

Intelligence—Concept, Theories and Measurement

CHAPTER COMPOSITION

- Introduction
- Concept and Meaning
- Theories of Intelligence
- Measurement of Intelligence
- Concept of Mental Age (M.A.) and Intelligence Quotient (I.Q.)
- Summary
- References and Suggested Readings

INTRODUCTION

In contrast to animals, man is considered to be endowed with certain cognitive abilities that make him a rational being. He can reason, discriminate, understand, adjust and face new situations. He is definitely superior to animals in all such aspects of behaviour. But human beings themselves are not alike. There are wide individual differences. A teacher easily discovers these differences among his pupils. Some learn with a good speed while others remain lingering for long. There are some who need only one demonstration for handling the tools properly while for others even the repeated individual guidance brings no fruitful result.

What is it that causes one individual to be more effective in his response to a particular situation than another. No doubt, interest, attitude, desired knowledge and skill etc., count towards this achievement. But still there is something that contributes significantly towards these varying differences. In psychology, it is termed as 'Intelligence'. In ancient India, our great *rishis* named it 'Viveka'.

CONCEPT AND MEANING

Since time immemorial, attempts have been made to understand the meaning and concept of intelligence. Let us be acquainted with the concept and meaning of intelligence by throwing light on the following aspects:

- A. Meaning and definition of intelligence.
- B. Some established facts about intelligence.
- C. Misconception about intelligence.

Meaning and Definitions of Intelligence

As discussed earlier, in our day-to-day conversation an individual is said to be intelligent in proportion to his success in general life situations. What is this intelligence that contributes towards such success, is a question that has been attempted by psychologists in different ways resulting in so many varied definitions. Below we give some of these important definitions.

Woodworth and Marquis

Intelligence means intellect put to use. It is the use of intellectual abilities for handling a situation or accomplishing any task. (1948, p. 33)

Stern

Intelligence is a general capacity of an individual consciously to adjust his thinking to new requirements. It is general mental adaptability to new problems and conditions of life. (1914, p. 3)

Terman

An individual is intelligent in proportion as he is able to carry on abstract thinking. (1921).

Wagnon

Intelligence is the capacity to learn and adjust to relatively new and changing conditions. (1937, p. 401)

David Wechsler

Intelligence is the aggregate or global capacity of an individual to act purposeful to think rationally, and to deal effectively with his environment. (1944, p. 3)

ANALYSIS OF THESE DEFINITIONS

Above we have given some definitions, more of such definitions can further be cited. All these definitions when taken separately, give an incomplete picture because they partly emphasize that intelligence is the ability—

- (i) to learn,
- (ii) to deal with abstraction,
- (iii) to make adjustment or to adapt to new situations.

The definition given by Wechsler seems to combine all the three viewpoints but this definition too has come under criticism due to difference of opinion among psychologists. Several attempts have been made to reach at some general agreement but in vain. However, British psychologists are said to have reached some measures or agreement regarding a suitable definition of intelligence.

To them intelligence consists of the ability—

- (i) to see relevant relationships between objects or ideas; and
- (ii) to apply these relationships to novel situations.

It leads to the conclusion that intelligent behaviour can be divided into two categories—theoretical and practical, abstract and concrete. The theoretical operations make an individual capable to face and solve the actual life problems and make adjustment to the environmental situations. If we try to analyze the factor which determines the success of an individual's activities, we can by all means say that cognitive or mental abilities have a dominant role to play in the success or failure. "Intelligence," as Rex and Margeret Knight have put it, "*is the factor that is common to all mental abilities*" (1952, p. 124) and therefore, the judgement about intelligence can ever be taken with the evaluation of the task one performs, how he reacts and responds to a situation. In this way, if we try to come to the practical ground, we can define intelligence as follows:

Intelligence consists of an individual's those mental or cognitive abilities which help him in solving his actual life-problems and leading a happy and well-contented life.

Some Established Facts about Intelligence

1. **The relation of intelligence with nature and nurture:** There have been a number of attempts on the part of psychologists to weigh the relative importance of nature and nurture. The conclusion of their studies reveals that intelligence is the product of heredity and environment. Both are necessary for the intellectual growth of an individual and neither can be considered more important than the other.
2. **Distribution of intelligence:** There are individual differences with regard to the distribution of intelligence in nature like wealth, health etc. This distribution is governed by a definite principle that states "The majority of the people are average, a few very bright and a few very dull."
3. **Growth of intelligence:** As a child grows in age, so does his intelligence as shown by intelligence tests. Now the questions arises as to at what age does this growth cease? The age of cessation of mental growth varies from individual to individual. However, in majority of cases, intelligence reaches its maximum somewhat at the age of 16 or 20 in an individual. After that the vertical growth of intelligence ceases. But the horizontal growth—accumulation of knowledge and acquisition of skills—continues throughout the life span of an individual.
4. **Intelligence and Sex differences:** Various studies have been concluded to find out if women are less intelligent than men and vice versa. The result of these researches have been either ways. In some of the cases, no significant difference has been found. Therefore, it is proper to think that difference in sex does not contribute towards the difference in intelligence.

5. **Intelligence and racial or cultural differences:** Whether a particular race, caste, or cultural group is superior to other in intelligence — the hypothesis has been examined by many research workers. In U.S.A., it has been a burning problem for centuries. The results of earlier studies, which considers the whites to be a superior race in comparison to the Negroes, have been questioned. Now it has been established that intelligence is not the birth right of a particular race or group. The 'bright' and the 'dull' can be found in any race, caste or cultural group and the differences that are found can be explained in terms of environment influences.

Misconception about Intelligence

There are a number of misconceptions prevalent about the nature and concept of intelligence. For the clarification let us be clear about what is not meant by intelligence.

- (i) Intelligence is not knowledge though acquisition of knowledge depends, to a great extent, on intelligence and vice versa.
- (ii) Intelligence is not memory. A very intelligent person may have a dull memory and vice versa.
- (iii) Intelligence is not guarantee against abnormal behaviour, backwardness and delinquency in spite of the fact that it is one of the major factors contributing towards achievement, adjustment and character formation.

THEORIES OF INTELLIGENCE

With the help of definitions, we can be able to understand how intelligence operates or what type of behaviour makes an individual intelligent or unintelligent. But it does not explain the structure of intelligence or in other words, the different components or elements of intelligence. The theories of intelligence propagated by psychologists from time to time have tried to answer this question. These theories can be grouped under two heads, namely, factor theories and cognitive theories. However, in this text we will limit our discussion to factor theories.

Factor Theories of Intelligence

Let us try to discuss some of these theories below:

UNITARY THEORY OR MONARCHIC THEORY

This theory holds that intelligence consists of one factor—a fund of intellectual competency—which is universal for all the activities of an individual.

A man who has vigour can move so much to east as to the west. Similarly if one has the fund of intelligence, he can utilize it in any area of his life and can be as successful in one area as in the other depending upon his fund. However, in actual life situations, the ideas propagated by this theory do not fit well. We find that the children who are bright in mathematics may, despite serious interest and hard work, be not so good in civics. A student very good in conducting science experiments does not find himself equally competent in learning languages. This makes us conclude

the last four have been the subject of great controversy as to whether they should be categorized as separate types of intelligence or as different talents. However, as far as the broader and global assessment of one's intellectual competencies and abilities is concerned, there is sufficient truth in the assertion of Gardner's theory that knowledge of all the seven types of intelligence is essential for the true assessment of one's level of intellectual functioning.

The other striking feature and contribution of Gardner's theory of multiple intelligence is its bold declaration that the concept of a measurable "g" is at best limited and at worst educationally misleading. It is not at all essential that an individual highly loaded with linguistic and/or logical mathematical abilities will also display exceptional ability (or even interest) in all or any remaining domains, i.e. spatial and musical abilities etc. It happens on account of a sort of autonomy maintained by each type of the seven different human intelligence which are said to be quite capable of developing independently of each other and also quite independently of an all-encompassing general intelligence, "g".

NATURE OF INTELLIGENCE

The true nature of intelligence can be understood by first defining it to understand its meaning, discussing the various theories explaining its structure in terms of the several constituents and factors, and identifying the numerous other aspects and characteristics related to intelligence and its functioning. We have already covered the first two points in the present chapter, let us now concentrate briefly on last point through the following description.

Distribution of Intelligence

The distribution of intelligence is not equal among all human beings. It resembles the pattern of distribution of health, wealth, beauty and similar other attributes or endowments. It is a normal distribution that is governed by a definite principle which states that *the majority of people are at the average, a few very bright and a few very dull.*

Individual Differences in Intelligence

Wide individual differences exist among individuals with regard to intelligence. Truly speaking, no two individuals, even identical twins or individuals nurtured in identical environments, are endowed with equal mental energy. The assessment of intelligence by various tests has given reasons enough to believe that not only does intelligence vary from individual to individual but it also tends to vary in the same individual from age to age and situation to situation.

Intelligence and Changes in Age

As the child grows in age, so does the intelligence as shown by intelligence tests. The question which now arises is, at what age does this increase stop? The age at which mental growth ceases, varies from individual to individual. It tends to stabilize after the age of 10 and is fully stabilized during adolescence. The idea

that intelligence continues to grow throughout life is not strictly true. Since intelligence is basically a function of neurons and neuroglia, its development or deterioration goes hand in hand with the development or deterioration of the nervous system. However, in the majority of cases, the growth of a person's intelligence reaches its maximum sometime between the age of 16 and 20 years after which the vertical growth of intelligence almost ceases. Horizontal growth i.e. achievement, the realization of the intelligence in terms of accumulation of knowledge and acquisition of skills etc. may continue throughout an individual's life.

Intelligence and the Sexes

Many studies have been conducted to find out whether men are more intelligent than women and vice versa but no significant difference has been found. It may, therefore, be stated that difference in sex does not contribute towards difference in intelligence.

Intelligence and Racial or Cultural Differences

The hypothesis whether a particular race, caste, or cultural group is superior to another in intelligence has been examined by many research workers. In the U.S.A. it has been a burning problem for centuries. The results of earlier studies which take the Whites to be a superior race in comparison to the negroes have been questioned. It has now been established that intelligence is not the birthright of a particular race or group. The 'bright' and the 'dull' can be found in any race, caste or cultural group and the differences which are found can be the result of environmental factors and influences.

INTELLIGENCE: THE ROLE OF HEREDITY AND ENVIRONMENT

Whether one's intelligence is largely dependent upon heredity—genetic materials and codes inherited from one's parents or is chiefly designed by one's life experiences or environmental factors has been a controversial issue. While geneticists in this debate attach all importance to heredity, the environmentalists give all credit to environment. In support of their viewpoints, both of them put forward the following experimental evidence.

Evidence in Support of the Role of Heredity

Family resemblance studies. Bouchard and McGue (1981) reported a study based on the computation of coefficients of correlation and their comparison. The results of their studies can be summarised as follows:

Identical twins	0.86
Parents and children	0.56
Brothers and sisters	0.53
Half siblings	0.31
Cousins	0.15

Through this study they tried to establish that the closer the kinship or blood relationship between individuals, the more similar their I.Q. scores tend to be, leading to the conclusion that similarity from the point of view of heredity potential increases the probability of the intelligence potential being similar.

A similar conclusion has been arrived at by Teasdale and Owen (1984) through their comparative study of intelligence scores of full siblings, half siblings and individuals who were unrelated but reared together, and apart. This study demonstrates a very high correlation in the I.Q. scores of full siblings, whether they were raised together or apart in comparison to half siblings and unrelated individuals who demonstrated comparatively less correlation and no correlation respectively.

Further evidence of this theory of blood relationship and family resemblance may be seen in the studies reported by Jencks (1972) and Munsinger (1978). These studies demonstrate a positive correlation ranging from .40 to .50 between adopted children and their real parents in contrast to a very small correlation of +.10 to +.20 between the adopted children and adopted parents, leading to the conclusion that people closer to each other from the point of view of heredity potential have comparable I.Q.

Twins studies. Twins are said to be genetically more closely related than normal siblings and among twins also, identical twins (having exactly the same genes) are said to be even closer in terms of heredity potential than fraternal twins (having different sets of genes). Many studies involving the separation of twins at birth and their rearing in different environments have been carried out.

In one such study, Wilson (1975) tried to test I.Q. of over 100 pairs of twins on the Wechsler scales at ages 4, 5 and 16 and found a strong correlation between the I.Q. scores of identical twins in comparison to the scores of fraternal twins.

In another study Bouchard and his colleagues (1984, 1987) located a number of identical twins (who were separated from their parents only a few days after their birth and reared in different homes) and subjected them to intelligence tests. This study demonstrated a very high correlation in the I.Q. scores of identical twins reared apart to almost the same degree as found in the case of identical twins reared together. Moreover, twins reared apart are found to resemble each other in other aspects of human personality—physical appearance, interests, aptitudes, habits and mannerism, etc. also.

In the light of the findings of such studies, psychologists like Arthur Jensen have taken a firm stand that heredity decides everything about the observed differences in human intelligence. Through a study of 1200 California school children in which blacks on the average were found to score 16 points lower on I.Q. tests than whites, he tried to establish that genetic factors are strongly responsible for measured differences in intelligence.

Evidences in Support of the Role of Environment

Family resemblance studies. Many studies have indicated that the individuals (having same degree of blood relationship or family relationship) have more comparable I.Q. if they happen to be reared in the same environment in comparison

to those raised apart and in different environments. The results of two such studies, Study 1: Loehlin, Lindzey and Spuhler (1975), and Study 2: Bouchard and McGue (1981) are given below:

<i>Modes of relationship and rearing</i>	<i>Coefficient of correlation</i>	
	<i>Study 1</i>	<i>Study 2</i>
Identical twins (reared together)	0.88	0.85
Identical twins (reared apart)	0.75	0.67
Siblings (reared together)	0.49	0.45
Siblings (reared apart)	0.46	0.24

Studies of environmental deprivation or enrichment. The adverse effects of environmental deprivation and positive, favourable effects of environmental enrichment upon the children's intellectual development have been demonstrated in many studies.

In one of his studies Gottfried (1984) concluded that if the children are subjected to certain forms of environmental stimulation early in life, their intellectual development gets adversely affected. Similar conclusions were drawn in another study conducted by Sherman and Key (1932) in an unprivileged remote hilly area of U.S.A. to the effect that lack of language training and school experience accounted for the very poor scores of the children in the standardized intelligence tests.

However, when the children were provided with favourable environmental situations in the form of appropriate adoptive homes, better schooling, and learning facilities, etc., the results were quite encouraging in terms of intellectual development. A well known adoption study (Schiff et al., 1978) conducted in France is a good example. In this study, the investigators compared the I.Q. scores of the children who had been adopted by parents belonging to higher socio-economic class with those of their siblings who had not been adopted. The average score of the adopted children was 111 in comparison to the average score of 95 of their siblings (brothers and sisters) raised by their biological parents. The privileged environment may thus be said to be responsible for raising the average I.Q. score by 16 points.

Family structure and birth order studies. The environmental influences related to the composition and structure of the family even to the extent of the birth order of the child has been found to affect his intellectual growth. There have been many studies, e.g. those conducted by Belmont and Marolla (1973), and Robert Zajonc (1983), to demonstrate that (a) children from large families tend to have lower I.Q. scores than children from small families, and (b) later-born children usually score lower than early-born children.

Zajonc (1976, 1986) proposed the confluence theory to explain the difference in intelligence on account of order of birth. According to this theory one's intellectual development is dependent upon the intellectual environment available in one's family. A first-born child enjoys the benefit of the company of two parents—a relatively advantaged intellectual environment compared to the

second-born child in whose case the attention of the parents is divided between the two. The first-born also has the initial advantage of a better intellectual environment in living only with adults rather than with both, adults and with their younger siblings. Consequently, in the matter of intellectual development, the second child is bound to suffer. Such effects become more apparent in the third-borns and continue to multiply as the number of children in the family increases.

Apart from the above mentioned considerations, the other things related to the family environment like education of the parents, economic and social status of the family, nutrition, physical and social surroundings of the home, etc., are also found to contribute significantly to the intellectual growth of the children. Enough experimental evidence has been put forward by geneticists and environmentalists to support their respective view points. Prem Pasricha (1963) has made a very interesting observation regarding these experiments. According to her:

It is quite customary for the psychologists wedded to either side, viz. heredity and environment, to perform experiments and quote findings in favour of either of the factors. It has also been found that the findings of these experiments can be interpreted either way and can be easily made to support the opposite view. When analysed in an objective manner, it indicates clearly that the two are so closely interwoven that it is difficult to separate the effect of one from that of the other.

Let us discuss why it is difficult to conduct actual experiments for the study of the impact of pure heredity or environment on the growth and development of intelligence.

To accurately study the impact of environment on intellectual development we have to have subjects with the same heredity. After keeping them in different environments, comparisons can be made. Conversely, for studying the impact of heredity, the environmental factors need to be identical and individuals belonging to different hereditary stock and brought up in exactly the same environments may be compared for this purpose.

The following difficulties arise while conducting these studies:

1. It is impossible to get individuals having the same heredity. Even identical twins are not supposed to have exactly the same genes and therefore, the same hereditary characteristics.
2. If we assume that identical twins at the time of conception, belong to approximately similar hereditary stock, then the question arises: Is it possible to experiment upon them from the moment of conception? Starting from the time of fertilization and division of the ovum, can these twins be exposed to different types of environment for studying the impact of environmental differences? This is obviously not possible and only after their birth—approximately nine months after their conception—is the pair available for experimentation. We cannot rule out the environmental effects inside the womb of the mother. Nor can these effects as a common influence upon the pair be ruled out. It may happen that one of the twins gets a major share of nourishment and is favoured by the inner environment in one way or the other while the other is to some extent neglected. It is, thus, difficult to ensure exactly identical heredity even in identical twins.

3. Further, the environmental influences cannot be identically controlled; hence it is very difficult to provide exactly the same environment for different individuals. Even the mother cannot show equal amount of love and affection to all her children. There are individual differences and as a result one individual may be favoured in comparison to another. In the same foster home or orphanage, the various individuals are subjected to different environmental conditions depending upon their own nature as well as the attitude of the officials and the people in charge.

The main reason for the failure to specifically control the hereditary or environmental factors is that the influence of both these factors on the growth of the individual's intelligence is inseparable. Right from the time of conception, the two factors are so intimately intermingled and interwoven that it is difficult to say whether the differences in intellectual capacities of different individuals are due to the genes or due to the environmental influences. It is obvious, therefore, that the claims of both geneticists and environmentalists are one-sided and exaggerated. However, there is no gainsaying the fact that a person's intellectual development at a particular age is the sum of what he inherited from his parents and his experiences as a result of interaction with the environmental situations. Since we cannot control or modify the hereditary factors, we need to direct all our efforts and resources towards providing the most conducive environmental situations for the proper intellectual development of the children in our charge.

Assessment of Intelligence

We can observe the intelligence of an individual only to the extent that it is manifested by him in one or more intelligence tests. Many such tests have been devised by psychologists for the measurement of intelligence. In reference to these, however, the term 'assessment' is preferred because, intelligence being only a concept or an abstraction rather than a substance, it cannot be measured in physical units like a length of cloth or temperature of the body.

In this context, Griffiths (1933) observes: "the standard of measurement is a group performance". Therefore, when we measure an individual's intelligence by means of an intelligence test, we try to interpret his score in terms of the norms set (group performance) by the author of the test. One's intelligence is thus determined in relation to the classified group to which one belongs. Thus, whereas a piece of cloth may be measured in absolute terms, relative measurement or assessment has to be resorted to in the case of intelligence.

Classification of Intelligence Tests

Intelligence tests may be classified broadly as follows:

1. *Individual tests* in which only one individual is tested at a time.
2. *Group tests* in which a group of individuals is tested at the same time.

(Intelligence tests may also be classified on the basis of their form as *verbal or language tests* and *non-verbal or non-language tests*.)

5. **Intelligence and racial or cultural differences:** Whether a particular race, caste, or cultural group is superior to other in intelligence — the hypothesis has been examined by many research workers. In U.S.A., it has been a burning problem for centuries. The results of earlier studies, which considers the whites to be a superior race in comparison to the Negroes, have been questioned. Now it has been established that intelligence is not the birth right of a particular race or group. The 'bright' and the 'dull' can be found in any race, caste or cultural group and the differences that are found can be explained in terms of environment influences.

Misconception about Intelligence

There are a number of misconceptions prevalent about the nature and concept of intelligence. For the clarification let us be clear about what is not meant by intelligence.

- (i) Intelligence is not knowledge though acquisition of knowledge depends, to a great extent, on intelligence and vice versa.
- (ii) Intelligence is not memory. A very intelligent person may have a dull memory and vice versa.
- (iii) Intelligence is not guarantee against abnormal behaviour, backwardness and delinquency in spite of the fact that it is one of the major factors contributing towards achievement, adjustment and character formation.

THEORIES OF INTELLIGENCE

With the help of definitions, we can be able to understand how intelligence operates or what type of behaviour makes an individual intelligent or unintelligent. But it does not explain the structure of intelligence or in other words, the different components or elements of intelligence. The theories of intelligence propagated by psychologists from time to time have tried to answer this question. These theories can be grouped under two heads, namely, factor theories and cognitive theories. However, in this text we will limit our discussion to factor theories.

Factor Theories of Intelligence

Let us try to discuss some of these theories below:

UNITARY THEORY OR MONARCHIC THEORY

This theory holds that intelligence consists of one factor—a fund of intellectual competency—which is universal for all the activities of an individual.

A man who has vigour can move so much to east as to the west. Similarly if one has the fund of intelligence, he can utilize it in any area of his life and can be as successful in one area as in the other depending upon his fund. However, in actual life situations, the ideas propagated by this theory do not fit well. We find that the children who are bright in mathematics may, despite serious interest and hard work, be not so good in civics. A student very good in conducting science experiments does not find himself equally competent in learning languages. This makes us conclude

that there is nothing like one single unitary factor in intelligence. Therefore, the unitary theory stands rejected.

ANARCHIC THEORY OR MULTIFACTOR THEORY

The main propagator of this theory was E.L. Thorndike. As the name suggests, this theory considers intelligence a combination of numerous separate elements or factors, each one being a minute element of one ability. So, there is no such thing as general intelligence (a single factor) and there are only many highly independent specific abilities which go into different tasks.

Monarchic and Anarchic theories thus hold the two extremes. Just as we cannot assume good intelligence to be a guarantee of success in all the fields of human life, we cannot also say with certain specific type of abilities, one will be successful in a particular area and completely unsuccessful in the other. As Gardner Murphy puts it, "*There is a certain positive relationship between brightness in one field and brightness in another and so on.*" (1968, p. 358). This brings us to the conclusion that there should be a common factor running through all tasks. The failure to explain such phenomena gave birth to another theory named Spearman's two factor theory.

SPEARMAN'S TWO FACTOR THEORY

This theory was advocated by Spearman. According to him every different intellectual activity involves a general factor 'g' which is shared with all the intellectual activities and a specific factor 's' which it shares with none (Fig. 22.1).

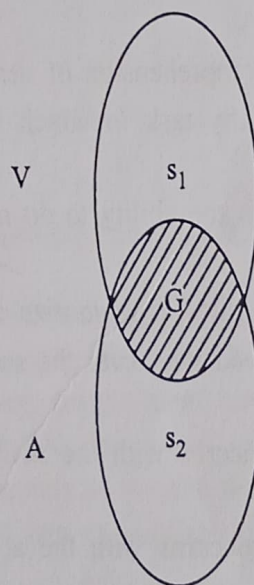


Fig. 22.1 Spearman's two factor theory.

In this way, he suggested that there is something which might be called 'general intelligence', a sort of general mental energy, running through all the different tasks but in addition to this general factor, there are specific abilities, which make an individual able to deal with particular kinds of problems. For example, an individual's performance in Hindi is partly due to his general intelligence and partly some kind of specific ability in language which he might possess, *i.e.* $g+s_1$; or in mathematics his performance would be due to $g+s_2$; or in drawing it will be due to $g+s_3$; and so on and so forth. The factor g (in lesser or greater degree) will enter in all specific activities. The total ability or intelligence of such an individual (symbolized as A) thus will be expressed by the following equation schedule:

$$G + s_1 + s_2 + s_3 + \dots = A.$$

This two factor theory of Spearman has been criticized on various grounds, some of which have been listed below:

- (i) Spearman said that there are only two factors expressing intelligence but as we have seen there are not only two but several factors (g s_1, s_2, s_3, \dots etc.) expressing it.
- (ii) According to Spearman, each task requires some specific ability. This view was not proper as it implied that there was nothing common in the tasks except a general factor and professions such as those of nursing, compounders and doctors could not be put in one group. In fact the factor $s_1, s_2, s_3, s_4, \dots$ etc. are not mutually exclusive. They overlap and give birth to certain common factors.

This idea of overlapping and grouping has been responsible for the origin of a new theory called Group Factor theory.

THURSTONE'S GROUP FACTOR THEORY

For the factors not common to all the intellectual abilities but common to certain activities comprising a group, the term 'group factor' was suggested. Prominent among the propagators of this theory is L.L. Thurstone. While working on a test of primary mental abilities, he came to the conclusion that certain mental operations have a primary factor in common which gives them psychological and functional unity and differentiates them from other mental operations. These mental operations constitute a group factor. So, there are a number of groups of mental abilities each of which has its own primary factor. Thurstone and his associates have differentiated nine such factors. These are:

- (i) Verbal factor (V): concerns with comprehension of verbal relations, word and ideas.
- (ii) Spatial factor (S): is involved in any task in which the subject manipulates an object imaginatively in space.
- (iii) Numerical factor (N): concerns with the ability to do numerical calculations, rapidly and accurately.
- (iv) Memory factor (M): involves the ability to memorize quickly.
- (v) Word Fluency Factor (W): is involved whenever the subject is asked to think of isolated words at a rapid rate.
- (vi) Inductive reasoning factor (RI): concerns with the ability to generalize through specific examples.
- (vii) Deductive reasoning factor (RD): concerns with the ability to make use of generalized result.
- (viii) Perceptual factor (P): concerns with the ability to perceive objects accurately.
- (ix) Problem-solving ability factor (PS): concerns with the ability to solve problems independently.

The weakest link in the group factor theory was that it discarded the concept of common factor. However, it did not take Thurstone too long to realize his mistake and reveal a general factor in addition to group factors.

G.H. THOMSON'S SAMPLING THEORY

This theory was propagated by G.H. Thomson, a brilliant psychologist. According to the theory, mind is made up of many independent bonds or elements. Any specific test or school activity sample some of these bonds. It is possible that two or more tests sample and utilize the same bonds. In such

cases, general common factor can be said to exist among them. It is also possible that some other tests sample different bonds, then the tests have nothing in common and each is specific.

This theory seems to combine various theoretical viewpoints as:

- (i) It appears to be similar to Thorndike's multifactor theory except that it concedes to the practical usefulness of a concept like 'g'.
- (ii) At the same time Thomson seems to maintain that the concept of group factor (G) is of equal usefulness.

VERNON'S HIERARCHICAL THEORY

P.E. Vernon, a British psychologist, has propagated a theory of intelligence by suggesting hierarchical structure for the organization of human intelligence (See below figure 22.2).

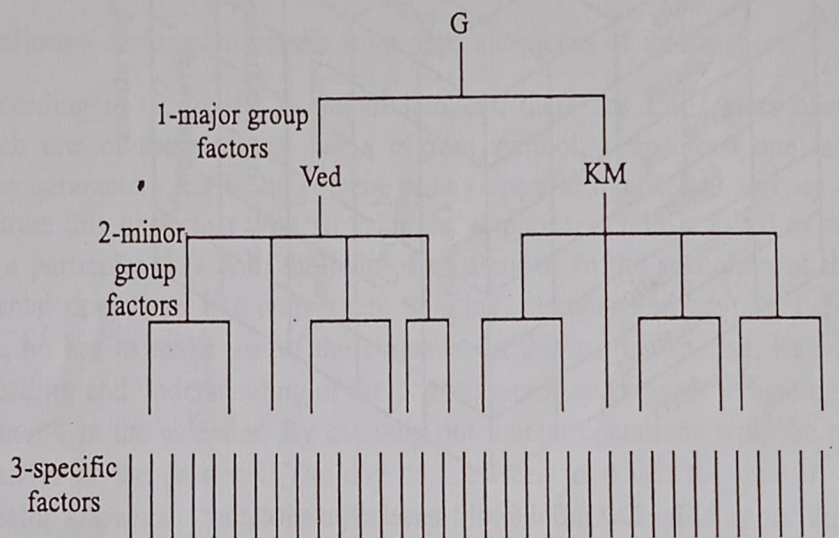


Fig. 22.2 Vernon's hierarchical structure of human intelligence.

Thus, according to Vernon, intellectual abilities or factors of intelligence lie in hierarchical order. On top we have G, a general type of major factor representing the overall intelligence of an individual. Under G, there lie two prominent group factors namely Ved (concerning with the verbal, numerical and educational abilities) and KM (connected with practical, mechanical, spatial and physical abilities). These two major factors may be divided into minor group factors and these minor factors in turn may be further sub-divided into various specific factors related with minute specific mental abilities.

GUILFORD'S THEORY INVOLVING A MODEL OF INTELLECT

J.P. Guilford and his associates have developed a model of intellect on the basis of the factor analysis of several tests employed for testing intelligence of human beings. They have come to the conclusion that any mental process or intellectual activity of the human being can be described in terms of three basic dimensions or parameters known as operation (the act of thinking or way of processing the information); contents (the terms in which we think or the type of information involved); and products (the ideas we come up with, i.e. the fruits of a thinking). Each of these parameters—operations, contents and products—may be further subdivided into some specific factors or elements. As a result, operations may be subdivided into 5 specific factors, contents into 5 and products into 6. The interaction of these three parameters, according to Guilford, thus results into the $5 \times 5 \times 6 = 150$ different elements or factors in one's intelligence. In a figural form, these

150 factors or independent abilities of the human beings along with the basic parameters and their divisions can be represented through a model named as Guilford's Model of Intellect or Intelligence (See figure 22.3).

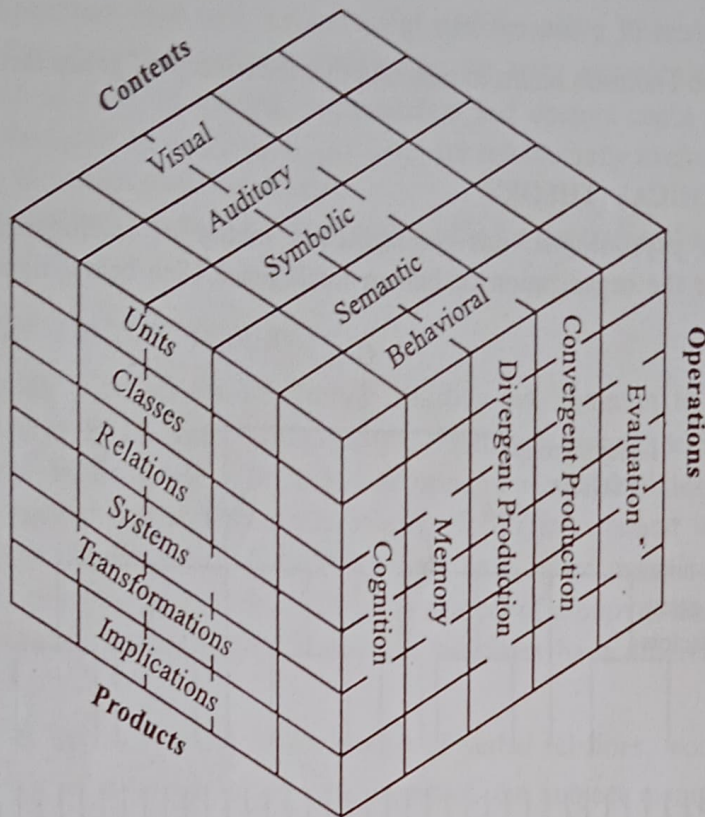


Fig. 22.3 Guilford's model of intellect.

This model proposes that intelligence consists of 150 independent abilities that result from the interaction of five types of contents, five types of operations and six types of products. Guilford, 1982.

What is implied by these contents, operations and products can be understood through the following brief description.

Contents (The type of Information involved).

- **Figural (visual)**—The properties of stimuli we can experience through visual senses e.g. colour, size, shape, texture and other visual characters of figure.
- **Figural (Auditory)**—The properties of stimuli we can experience through the auditory senses, e.g. voice and sound.
- **Symbolic**—Numbers, letters, symbols, designs.
- **Semantic**—The meaning of words, ideas.
- **Behavioural**—The actions and expressions of people.

Operations (The way of Processing information).

- **Cognition**—Recognizing and discovering.
- **Memory**—Retaining and recalling the contents of thought.
- **Divergent production**—Producing a variety of ideas or solutions to a problem.

- **Convergent production**—Producing a single best solution to a problem.
- **Evaluation**—Taking decision about the nature of the intellectual contents or gathered information whether it is positive or negative, good or bad etc.

Products (The results obtained through Operations).

- **Units**—Individual pieces of information limited in size, e.g. a single number, letter or word.
- **Classes**—Groups of units information related to each other on the basis of some common characteristics involving a higher order concept (e.g. men + women = people).
- **Relations**—A connection between concepts.
- **Systems**—An ordering or classification of relations.
- **Transformation**—Altering or restructuring intellectual contents.
- **Implications**—Making inferences from separate pieces of information.

In this way, according to Guilford's model of intellect, there are 150 factors operating in one's intelligence. Each one of these factors has a trigram symbol, i.e. at least one factor from each category of three parameters has to be present in any specific intellectual activity or mental task.

Let us illustrate this basic fact with an example. Suppose a child is asked to find out the day of the week on a particular date with the help of a calendar. In the execution of this mental task, he will need mental operations like convergent thinking, memory and cognition. For carrying out these operations, he has to make use of the contents. In this particular case, he will make use of semantics, i.e. reading and understanding of the printed words and figures indicating days and dates of a particular month in the calendar. By carrying out mental operations with the help of contents he will finally arrive at the products. The day of the week to which the date in question refers, represents the factor known as "relations". He may further transform and apply this knowledge to identify the days for contiguous dates or vice versa.

Conclusion about the Factor's Theory of Intelligence

Each of the seven theories of intelligence described above attempts to provide a structure of intelligence in terms of its constituents or factors. These theories exhibit wide variations in terms of the numbers of factor that they consider important. The range of all such factors also varies from 1 (Unitary theory) to 150 (Guilford's Intellect Model). However, for understanding what goes on inside one's intelligence we must try to build an eclectic view by incorporating the essence of all the workable theories of intelligence. Consequently, any intellectual activity or mental task may be said to involve the following three kinds of basic factors (arranged in the order as suggested by Vernon or in the form of the model suggested by Guilford).

1. General factor g (Common to all tasks)
2. Specific factors s_1, s_2 , etc. (Specific to the tasks)
3. Group factor G (Common to the task belonging to a specific group)

MEASUREMENT OF INTELLIGENCE

We are only familiar with that intelligence of an individual which is manifested by him on an intelligence test or tests. Psychologists have devised many such tests for the measurement of intelligence.

i.e. at least one factor from each category of the three parameters has to be present in any specific intellectual activity on mental task.

Let us illustrate this with an example. A child is asked to determine the day of the week on a particular date with the help of a calendar. The task involves operations like convergent thinking, memory and cognition. In carrying out these operations, he has to make use of the contents. In this particular case, he will make use of semantics, i.e. reading and understanding of the printed words and figures indicating days and dates of a particular month in the calendar. By carrying out mental operations with the help of the contents he will finally arrive at the products. The day of the week to which the date in question refers represents the factor known as 'relations'. He may further transform and apply this knowledge to identify the days for contiguous dates or vice versa.

Conclusion

The theories discussed so far fall in the broad category of factor theories of intelligence as these employ factor analysis techniques for identification of factors or common abilities which constitute one's intelligence. These theories exhibit wide variations in terms of the number of factors that they consider important. The range of such factors goes from 1 (monarchic theory) to 150 (Guilford's intellect model).

Each of the above theories of intelligence attempts to provide a structure of intelligence in terms of its constituents or factors. The unitary theory is right in claiming that intelligence in its functional form is always used as a whole in the form of a total fund of mental energy. However, for understanding what goes on inside one's intelligence we must try to build an eclectic view by incorporating the essence of all the workable theories of intelligence. Consequently, any intellectual activity or mental task may be said to involve the following factors. These factors may be arranged in hierarchical order as suggested by Vernon or in the form of some model like the one designed by Guilford. These factors may also be classified as unlearned and learned as advocated by Cattell and Jensen.

1. General factor g (common to all tasks) as advocated by Spearman in his two factor theory.
2. Group factor G (common to the tasks belonging to a specific group) as advocated by Thurston and others in the group factor theory.
3. Specific factors s_1, s_2 , etc. (specific to the task) as advocated by Thorndike in his multifactor theory.

Cognitive Theories of Intelligence

These theories of intelligence tried to analyse and describe intelligence in terms of certain fundamental cognitive processes. The important theories falling in this category are:

✓ Cattell and Horn's Theory of Intelligence

Cattell (1965) and Horn (1978) proposed a theory of intelligence by

distinguishing between two types of intelligence, i.e. *fluid intelligence* and *crystallized intelligence*. Although viewed as different and distinct, these two types of intelligence intermingle and interact to produce overall intelligence.]

[Fluid intelligence is considered to be the mental capacity of an individual, which is required for learning and problem solving. It is dependent on neurological development and is relatively free from the influences of education and culture. In other words, it is derived more from biological and genetic factors and is less influenced by training and experience. This type of intelligence is put to use when facing new and strange situations requiring adaptation, comprehension, reasoning, problem solving and identifying relationships etc. It reaches full development by the end of an individual's adolescence.]

[Crystallized intelligence, on the other hand, is not a function of one's neurological development and therefore is not innate or unlearned like fluid intelligence. Rather, it is specially learned and is, therefore, dependent on education and culture. It involves one's acquired fund of general information consisting of knowledge and skills essential for performing different tasks in one's day-to-day life. It can be identified through one's fund of vocabulary, general knowledge of the world affairs, the knowledge of customs, traditions and rituals, manner of behaving in the society, handling of machines and tools, craftsmanship and art, computation and keeping of accounts and various other such tasks requiring knowledge, experience and practice.]

Thus, while fluid intelligence is characterized by a relatively high degree of culture, education, experience and training-free performances in abstraction, thinking, reasoning and imagination, crystallized intelligence is known for its evolution through experience, training and interaction with of one's environment over a number of years. That is why it is found to continue to increase throughout one's life span.

Jensen's Theory of Mental Functioning

Arthur Jensen (1969) propounded the theory of mental functioning. According to this theory, the functioning of one's mind depends upon the type and degree of intelligence one possesses. Jensen describes one's intelligence as being composed of two types of abilities, namely, associative abilities and conceptual abilities.

[The first category includes one's ability to remember, reproduce, identify, discriminate, synthesize, associate, assimilate, transfer, and apply etc. Such abilities are usually measured by means of intelligence test items, or tasks involving free recall, recognition, serial learning, free and controlled associate learning, selection and discrimination, etc.] [Conceptual abilities on the other hand, involve one's ability to carry out higher order of thinking, reasoning, analysing and the capacity of problem solving, That is why this type of abilities are said to be measured through tasks and test items requiring the use of conceptual ability, abstract reasoning, novelty of situation and methods as also analytical and divergent thinking. According to Jensen associative abilities relate to biological maturation and show little variation among social classes and races. Conceptual abilities, however, are dependent on education and culture and are, therefore,

responsible for the observed differences in conceptual reasoning and abilities among social classes and races.

This attribute of intelligence in an individual according to Jensen, is two-dimensional, having intellectual breadth and intellectual altitude. What is described as the breadth of one's intelligence consists of the intellectual fund of general information, vocabulary, practice and skill of handling tools and machines, ways and manners of behaving in society, etc. It usually depends upon one's interaction with one's environment, the attitudes, values, interests one possesses, the experiences and training one receives and the things and treatments one obtains from one's environment. Thus, described as a function of one's learning, education and culture, it is similar to Cattell's concept of crystallized intelligence.

The altitude component of one's intelligence, on the other hand, depends more on innate and neurological factors than on learning, training and environmental influences. It imparts altitude to one's intellectual structure by involving the relatively high-level cognitive abilities like abstract and divergent thinking, logical reasoning, imagination and conceptualization, problem solving, etc.

A person's intelligence is thus said to be built up on the base provided by his intellectual breadth and height maintained by his intellectual altitude. How intelligently he will function in a given situation thus depends upon his innate basic abilities and the required mental functioning.

Campion and Brown's Theory of Intelligence

The American psychologist Joe Campion and Ann Brown (1979) developed a theory of intelligence according to which one's intelligence is composed of a two-part system. The first part is a biologically based architectural system and the second, an environmentally influenced executive system.

The architectural system works as a base for one's intellectual functioning. It includes such basic mental abilities as memory capacity, the rate of loss of memory, the ability of proper information processing, etc. The executive system works as a store-house of knowledge and information and is said to include the cognitive abilities like cognitive schemata, cognitive learning strategies and meta-cognition (i.e. the awareness of one's abilities to plan, evaluate and regulate learning). The executive system works on a higher level and is thus responsible for higher order mental functioning and the abilities comprising this system are dependent on training and experience. The abilities comprising the architectural system, on the other hand, are innate and biological and are thus relatively independent of the education, culture and training influences.

Sternberg's Information Processing Theory of Intelligence

The most recent acceptable theory of intelligence has been put forward by the American psychologist Robert Sternberg (1985) by adopting an information processing approach to cognition or problem solving. The information processing approach is the manner in which one proceeds to perform a mental task or solve a problem from the time one comes across it, gathers information and makes use of this information for completing the task or solving the problem in hand. The

theory propagated by Sternberg identified the following steps in the way one processes information:

1. Encoding (identifying the relevant available information in the mind)
2. Inferring (drawing the necessary inference)
3. Mapping (establishing the relationship between a previous situation and the present one)
4. Application (applying the inferred relationship)
5. Justification (justifying the analysed solution of the problem)
6. Response (providing the best possible solution)

Considering the way human beings process information in executing a mental task, Sternberg laid down a triarchic structure for his theory of intelligence based on three sub-theories, namely, (a) component sub-theory, (b) experimental sub-theory, and (c) contextual sub-theory.

(a) *Component sub-theory.* This is the core of Sternberg's theory. Sternberg advocates that a person's intellectual functioning is decided mainly by the components, i.e. elementary information processes operating on internal representation of objects or symbols. He listed three types of components serving distinct functions:

- (i) *Meta components* which represent higher order executive processes employed for planning, monitoring and regulating the execution of a task such as analysis of the problem, selection of the strategies, monitoring of the possible solutions and interpretation of the feed-back about performance etc.
- (ii) *Performance components* which represent the actual mental processes used for the execution of a task like task perception, concept identification and response making etc.
- (iii) *Knowledge-acquisition components* which represent the processes used in acquiring new information such as synthesizing old ideas in some original and creative ways.

(b) *Experimental sub-theory.* By this sub-theory, Sternberg proposed that intelligence represents the ability or capacity of an individual to deal with new tasks, problems and situations by adopting an information processing approach with as little conscious effort as possible. This means that to assess the degree of intelligence of an individual, we must give him the opportunity to perform new tasks or face novel situations or problems. This sub-theory has thus led psychologists and researchers to identify specific tasks and situations which may be utilized as reliable yardsticks for measuring intelligence.

(c) *Contextual sub-theory.* While proposing this sub-theory, Sternberg (1985) declared that intelligence should be regarded as "*a mental activity directed toward purposive adaptation to, and selection and shaping of, real-world environments relevant to one's life*".

This declaration made out intelligence—to be a factor of a practical nature rather than a mere abstraction. He, in fact, sought the real function and purpose

of human intelligence by considering it as a proper instrument for adaptation, and the selection and shaping of one's environment. The concept and structure of intelligence proposed by Sternberg thus went beyond the concept of I.Q. measurement and traditional cognitive processes as it gave greater freedom and power to an individual to solve his day-to-day problems and to become the master of his destiny.

Gardner's Theory of Multiple Intelligence

Howard Gardner of Harvard University has propounded a unique theory of intelligence called the "theory of multiple intelligence". It first appeared in his 1983 book, *Frames of Mind: The theory of multiple intelligence*. Through his new theory, Gardner challenged the notion of general intelligence, "g" and then questioned the very basis of prevailing intelligence tests by asking how an individual's intellectual capacities could be captured in a single measure of intelligence. Indeed, he tried to give a broad base to the concept of intelligence and its measurement by providing a multiple frame. He asserted that human intelligence or cognitive competence can be better described as a set of an individual's multiple abilities, talents and mental skills related to a multiple number of domains of knowledge in a particular cultural setting. Elaborating his pluralistic view of intelligence further, he concluded that there are seven independent types of intelligence that grow and develop differently in different people, depending upon their hereditary characteristics or environmental experiences. By calling them independent, Gardner meant that each intelligence is a relatively autonomous intellectual potential which is capable of functioning independently of the others. These different types of intelligence have been named by him as linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, intrapersonal and interpersonal.

Linguistic intelligence. This type of human intelligence is responsible for all kinds of linguistic competence-abilities, talents and skills, available in human beings. It can be best broken down into components like syntax, semantics and pragmatics as well as more school-oriented skills such as written or oral expression and understanding. This type of intelligence is most visible in professionals like lawyers, lecturers, writers and lyricists, and a number of other professionals exploiting linguistic intelligence.

Logical-mathematical intelligence. This type of intelligence is responsible for all types of abilities, talents and skills in areas related to logic and mathematics. It can be broken down into components like deductive reasoning, inductive reasoning, scientific thinking including solving of logical puzzles, carrying out calculations and the like. Professionals like mathematicians, philosophers, physicists, etc. are found to exhibit this type of intelligence in abundance.

Spatial intelligence. This type of intelligence is concerned with the abilities, talents and skills involving the representation and manipulation of spatial configuration and relationship. Many of us as adults make use of this kind of intelligence in the sphere of our work. For example, painters may be seen to

demonstrate spatial intelligence through their use of space when applying pigments to a canvas. This is also true of professionals like land surveyors, architects, engineers, mechanics, navigators, sculptures and chess players—who are found to rely upon the spatial intelligence in their own way.

Musical intelligence. This type of intelligence covers the abilities, talents and skills pertaining to the field of music. It may be well demonstrated through one's capacity for pitch discrimination, sensitivity to rhythm, texture and timbre, ability to hear themes in music; and in its most integrated forms, the production of music through performance or composition. It is visible in a quite large proportion in professionals like musicians and composers.

Bodily kinesthetic intelligence. This type of intelligence is concerned with the set of abilities, talents and skills involved in using one's body or its various parts to perform skillful and purposeful movements. A child may be seen to demonstrate such intelligence in moving expressively in response to different musical and verbal stimuli or bending different body parts in organised sports. Among professionals, dancers, athletes and surgeons may be seen to demonstrate a high degree of bodily-kinesthetic intelligence in their respective fields.

Intra-personal intelligence. This type of intelligence consists of an individual's abilities to enable him to know his self. It includes knowledge and understanding of one's own cognitive strengths, styles and mental functioning, as well as one's feelings, range of emotions and skills to utilize one's fund of knowledge in practical situations. In brief, intrapersonal intelligence helps an individual to understand his own self by providing an insight into his total behaviour—what he feels, thinks or does. It is, therefore, said to be the most private of the intelligences that a person possesses. On account of its secret and private nature, the access to this type of intelligence in an individual is available only through self-expression, i.e. language, music, visual art and similar other forms of expression. In our practical life, this type of intelligence is demonstrated by yogis, saints and masters of Zen.

Inter-personal intelligence. The counterpart of intrapersonal intelligence in one's cognitive structure is interpersonal intelligence. It consists of the abilities to understand individuals other than one's self and one's relations to others. In addition, it includes the ability to act productively, based on the understanding of others. The knowledge and understanding of others is the quality that is needed for social interactions in one's day-to-day life. In practical life, this type of intelligence is most visible among psychotherapists, teachers, sales people, politicians and religious leaders.

In this way, Gardner's theory of multiple intelligence provides a broad and comprehensive view of human abilities, extending from linguistic and logical-mathematical abilities (the type of skills most addressed and valued in traditional school settings as also in majority of standardized intelligence tests) on the one hand, to intrapersonal and interpersonal abilities on the other. Out of these seven types of intelligence, whereas the linguistic, logical-mathematical and spatial abilities have been accepted widely as the types and components of intelligence,

the last four have been the subject of great controversy as to whether they should be categorized as separate types of intelligence or as different talents. However, as far as the broader and global assessment of one's intellectual competencies and abilities is concerned, there is sufficient truth in the assertion of Gardner's theory that knowledge of all the seven types of intelligence is essential for the true assessment of one's level of intellectual functioning.

The other striking feature and contribution of Gardner's theory of multiple intelligence is its bold declaration that the concept of a measurable "g" is at best limited and at worst educationally misleading. It is not at all essential that an individual highly loaded with linguistic and/or logical mathematical abilities will also display exceptional ability (or even interest) in all or any remaining domains, i.e. spatial and musical abilities etc. It happens on account of a sort of autonomy maintained by each type of the seven different human intelligence which are said to be quite capable of developing independently of each other and also quite independently of an all-encompassing general intelligence, "g".

NATURE OF INTELLIGENCE

The true nature of intelligence can be understood by first defining it to understand its meaning, discussing the various theories explaining its structure in terms of the several constituents and factors, and identifying the numerous other aspects and characteristics related to intelligence and its functioning. We have already covered the first two points in the present chapter, let us now concentrate briefly on last point through the following description.

Distribution of Intelligence

The distribution of intelligence is not equal among all human beings. It resembles the pattern of distribution of health, wealth, beauty and similar other attributes or endowments. It is a normal distribution that is governed by a definite principle which states that *the majority of people are at the average, a few very bright and a few very dull.*

Individual Differences in Intelligence

Wide individual differences exist among individuals with regard to intelligence. Truly speaking, no two individuals, even identical twins or individuals nurtured in identical environments, are endowed with equal mental energy. The assessment of intelligence by various tests has given reasons enough to believe that not only does intelligence vary from individual to individual but it also tends to vary in the same individual from age to age and situation to situation.

Intelligence and Changes in Age

As the child grows in age, so does the intelligence as shown by intelligence tests. The question which now arises is, at what age does this increase stop? The age at which mental growth ceases, varies from individual to individual. It tends to stabilize after the age of 10 and is fully stabilized during adolescence. The idea