen, 2001) is a group-administered, standardized, norm-referenced test. This test has been designed to assess the basic skills that are prerequisite to classroom-based learning. It measures students' learned reasoning and problem-solving skills in three different areas: verbal, quantitative, and nonverbal. Each of these areas of cognitive abilities is measured by three subtests. Thus, there are a total of nine subtests.

CogAT is a multilevel battery consisting of a series of overlapping tests. There are two levels for students in kindergarten through grade 3 and eight levels covering grades 3 through 12. For each level, there are different sets of items. But adjacent levels contain some common contents. Because of the overlapping nature of test contents, proper assessment of students at both the extremes (i.e., poor and bright students) is possible.

The test provides age-based normalized standard scores for each battery with mean of 100 and standard deviation of 15. In addition, per centile ranks and stanines are also available. The reliability of the test is exceptionally good while the validity is also reasonably good.

iii) **Culture Fair Intelligence Test (CFIT)**

The Culture Fair Intelligence Test (Cattell, 1940; IPAT, 1973) is a nonverbal measure of fluid intelligence. It was designed to measure analytical and abstract reasoning ability in a manner so as to make it free from the effects of culture as far as possible. Originally the test was named as Culture Free Intelligence Test. Later the name was changed to Culture Fair Test as it was realized that cultural influences cannot be eliminated totally from any intelligence test.

The CFIT consists of three scales: Scale 1 is used with mentally retarded adults and children from four to eight years of age; Scale 2 is meant for use with adults with average intelligence and children aged eight to thirteen. High school and college students as well as adults with superior ability are administered the Scale 3. Each scale comprises four subtests: Series, Classification, Matrices, and Condition. Two equivalent forms, Form A and Form B are available for each scale.

Scale 1 requires considerable interaction between the tester and the test taker. Hence, in a strict sense, Scale 1 is not a group test. The other two scales are truly group tests of intelligence.

The scores are expressed in terms of normalized standard score IQs with mean 100 and standard deviation 16. Psychometrically the CFIT is a worthy test, but it needs to be revised.

iv) **Raven's Progressive Matrices (RPM)**

Raven's Progressive Matrices (Raven, 1938, 1986, 1992) is a nonverbal test of inductive reasoning, originally designed to measure Spearman's g factor. Spearman defined g as the "education of correlates". Education refers to the process of finding out the relationships based on the fundamental similarities among the stimuli. The test contains figures presented in a matrix form i.e., they are arranged in a pattern with rows and columns. The task of the test taker is to choose the missing part of the matrix from the alternatives given below it. The test taker, in order to perform the item correctly, must identify the recurring pattern of relationship among the figures.

Raven, in actuality, constructed three different instruments: Coloured Progressive Matrices for five to eleven year old children, Standard Progressive Matrices (1996 Edition) for individuals between the ages of 6 to 80 years, and Advanced Progressive Matrices for adults and adolescents with superior intelligence. Although the three forms of the test appear to resemble each other, the strategies required for solving the problem in each form are different.

The test is a nonverbal one. Use of language is restricted only to giving instructions to the test-taker. Even, if necessary, the test can be explained through pantomime also. Once the test-taker understands his task, he does not require language anymore for solving the problems. Therefore the RPM is best suited for testing persons who do not know English. Thus, culture's influence is kept at minimum.

The test can be administered individually or in groups. For normal adults and adolescents in their late teens the reliability coefficients (both split-half and test-retest) vary between .80s and .90s. But for very young subjects, RPM does not possess sufficient reliability. The predictive validity of the test against academic criteria is lower than that of usual verbal intelligence tests.

Self Assessment Questions III

1) Write the advantages of group tests of intelligence.

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5.6 VERBAL AND NONVERBAL TESTS

In the earlier sections, we described intelligence tests as grouped into individual and group tests based on administration. In this section, you will learn that intelligence tests can also be classified as verbal and nonverbal tests based on the nature of items in the test.

A verbal test, as the name suggests, is the one in which language is required for successful performance in it. Verbal intelligence is the ability to comprehend and solve language-based problems. The problems require the ability to analyze verbal information and language-based reasoning like verbal analogies. If we look back into the history, we can know that French physician, Esquirol (1838), attempted to diagnose and classify the mentally retarded on the basis of their language skills. Binet also overemphasized on language skills in his intelligence test. But psychologists soon began to realize that this test was inappropriate for people who do not know English and those who have limited language ability like illiterates, children and persons with speech and hearing impairments, due to its overemphasis upon verbal skills. Therefore, a number of nonverbal intelligence tests came into being. Though the Wechsler scales, Kaufman scales, Das-Naglieri test, Otis Quick-scoring Intelligence Test, Multilevel Ability Test etc. have a verbal component, they also include some nonverbal subtests.

Nonverbal tests of intelligence tap the ability to analyze visual information and solve problems without necessarily using words. The tasks may involve the ability to recognize visual sequences, understand and recognize the relationships between visual concepts and situations, as well as perform visual analogies.

The earliest nonverbal/performance test was the Seguin Form Board. Though several performance tests were developed in the early part of the twentieth century, two of the more known tests were the Kohs Block Design test (Kohs, 1920) and the Porteus Maze Test (Porteus, 1915, 1919). The Kohs Block Design test requires the individual to assemble painted blocks to match a pattern. The Porteus test consists of a graded series of mazes. This test is still available today, but is not in wide use.

The Army Beta test came into being out of the necessity to recruit the illiterate and non-English-speaking persons to the army. So obviously it was a non-language test consisting of a number of visual-perceptual and motor tests like tracing a path through mazes and saying the correct number of blocks shown in a three-dimensional drawing.

The Culture Fair Intelligence Test (Cattell, 1940; IPAT, 1973) and Raven's Progressive Matrices (Raven, 1938, 1986, 1992, 1995) are well-known nonverbal intelligence tests which are discussed in the previous section.

Self Assessment Questions IV

1) Name some nonverbal tests of intelligence.

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5.7 CULTURE FAIR TESTS

In 1910, Goddard was assigned the work of assessing intelligence of immigrants of Ellis islands. He noted that the immigrants, mostly constituted by Hungarians, Jews, Italians and Russians were having low IQs, and their low IQs were due to environmental deprivation. Goddard (1912, 1917) has pointed out that Non-white people are usually at a disadvantage as intelligence tests are biased towards White people. Critiques have highlighted that intelligence tests are biased towards the majority group in the society. The minority people, the disadvantaged group are usually at a disadvantage.

Between any two cultural groups there are cultural differences. Different cultural groups value, demand and thereby motivate different behaviour. Hence, for assessing individuals from different cultures, culture free tests are needed. Some of the earliest cross-cultural tests (Knox, 1914) were developed during 1910s. Usually cultures vary along the following parameters:

- i) Language – Different cultural groups speak different languages
- ii) Reading experience – Cultures are different with respect to their educational background. Illiteracy prevails in some cultures.
- iii) Speed – The tempo of daily life, motivation to hurry and the value attached to speed of performance vary widely among different cultural and ethnic groups, even within a nation.
- iv) Environmental experiences – People of different cultures experience different natural and social phenomena. For example, people of many cultures do not have an experience of snowfall. If they are asked about information relating to snowfall, they may be unable to answer.

The classic culture free tests earlier were attempting to control these cultural parameters. The authors try to make the test content culture free as far as possible. However, it is realized that impact of culture cannot be eliminated completely from these tests. Therefore the term ‘culture fair’ is used in place of ‘culture free’ tests.

Typical Culture Fair Instruments

- i) The Culture Fair Test (Cattell, 1940; IPAT, 1973) is a nonverbal test. We have already discussed about it under the section of ‘Group Tests’.
- ii) Raven’s Progressive Matrices (RPM -Raven, 1938, 1986, 1995) has also been discussed in the ‘Group Tests’ section. RPM frees itself from the effects of language and speed. The test contains abstract figures that are considered not to favour any particular culture.

- iii) The Leiter International Performance Scale-Revised (Roid&Miller, 1997) was originally published in 1940. This scale was developed for use with different ethnic groups of Hawaii, but later applied to several African groups. The distinctive feature of the test was almost elimination of verbal instructions and absence of any time limit. The test is individually administered. This test covers four domains of functions, namely, Reasoning, Visualization, Attention, and Memory.
- iv) Draw-a-Man Test developed by Goodenough (1926) and its revised version, the Goodenough-Harris Drawing Test (Harris, 1963) adopts a different approach. The test taker is asked to make a picture of a man. The test, instead of artistic skill, emphasizes on the child's ability to observe accurately and think conceptually. Credit is given for inclusion of body parts, clothing, proportion, and perspective etc. Credit points obtained by the test taker are converted to standard scores.

5.8 ISSUES IN INTELLIGENCE TESTING

In the previous sections we discussed some standardized intelligence tests which are quite sophisticated and widely used. However their widespread use has always been controversial. Critics of intelligence testing have raised a number of issues. Let us discuss some of the issues associated with intelligence testing.

- Intelligence tests have been found to be useful in predicting mainly academic achievement. Intelligence test findings can be used to help students find out their level in different mental abilities. This may help design further training and appropriate remedial programmes for the students. Given the benefits of intelligence testing, there is also the issue of labeling a child based on the test findings. A child who has not performed well on intelligence test may be labeled as dull or incompetent. Such a child may be stigmatized and discriminated in school as well as in family. The misuse of intelligence testing may do more harm than good to the child.
- There has been question raised with regard to the validity of intelligence tests also. It is pointed out that IQ tests measure factors other than intelligence like environmental factors such as quality of education, exposure to stimulation, prior knowledge of the information on the test and the individual's test-taking skills etc. If all these non-intelligent factors are responsible for individual differences in IQ scores, then it compromises the accuracy of IQ tests. In such cases, the use of IQ tests as part of diagnosis of intellectual disability and learning disability may not give the correct picture.
- Intelligence is not limited to IQ alone. The IQ tests measure only a part of overall competence of human beings. Success in life depends on several other aspects, such as creativity, social competence, practical problem solving abilities etc. Further, the traditional IQ tests may not recognize the other kind of intelligences, for example as proposed by Gardner.
- Some critics argue that most intelligence tests are biased against certain groups, particularly those who vary from mainstream Western society. Language and nature of the test items may create problems in estimating intelligence of people from non-white cultures. For instance, tribals have a rich source of indigenous knowledge, but they may not perform well on the standard tests of intelligence. The reason is that the tests do not reflect their context, knowledge and culture.
- Intelligence testing for infants and preschoolers has also been questioned for its sensitivity, accuracy and predictive value.

5.9 LET US SUM UP

Now that we have come to the end of this Unit, let us list all the major points that we learnt.

In the nineteenth and early part of twentieth century, interest in the care and treatment of mental retardation increased. Hence, the need for identifying the intellectually poor people was felt. Esquirol and Seguin had their own tests used for this purpose. However, the credit of the first intelligence test goes to Alfred Binet who was given the task of developing a measure to identify the retarded children. In 1905 Binet and Simon developed the first intelligence test, which is popularly known as the first Binet Simon Scale. In 1916, the American version of the Binet-Simon test was developed by Terman and his associates at Stanford University. The scores on the Binet test were expressed in terms of 'Mental Age' and later the expression, 'IQ' came into use to indicate the intellectual level of a child.

In order to address the inherent inconvenience in the interpretation of mental age and its use in finding out adult intelligence, David Wechsler talked of 'Deviation IQ'. He developed three scales, one designed for adults, one for school-age children, and one for preschool children.

Besides the Stanford-Binet and Wechsler scales, there are a number of other individual and group intelligence tests. An individual test is administered to one individual at a time and a group test is one that can be administered to more than one person at the same time.

Intelligence tests can also be classified as verbal and nonverbal tests. A verbal test is one in which language is required for successful performance in it. Nonverbal tests without necessarily using words tap the ability to analyze visual information to solve problems.

Psychologists acknowledged that intelligence tests developed for Western people are not suitable for use with nonwestern people. So they developed a number of culture fair tests for cross-cultural use.

Though intelligence tests have become popular, their widespread use is controversial. There are chances of misuse of IQ tests and if misused, they can be more harmful than useful.

5.10 KEY WORDS

- Mental age** : refers to the age at which an individual performs on the test items. For example, if a 6 year old child performs like a 9 year old child, then his mental age is 9 years.
- Intelligence quotient** : is a measure of intelligence expressed as the ratio of mental age divided by chronological age and multiplied by 100.
- Standardization** : refers to uniformity of procedures in administration and scoring of the test; and establishment of norms.
- Norm** : is the normal or average performance by the individuals of a particular age group.

- Binet Simon scale** : was the first intelligence test developed by Binet and Simon in 1905 to identify children with notably below average intelligence for their age, so that special education can be given to them.
- Wechsler scales** : consist of the intelligence scales developed by David Wechsler to assess intelligence of adults, school-age children and pre-primary school children.
- Deviation IQ** : refers to intellectual level of an individual compared to her/his age-mates. It has a mean of 100 and standard deviation of 15.
- Culture fair intelligence tests** : refer to tests which are not biased by cultural differences in the individuals taking the test.

5.11 ANSWERS TO SELF ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) 'Mental level' of a child corresponds to the age of normal children with whose performance he or she is equal. Soon after, in various translations of the Binet-Simon scale, mental level was substituted by 'mental age'.
- 2) IQ denotes the ratio of mental age to chronological age. Terman suggested for multiplying 100 to intelligence quotient in order to avoid fraction.
$$IQ = (\text{Mental Age} / \text{Chronological Age}) \times 100$$
- 3) Standardization implies two things: First, uniformity of procedures in administration and scoring the test, and second, establishment of norms.

Self Assessment Questions II

- 1) Shortcomings the Stanford-Binet scale:
 - the test items were not suitable for adults,
 - manipulation of words were over-emphasized,
 - speed of performance was emphasized at the expense of accuracy,
 - mental age norms used were not relevant to adult testing.
- 2) Planning, Attention, Simultaneous and Successive processing
- 3) Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed.

Self Assessment Questions III

- 1) Advantages of group intelligence tests:
 - They can be simultaneously administered to a number of persons.
 - The examiner does not need extensive training for administering the test.
 - Scoring is more objective and simpler in comparison to individual tests.

- As it is easier to obtain large amount of data with group tests, they provide better established norms.

Self Assessment Questions IV

- 1) The Seguin Form Board, the Kohs Block Design test, the Porteus Maze Test, the Army Beta test, the Culture Fair Intelligence Test and the Raven's Progressive Matrices.

5.11 UNIT END QUESTIONS

- 1) Give a historical account of intelligence testing.
- 2) Describe some individually administered intelligence scales.
- 3) Discuss group intelligence tests.
- 4) What is a culture fair test? Give some examples of culture fair intelligence tests.

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UNIT 6 APTITUDE: CONCEPT AND MEASUREMENT*

Structure

- 6.1 Objectives
- 6.2 Introduction
- 6.3 Definition and Nature of Aptitude
- 6.4 Aptitude and Related Concepts
 - 6.4.1 Aptitude and Intelligence
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6.1 OBJECTIVES

After reading this unit, you will be able to:

- Define aptitude;
- Know the characteristic features of aptitude;
- Differentiate aptitude from intelligence, achievement and interest;
- Know about some of the widely used aptitude tests; and
- Describe the uses, advantages and limitations of aptitude tests.

6.2 INTRODUCTION

In the previous Unit you have read about the assessment of intelligence, particularly about the development of intelligence tests. By now you know that intelligence tests were originally designed to estimate the individual's general intellectual level by testing a

* Dr. Manaswini Dash, Assistant Professor, Department of Psychology, Utkal University, Bhubaneswar, Odisha

wide variety of mental functions. But soon it was felt that these tests were not giving adequate information about the individual's abilities. Mostly, they were covering only those abilities that were valued and considered important in the culture for which they were designed, ignoring many others. Psychologists gradually came to realize that the term "intelligence test" was a misnomer, as they were tapping only certain aspects of intelligence.

Moreover, it was also observed that an individual's performance on different parts or subtests of a test often showed variations. Most intelligence tests were primarily measuring verbal ability with some numerical ability and the ability to find out the relation between abstract figures. A person might obtain relatively high score on a verbal subtest while scoring relatively low on a numerical subtest. On the other hand, another person might have scored low on verbal items, while obtaining an excellent score on numerical subtest. Such inter-subtest performance comparisons are helpful in understanding the individuals' psychological makeup. But their global or general IQ scores may obscure their true potentiality. Thus, two individuals may have the same IQ, and yet have different abilities. Therefore, it was felt that while evaluating a person, performance on subtests should be considered, so that her/his abilities in different tasks could be known. However, intelligence tests were not adequate enough for assessing the individual's abilities in different areas separately, because the subtests in a test were too short to be a reliable measure of the specific abilities. Thus tests of special aptitudes were deemed necessary for making intra-individual comparisons. Aptitude can be understood as an ability to acquire a specific type of skill or knowledge. In this Unit, we are going to discuss the concept and measurement of aptitude.

6.3 DEFINITION AND NATURE OF APTITUDE

The word aptitude is derived from the word "aptos" which means 'fitted for'. Very often words such as 'potentiality', 'capacity', 'talent' etc. are used synonymously with aptitude.

In the Dictionary of Education, aptitude is defined as a "pronounced innate capacity for or ability in a given line of endeavour such as a particular art, school subject or vocation.

In Warren's Dictionary of Psychology, aptitude has been defined as "a condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some (usually specified) knowledge, skill, or set of responses, such as the ability to speak a language, to produce music" (Bingham, 1942).

English and English (1958) defined the term as "the capacity to acquire proficiency with a given amount of training."

According to Traxler (1957), "Aptitude is a condition, a quality or a set of qualities which is indicative of the probable extent to which an individual may be able to acquire, under suitable training, some knowledge, understanding, or skill."

If we analyze all the above definitions, we can discern certain features of aptitude as follows:

- Aptitude is symptomatic or indicative of one's potentialities.
- Aptitude is the result of interaction of heredity and environment. An individual is born with certain potentialities. After that, the environment helps or hinders the expression of these potentialities.

- The concept of aptitude is very broad. That means aptitude embraces any characteristic which contributes to learning, including intelligence, achievement, personality, interests and skills.
- It is not confined to ‘specialized learning capacities’ such as music or painting. Most intelligence tests predict the student’s ability to learn to read, write, and do mathematics. In other words, these tests measure the student’s potentiality for learning academic subjects. Therefore, it can be said that these intelligence tests are scholastic aptitude tests.
- Aptitude predicts future ability. When you say, “X has scholastic aptitude”, it means that X will be successful or do good in academic activities. Thus aptitude always has a future reference.
- Aptitudes are qualities of an individual that can be harnessed by appropriate training. In other words, for example, if a person does not have the aptitude required to become a musician, that is she/he does not have the ability to discriminate between pitch, tone, rhythm, and other aspects of musical sensitivity, she/he would not be a musician, even after sufficient training.

Self Assessment Questions I

1) Define aptitude.

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2) Is aptitude innate or acquired? Explain.

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6.4 APTITUDE AND RELATED CONCEPTS

In this section we will discuss the relationship of aptitude with concepts like intelligence, achievement and interest.

6.4.1 Aptitude and Intelligence

Psychologists are divided so far as their opinion about the relationship between aptitude and intelligence is concerned. One group thinks that both the terms are essentially the same whereas for the other group, aptitude is a specific type of intelligence. They believe that intelligence is represented as a unitary trait in terms of IQ, while aptitude has a multi view of human ability. Aptitude represents the multi/several characteristics that are part of intelligence, and these characteristics are relatively independent from each other.

In other words, aptitude is a subset of intelligence referring to specific competencies like drawing, playing chess, flair in music, running etc. Intelligence is a broader term encompassing various aptitudes including both competency as well as mental/intellectual capability. Intelligence in terms of the traditional tests of mental ability is more related to success in school whereas aptitude can be said to be more related to success in the vocational and career arena.

A comparison between the two concepts can be described as follows:

- Aptitude can be described as a specific ability of an individual; whereas intelligence refers to a general mental ability cutting across different types of tasks.
- Thus, aptitude has a defined or narrow scope; and intelligence has a broader scope.
- Aptitude has future orientation as it indicates the potential for learning. It does not indicate what the person can do now. Intelligence, on the other hand, indicates the present ability; what the person knows and what he can perform in different areas. Aptitude refers to how well the person can do in future.
- Aptitude refers to the capability the person can achieve with training. Intelligence tests, based on the existing capability of the person, can predict her/his success in different areas involving those mental capabilities.
- In general, aptitude tests are designed and used for career and employment decisions. Intelligence tests are more likely to be used for educational, clinical and research purposes.

6.4.2 Aptitude and Achievement

Aptitude is also different from achievement. In general, aptitude refers to an individual's potentiality, that is, what she/he can do (but has not yet done). Thus, it is the potential capability of the person or what the person can do without any previous knowledge/learning. Achievement, on the other hand, refers to what a person has already done. It assesses knowledge which you have already learned. Thus, achievement can refer to your performance at any given point of time in a particular subject (e.g., mathematics), which you have already acquired through training.

The differences between the two concepts can be described as follows:

- Aptitude refers to what the person can do, not what he has done. Achievement refers to what a person has already done. Aptitude tests measure the ability to learn; they have the potential to predict a person's success in future academic or career field. Achievement tests, on the other hand, assess the existing learning status of the person, i.e., what the person already knows.
- Thus, while aptitude is future-oriented, achievement is past-oriented.
- Aptitude tests measure how well the person will learn in future; achievement tests assess how well the person has learnt in the past.
- Aptitude tests are administered before training is given. Achievement tests are given after training is given.
- Aptitude tests are evaluated in terms of predictive validity, how well they can predict a person's success in a particular area with training. Achievement tests are evaluated in terms of content validity, how well the person has mastered the particular content. That is why, they are also called 'content tests'.

6.4.3 Aptitude and Interest

Interests reflect the things that one likes to do regardless of her/his skill. They provide a direction to the development of habits and activities. But a skill will be developed only if both the interest and the necessary talent (aptitude) are present in the individual.

Interest refers to the liking of a person for a particular thing/activity. For example, I may like music, but I may not have aptitude for it. Here, the interest that is shown may not be the result of my inner potential, but may be due to some other influences such as peer pressure, or school requirement or even parents wanted it. Thus, interests are temporary, not stable. They may change over time.

Even if one has aptitude for a particular thing, if one does not have interest in it, s/he will not put in that much time and effort required for it. For instance, you may have wonderful aptitude for drama and theatre, but without sufficient interest in it, you will not devote the time and effort required to develop the skill.

Similarly, in the absence of sufficient aptitude, even if the individual has the strongest interest, s/he will be able to acquire the skill only to a limited extent. Hence both aptitude and interest are required to perform well in a particular area.

The difference between aptitude and interest are given below.

- Aptitude refers to what the individual can do. However, the person may not have interest in it. Interests reflect the things that one likes to do. Having potential does not guarantee one's interest in it also.
- Aptitudes do not change over time. They are primarily innate abilities. Interests may change over time with change in the knowledge and experience of the person. Interests are acquired, hence they are influenced by a variety of factors including the parental, peer group, school and media influences.
- Thus, if one has the potential (aptitude) for a particular thing/activity, and also interest in it, then it becomes easier for one to acquire the skills necessary for the activity.

Self Assessment Questions II

1) Write the difference between aptitude and achievement.

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6.5 MEASUREMENT OF APTITUDE

In the beginning of the Unit, we have already mentioned that the traditional intelligence tests which were assessing the individual's general intellectual level and giving a global score were found to be giving limited information about individual's true abilities. Two persons obtaining the same global IQ score may be quite different from each other in terms of their special abilities. It was felt that tests of special aptitudes are needed in order to get a true picture of the individual. This resulted in the development of a number of aptitude tests, measuring single aptitude as well as multiple aptitude test batteries.

The development of aptitude tests gained momentum because of two reasons. First, with the use of the statistical technique of 'factor analysis', psychologists like Spearman (1904, 1927), Kelley (1928), Thurstone (1938, 1947) and a number of other British and American researchers opined that intelligence is not a unitary construct. It was

viewed that an individual's psychological make-up can be better defined by a number of special distinctive abilities or aptitudes. Consequently, a number of multiple aptitude test batteries were developed to examine the individual in several separate homogeneous aptitude areas. The subtests of these test batteries were based on the findings of factor analysis. One of the earliest examples of multiple aptitude test batteries is Thurstone's Primary Mental Abilities Test which consisted of seven subtests selected on the basis of factor analytic result (Thurstone, 1938).

And secondly, though the need for aptitude tests was felt before the World War I, it was during the World War II when special batteries were constructed for use in the armed forces to recruit pilots, bombardiers, fight engineers and many other military specialists that these tests were proved to be very successful. Likewise, a number of aptitude tests were also developed for civilian use, particularly in educational and vocational counseling and personnel selection.

In the late 1980s and early 1990s, a trend of integrating traditional intelligence tests with multiple aptitude tests has emerged (Anastasi, 1994). Recently developed intelligence tests such as the Differential Ability Scales and the Stanford-Binet IV cover narrowly defined multiple aptitudes through increasing broader traits with flexible multilevel scoring. Often psychologists also use these tests of abilities as measures of aptitudes. On the basis of scores on these measures, candidates get admission into different courses. These abilities may be necessary for getting along in schools. Nevertheless, these cognitive abilities are not of much use once the person enters into an occupation. For example, an X-ray technician or a plumber may be requiring such cognitive abilities very less for carrying out their jobs. So for predicting success in different jobs, we have to administer tests that measure that particular skill.

As aptitude tests are concerned with the potential of doing something, they are used for prediction. If we are going to predict academic success, we have to measure scholastic aptitude. If our intention is to predict success in a particular job, we have to administer a vocational aptitude test that measures the skills necessary for carrying out that particular job. Vocational/career aptitude tests are used by employers to select employees as well as by vocational counselors to help people assess their potentialities for different types of work. Employers need tests designed for that purpose only.

Now let us see the various uses of aptitude tests below.

6.5.1 Uses of Aptitude Tests

- 1) *Career counseling:* Aptitude tests are used mostly by career counselors to help students make a proper choice of courses or occupation. In such cases, the counselor administers aptitude test batteries that are a combination of tests measuring a wide variety of abilities.
- 2) *Clinical service:* Information obtained from aptitude tests can also be used for making a clinical decision regarding an underachieving, maladjusted student—whether he has motivational or other conduct problem or he simply lacks the ability to learn.
- 3) *Personnel selection:* Employers use vocational aptitude tests to select employees. Usually, they use special aptitude tests that measure the particular skill required for the job. These tests predict success in the particular job.
- 4) *On the job training:* Organizations rely on aptitude test scores for training and need analysis, i.e., exploring the strengths and weaknesses of the individual employees, so as to provide them need-based on the job training.

- 5) *Screening for admission:* Most educational institutions select candidates to give admission into different courses on the basis of scores on aptitude tests, e.g., courses on education (B.Ed) and management.
- 6) *Curricular planning:* School administrators use performance on multiple aptitude test batteries as a frame of reference for curricular planning- which courses to be taught and who are to be taught etc.

6.5.2 Examples of Aptitude Tests

Here we will describe the tests used to assess aptitude. First some of the widely used multiple aptitude test batteries are discussed, following which some tests of specific aptitudes are described. Thereafter some tests used for admission purposes to predict college performance are given.

6.5.2.1 Multiple Aptitude Test Batteries

i) Differential Aptitude Test (DAT)

The Differential Aptitude Test (DAT) is developed by Bennett, Seashore, and Wesman (1947, 1982, 1984). It is one of the most widely and commonly used multiple aptitude test batteries. First published in 1947, the test is now available in its fifth edition (1992). The fifth edition of the battery has been designed for use in educational and career counseling of students in Grades seven through twelve; organized into two levels; one for students in Grades seven to nine and the other for students in Grades ten to twelve. The DAT consists of eight independent tests:

- i) Verbal Reasoning (VR)
- ii) Numerical Reasoning (NR)
- iii) Abstract Reasoning (AR)
- iv) Perceptual (Clerical) Speed and Accuracy (PSA)
- v) Mechanical Reasoning (MR)
- vi) Space Relations (SR)
- vii) Spelling (S)
- viii) Language Usage (LU)

All the above subtests except the Perceptual (Clerical) Speed and Accuracy are multiple-choice power tests. A power test is one which allows enough time to complete the test, but some of the items are so difficult that no one can get a perfect score. On the contrary, the Clerical Speed and Accuracy is a speed test in which the items are of low difficulty level, but the time limit is too short to finish all the items. Alternate forms of the DAT are available.

A special form of the DAT is available for Personnel and Career Assessment which consists of shortened versions of all the eight tests.

With respect to the psychometric properties of the DAT, reliability (both split-half and alternate-forms) is high. The VR+NR score, due to its correlation with school grades, is often considered as an index of scholastic aptitude. The norms for the fifth edition of the test are derived from a huge sample, as big as 100,000 students. The scores on the eight subtests can be converted to per centile ranks, thus yielding a profile.

The DAT has been translated into a number of other languages. The test has been

adapted under Indian conditions in Hindi by J.M. Ojha (1965). It is widely used for vocational guidance and research purposes.

You can see the sample items of all the subtests of DAT along with the directions to administer the test at the end of this Unit.

ii) Multidimensional Aptitude Battery (MAB)

The Multidimensional Aptitude Battery (MAB) was developed by Jackson (1984, 1994). This test is a paper-and pencil equivalent of the Wechsler Adult Intelligence scale – Revised (WAIS-R), designed to measure the same aptitudes as the latter. It is a group test. It includes 10 subtests, five verbal and five performance scales to yield Verbal, Performance and Full Scale IQ. All the subtests except one bear the same names as the WAIS-R. The 10 subtests are listed as follows:

Verbal	Performance
Information	Digit symbol
Comprehension	Picture Symbol
Arithmetic	Spatial
Similarities	Picture arrangement
Vocabulary	Object Assembly

The Block Design subtest of WAIS-R has been replaced by the Spatial subtest in MAB. The items are original and are in multiple-choice format. Unlike WAIS-R in which the verbal subtests except Arithmetic do not have any time limit, the MAB verbal subtests contain elements of both power and speed. The items within each of the subtests are arranged in order of increasing difficulty, the beginning items being quite easy and advanced items very difficult. Each subtest has to be performed within seven minutes.

MAB is suitable for adolescents and adults. However, the test is not suitable for persons with below average intelligence/intellectually disturbed or mentally disturbed persons.

Raw scores on each of the MAB subtests are converted to scaled scores. The sum of scaled scores is then used to find out deviation IQ. The MAB is considered to have psychometric excellence. Research studies have reported strong internal consistency, test-retest reliability as well as construct validity.

The MAB is used in career counseling and personnel selection.

iii) General Aptitude Test Battery (GATB)

The General Aptitude Test Battery (GATB) is a multiple aptitude test battery that is used to predict job performances in 100 specific occupations. Though the battery was developed in the 1940s, it has been periodically revised and updated. It is based on factor analysis of 59 tests. The test consists of twelve tests (eight paper-and-pencil tests and four apparatus measures) that yield nine factors such as:

- i) General Learning Ability (G)
- ii) Verbal Aptitude (V)
- iii) Numerical Aptitude (N)
- iv) Spatial Aptitude (S)

- v) Form Perception (P)
- vi) Clerical Perception (Q)
- vii) Motor Coordination (K)
- viii) Finger Dexterity (F)
- ix) Manual Dexterity (M)

The nine factor scores give rise to three general factors, such as Cognitive, Perceptual and Psychomotor. These three factors are involved in different proportions in different jobs. By observing the pattern of scores on the three general factors, job performance can be predicted (Hunter, 1994). Another way of using the GATB is to compare an examinee's score with Occupational Aptitude Patterns (OAPs). Occupational Aptitude Patterns have been obtained from test results of vast number of employees in different occupations from which the test score pattern needed for success in a particular job can be known.

The GATB manual provides information relating to the reliability and validity of the test. One limitation of the GATB is that it is available mainly to the state employment offices under the U.S. Department of Labour.

iv) **Armed Services Vocational Aptitude Battery (ASVAB)**

The Armed Services Vocational Battery (ASVAB) has been designed for screening and recruiting the personnel and placing them in different jobs and training programmes in the U.S. Army. The current version of the test consists of the following ten subtests:

- i) Arithmetic Reasoning
- ii) Mathematics Knowledge
- iii) Paragraph Comprehension
- iv) Word Knowledge
- v) Coding Speed
- vi) General Science
- vii) Numerical Operations
- viii) Electronics Information
- ix) Mechanical Comprehension
- x) Auto and Shop Information

Out of the above ten subtests, eight are power tests and two (Numerical Operations and Coding Speed) are speed tests. Decisions regarding the examinee's placement depend on composite scores. Composite scores are computed from the examinee's subtest scores. They are derived empirically and are regularly updated. Therefore, though the Armed Services relied on seven composite scores at one point of time, new ones can also be developed according to the changing requirements of the modern recruiters.

The ASVAB reports to have moderate to high reliability and validity. The norm is based on a representative sample of 12000 persons of 16 to 23 years of age.

A computerized version of the ASVAB is also available.

6.5.2.2 Tests Measuring Specific Aptitudes

There are a number of tests that measure specific aptitudes. They aim at predicting performance in specific tasks, particularly in vocational endeavor. They are used in employment procedures. *Stenquist's Mechanical Aptitude Test (1921)*, *Thurstone's Examination in Clerical Work (1922)*, *Minnesota Mechanical Assembly Test*, *Minnesota Spatial Relations Test*, *Minnesota Paper Form Board*, *Johnson O'Connor's Wiggly Blocks*, *Sharma's Mechanical Aptitude Test Battery*, *General Clerical Aptitude Test*, *Graphic Arts Test*, *Musical Aptitude Tests* are examples of some of the tests measuring specific aptitudes.

6.5.2.3 Tests Predicting Academic Success in Colleges

A major use of the aptitude tests is prediction of academic success. Aptitude tests are used to make decisions regarding admission into various graduate and professional programmes.

i) Scholastic Assessment Test (SAT)

The Scholastic Assessment Test (SAT) was formerly known as the Scholastic Aptitude Test. It was first published by the College Board in 1926. It is used for admission into various colleges. The test is continuously revised and updated. The SAT, with its two parts- SAT-I and SAT-II, assesses reasoning skills and mastery in high school subject matter. The SAT scores are anchored to the scores of a standard reference group which has a mean of 500 and standard deviation of 100.

ii) Graduate Record Exam (GRE)

The Graduate Record Examination (GRE) is a multiple-choice and essay test. It is used for admission into graduate programmes in many fields and selection of candidates for advanced training. The test measures verbal, quantitative, and analytical writing aptitude as well as offers subject examinations in a number of fields like Biology, Computer Science, History, Mathematics, Philosophy and Psychology. The scores obtained in the Verbal (GRE-V) and Quantitative (GRE-Q) sections are expressed as standard scores with an approximate mean and standard deviation of 500 and 100 respectively. The Analytical Writing section is rated on a 6-point scale.

The GRE norms vary widely among institutions and among subject fields. For example, the requirement for admission into Physics department could be a substantially higher score on quantitative section than on the verbal section. But for admission into English department a higher verbal score than the quantitative score may be required. Thus, both departments could have quite different norms for the quantitative and verbal sections.

iii) Miller Analogies Test (MAT)

The Miller Analogies Test (MAT) has been published by Pearson Assessments. It is used for selection for admission into graduate courses. The test consists of 120 complex analogy items selected from academic subjects. The test has to be completed within 60 minutes. Parallel forms of the test are available. The test is available in both paper-and-pencil and computer formats. It is a valid predictor of graduate school grades and time taken to finish a graduate degree. Like GRE, the MAT norms are different in different institutions and different departments.

iv) Professional School Tests

Different professional bodies have developed their tests for admission into different professional schools. Names include the *Medical College Admission Test* (Association

of American Medical colleges, 2000), *the Dental Admission Test* (Division of Educational Measurements, Council on Dental Education, 1994), *the Law School Admission Test* (Law school Admission council, 2005), and *the Graduate Management Admission Test or GMAT* (Educational Testing Service, 2004). These tests, like the scholastic aptitude tests, measure verbal and numerical ability. In addition, they also contain items relevant to their respective profession.

The GMAT is available in a computer-adaptive format only and candidates can take the test online at different centers throughout the world.

Self Assessment Questions III

- 1) What are the reasons behind the increase in popularity of aptitude tests?
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- 2) How many subtests are there in the DAT?
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- 3) Which test is considered as a paper-and pencil equivalent of the Wechsler Adult Intelligence scale – Revised?
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- 4) Name some aptitude tests that are used for admission into graduate courses.
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6.6 ADVANTAGES AND LIMITATIONS OF APTITUDE TESTS

Aptitude tests have their own advantages as well as limitations. Let us discuss these.

Advantages of Aptitude Tests

- 1) *Aptitude tests allow objective comparisons.*

Most of the aptitude tests available in the market are standardized tests. Hence, they make it possible to select individuals objectively, be it for admission into schools or employment in organizations. Standardized aptitudes like SAT or GRE can compare students from different areas objectively. Other metrics like marks, Grade Point Average (GPA) or class rank cannot be effectively used for making objective comparisons. Schools differ from each other with respect to their marking standards. In one school, the marking may be very strict while in another school, it may be lenient.

2) **Aptitude tests are efficient.**

Standardized aptitude tests are reliable and valid. They have been found to be accurate in predicting the potential for success in comparison to other modes of selection, such as interview, essay type test or letter of reference. These tests can also assess a person's strengths and weaknesses quite accurately. Thus, they help place the right candidate in the right place.

3) **Aptitude tests help assess the training needs of the organization.**

Aptitude tests help find out the key areas or the gaps in which the employees of the organization require training. Accordingly, training programs can be organized, for instance, in customer care or time management or dealing with conflicts etc. This helps increase the employee efficiency, thereby increasing the overall organizational productivity.

4) **Aptitude tests can minimize anxiety.**

Many people cannot show their true ability due to anxiety in a face-to-face interview situation. For them, aptitude tests provide an opportunity to show their best performance without feeling nervous or anxious.

5) **Aptitude tests are less time-taking and cost effective.**

Since aptitude tests are usually group tests, a large number of candidates can take the test simultaneously. Many of the aptitude tests can now be administered online. This expedites the scoring process.

Limitations of Aptitude Tests

1) **Aptitude tests are culturally biased.**

Performance on a test depends on the individual's social and cultural experiences, such as her/his upbringing, education and environmental opportunities etc. Most aptitude tests do not favour minority and economically disadvantaged students. If an aptitude test require proficiency in English language and the test taker's mother tongue is not English, the test scores would not reflect her/his true potentiality.

2) **Aptitudes do not necessarily result in good performance.**

An aptitude test always predicts the probability of performance/success. There is never any certainty that the prediction will come true. Besides aptitude, there are also other factors like training, motivation and interest which contribute to success.

3) **Aptitude tests need constant modification.**

With technological advancements and organizational changes, job descriptions and requirements are also changing. New types of jobs are evolving. Unless aptitude tests change according to the organization's evolving needs, existing tests may not be of much help.

4) **Test anxiety may affect performance negatively.**

While taking the aptitude test, the test taker may be apprehensive of her/his performance due to test anxiety. This would result in a decrease in performance. Thus, the scores may not be indicative of her/ his true ability.

6.7 LET US SUM UP

In this Unit, we learned about what is aptitude, how it is related to other similar concepts

and how to measure aptitude. Aptitude can be simply understood as an ability to acquire a specific type of skill or knowledge. It refers to one's potentialities. It is the result of interaction of heredity and environment. Aptitude embraces any characteristic which contributes to learning, including intelligence, achievement, personality, interests and skills. These are the qualities of an individual that can be harnessed by appropriate training.

We learned that aptitude predicts future ability and thus is different from intelligence, achievement and interest.

Due to the demands of the Army, during the Second World War, aptitude tests were highly in use by the Army. With the help of "Factor analysis", a number of aptitude tests were also developed. Some of them were multiple aptitude tests like DAT, GATB, etc. and others were specific ability tests like the SAT, GRE, and MAT. These tests are used for admission into different colleges, career counseling, vocational placement and training. Though these tests are very helpful, they also have some limitations. So they should be used cautiously.

6.8 KEY WORDS

Aptitude	: refers to the individual's potentialities, which can be expressed with right training.
Interest	: reflect the things that one likes to do regardless of her/his skill in it.
Achievement	: refers to one's performance at any given point of time in a particular task or activity, which one has already acquired through training.
Intelligence	: refers to a general mental ability across different types of tasks. It indicates the present ability of a person.
Differential Aptitude Test (DAT)	: is a widely used aptitude test battery developed by Benett, Seashore and Westman (1947). It consists of eight independent tests in the area of verbal reasoning, numerical reasoning, abstract reasoning, clerical speed and accuracy, mechanical reasoning, spatial relations, spelling and language usage.

6.9 ANSWERS TO SELF ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) Aptitude has been defined as "a condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some (usually specified) knowledge, skill, or set of responses, such as the ability to speak a language, to produce music" (Bingham, in Warren's Dictionary of Psychology). English and English defined the term as "the capacity to acquire proficiency with a given amount of training.)

- 2) Aptitude is the result of interaction of heredity and environment. An individual is born with certain potentialities. But they can be harnessed by appropriate training.

Self Assessment Questions II

- 1) Aptitude is an individual's potentiality, what she/he can do, but achievement refers to what a person has already done. Aptitude tests are used to predict how well a person might perform in school or employment situation, whereas achievement tests are used to determine what the person has already learned prior to being tested.

Self Assessment Questions III

- 1) Due to two reasons, aptitude test became popular. First, with the use of 'Factor analysis' psychologists realized that intelligence is not a unitary construct; majority of the intelligence tests actually measure a number of separate abilities. The second reason is during World war-II, tests were needed to recruit personnel to various jobs in Army.
- 2) Verbal Reasoning, Numerical Reasoning, Abstract Reasoning, Perceptual (Clerical) Speed and Accuracy, Mechanical Reasoning, Space Relations, Spelling, and Language Usage.
- 3) The Multidimensional Aptitude Battery (MAB) developed by Jackson (1984, 1994).
- 4) The Scholastic Assessment Test (SAT), the Graduate Record Examination (GRE), and the Miller Analogies Test (MAT).

6.10 UNIT END QUESTIONS

- 1) Define aptitude. Discuss its nature.
- 2) Compare aptitude with intelligence, achievement and interest.
- 3) Discuss some multiple aptitude test batteries.
- 4) Discuss the advantages and limitations of aptitude tests.

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Do not make any marks in this booklet

VERBAL REASONING

Mark your answers on the separate Answer Sheet

DIRECTIONS

Each of the fifty sentences in this test has the first word and the last word left out. You are to pick out words which will fill the blanks so that the sentence will be true and sensible.

For the first blank, pick out a numbered word — 1, 2, 3, or 4. For the blank at the end of the sentence, pick one of the lettered words — A, B, C, or D. Combine the number and the letter you have chosen and mark that combination on the separate Answer Sheet after the number of the question you are working on.

EXAMPLE X. is to water as eat is to

- | | | | |
|-------------|----------|---------|-------------|
| 1. continue | 2. drink | 3. foot | 4. girl |
| A. drive | B. enemy | C. food | D. industry |

Drink is to water as eat is to food. Drink is numbered 2, and food is lettered C, 2 and C are combined as 2C. The space under 2C has been filled in on line X on the sample Answer Sheet shown below.

NUMERICAL ABILITY

DIRECTIONS

This test consists of forty numerical problems. Next to each problem there are five answers. You are to pick out the correct answer and fill in the space under its letter on the separate Answer Sheet.

EXAMPLE X

Add	13	A	14
	12	B	25
		C	16
		D	59
		E	none of these

In Example X, 25 is the correct answer, so the space under the letter for 25—B—has been filled in.

EXAMPLE Y

Subtract	30	A	15
	20	B	26
		C	16
		D	8
		E	none of these

In Example Y, the correct answer has not been given, so the space under the letter for "none of these"—E—has been blackened.

SAMPLE OF ANSWER SHEET

	A	B	C	D	E
X					
	A	B	C	D	E
Y					■

Do not make any marks in this booklet

ABSTRACT REASONING

Mark your answers on the separate Answer Sheet

DIRECTIONS

In this test you will see rows of designs or figures like those on this page. Each row is a problem. You are to mark your answers on a separate Answer Sheet as shown in the samples below.

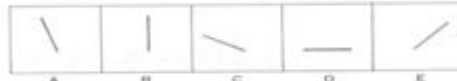
Each row consists of four figures called Problem Figures and five called Answer Figures. The four Problem Figures make a series. You are to find out which one of the Answer Figures would be the next, or the fifth one in the series.

EXAMPLE X

PROBLEM FIGURES



ANSWER FIGURES

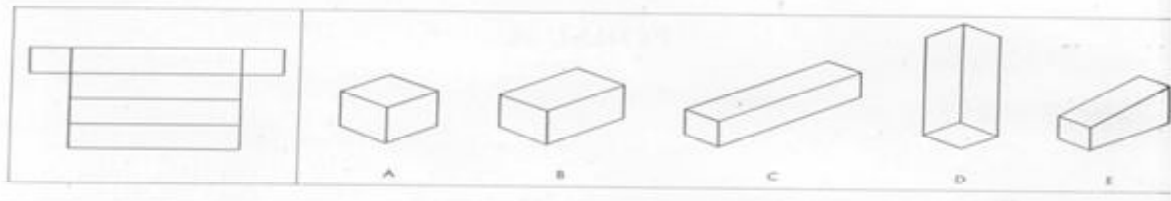


SPACE RELATIONS

DIRECTIONS

This test consists of forty patterns which can be folded into figures. For each pattern, five figures are shown. You are to decide which of these figures can be made from the pattern shown. The pattern always shows the outside of the figure. Here is an example:

EXAMPLE X



(Sample items and directions given in the subtests of DAT)

Do not make any marks in this booklet

SPEED AND ACCURACY

Mark your answers on the separate Answer Sheet

DIRECTIONS

This is a test to see how quickly and accurately you can compare letter and number combinations. On the following pages are groups of these combinations; each Test Item contains five. These same combinations appear after the number for each Test Item on the separate Answer Sheet, but they are in a different order. You will notice that in each Test Item one of the five is underlined. You are to look at the one combination which is underlined, find the same one after that item number on the separate Answer Sheet, and fill in the space under it.

These examples are correctly done. Note that the combination on the Answer Sheet must be exactly the same as the one in the Test Item.

TEST ITEMS

V.	<u>AB</u>	AC	AD	AE	AF
W.	aA	aB	BA	Ba	<u>Bb</u>
X.	A7	7A	B7	<u>7B</u>	AB
Y.	Aa	Ba	<u>bA</u>	BA	bB
Z.	3A	3B	<u>33</u>	B3	BB

SAMPLE OF ANSWER SHEET

V	AC	AE	AF	<u>AB</u>	AD
W	BA	Ba	Bb	aA	aB
X	<u>7B</u>	B7	AB	7A	A7
Y	Aa	<u>bA</u>	bB	Ba	BA
Z	BB	3B	B3	3A	<u>33</u>

MECHANICAL REASONING

DIRECTIONS

This test consists of a number of pictures and questions about those pictures. Look at Example X on this page to see just what to do. Example X shows a picture of two men carrying a machine part on a board and asks, "Which man has the heavier load? If equal, mark 'C.'" Man "B" has the heavier load because the weight is closer to him than to man "A," so on the separate Answer Sheet you would put a cross (X) in the circle under B, like this \rightarrow A B C

Now look at Example Y. The question asks, "Which weighs more? If equal, mark C." As the scale is perfectly balanced, "A" and "B" must weigh the same, so you would put a cross (X) in the circle under C on your separate

Answer Sheet, like this \rightarrow A B C



Which man has the heavier load?
(If equal, mark C.)

Do not make any marks in this booklet

LANGUAGE USAGE

Mark your answers on the separate Answer Sheet

Part II SENTENCES

DIRECTIONS

This test consists of 50 Sentences. Each sentence is divided into five parts. Each part has a letter—A, B, C, D and E.

You are to look at each sentence and decide which of the lettered parts have errors in them. The mistakes may be in grammar, punctuation or spelling. When you have decided which parts are wrong, mark the circles (by putting X in them) under those letters on the separate Answer Sheet. (Be sure to put the marks after the right sentence-numbers.) Study the examples given below.

EXAMPLES

X. Was we / going to the / office / next week / at all.
A B C D E

SAMPLE OF ANSWER SHEET

X. A B C D E

(Sample items and directions given in the subtests of DAT)



130 blank
ignou
THE PEOPLE'S
UNIVERSITY