

Intelligence : Nature, Theories, I.Q. and Measurements

No two individuals are exactly alike. Some are bright, others dull, some are quick, others slow, some solve problems quickly and directly, others fumble over them for a long time, some adapt themselves to new situations easily while others experience difficulty. The teacher is conscious that there are individual differences in intelligence. The modern psychology pays utmost attention to these individual differences. The study of intelligence has sustained itself to a large measure from the four closely related problems – Nature of Intelligence, Theories of Intelligence, I.Q. and the Measurement of Intelligence.

(A) NATURE OF INTELLIGENCE

Meaning of Intelligence :

There is no agreement as regards the exact definition and nature of intelligence. *Ballard* has remarked "While the teacher tried to cultivate intelligence and psychologist tried to measure intelligence, no body seemed to know what was intelligence." Let us face this challenge and try to define it.

It is said that intelligence is the ability when we have some aim or question in mind :

- (a) to discover relevant qualities and relationship of objects or ideas that are present before us and
- (b) to evoke other relevant ideas

In other words, intelligence is the *capacity for relational constructive thinking directed to the attainment of some end*. In intelligent study of literature, in intelligent running of a house, in intelligent business organization – in all forms of activities, capacity for relational constructive thinking is involved which is directed to the attainment of some end.

Authorities which support our views :

(1) *Spearman* supports our views when he says that intelligence is comprised of three abilities which are :

- (a) Ability to observe one's own mental processes.
- (b) Ability to discover essential relations between items of knowledge whether perceived or thought of.
- (c) Ability to deduce correlates.

Suffice to say that all these abilities are nothing but capacities for relational constructive thinking directed to the attainment of some end.

(2) *Thorndike* at later state believed that intelligence consists in capacity of making controlled association. Controlled association requires the capacity for relational and constructive thinking directed to the attainment of some end. Here Thorndike gives views like us.

Some more meanings and definitions of intelligence are given ahead :

1. Derivative meaning : The word intelligence comes from a Latin word which means "cognitive processes."

2. Dictionary meaning : Intelligence is "the capacity to accumulate knowledge and put it into use."

3. Vernon's view : According to Vernon, there are three meanings of intelligence :

(i) **Biological meaning :** Biological meaning of intelligence emphasises adaptive nature of human beings. So intelligence is the capacity of the individual to adapt or adjust to environmental situations.

(ii) **Psychological meaning** : It emphasises mental efficiency and the capacity for abstract thinking and reasoning. Therefore intelligence is an innate general cognitive ability.

(iii) **Operational meaning** : It emphasises specific characteristics of intelligent behaviour and measurement of these specifications. Hence, intelligence is "what intelligence tests measure."

Many definitions of intelligence have been given. We can divide them in three groups :

1. **Ability to adjust** : One group of definitions emphasises that intelligence is the ability to adapt or adjust to new situations. Ross, Burt, Stern, Woodworth, Ebbinghaus, Binet, McDougall, Goddard, William James and many others belong to this group.

(i) **View of Ross** : "Conscious adaptation to new situation is intelligence."

(ii) **Burt's view** : "Intelligence is the capacity of flexible adjustment."

(iii) **Stern's view** : "Intelligences is the ability to adjust oneself to a new situation."

(iv) **Woodworth's view** : "Intelligence means intellect put to use. It is the use of intellectual abilities for handling a situation or accomplishing any task."

(v) **Piaget's view** : "Intelligence is the ability for adaptation to physical and social environment."

(vi) **William James' view** : "Intelligence is the ability to adjust oneself successfully to a relatively new situation of life."

2. **Ability to learn** : According to another group of psychologists intelligence is the ability to learn. Buckingham, Dearborn, Thorndike, and Colvin belong to this group.

(i) **Buckingham's view** : "Intelligence is the ability to learn."

(ii) **Dearborn's view** : "It is the capacity to learn or profit by experience."

(iii) **Thorndike's view** : "Intelligence is the ability to make profitable use of past experience."

(iv) **Woodworth's view** : "Intelligence is the ability to acquire knowledge."

3. **Ability to carry on abstract thinking** : According to this group of definitions, intelligence is the ability to carry on abstract thinking. Spearman, Terman, Binet, Burt, Garret and Gates and Others represent this group.

(i) **Spearman's view** : "Intelligence is relational thinking."

(ii) **Terman's view** : "An individual is intelligent in proportion as he is able to carry on abstract thinking."

(iii) **Binet's view** : "Intelligence is a capacity to think well, to judge well and to be self-critical."

(iv) **Burt's view** : "Intelligence is ability to judge well, to comprehend well, to reason well."

(v) **Garret's view** : "Intelligence is the ability to solve problems which require the comprehension and use of symbols i.e. words, numbers, diagrams, equations, formulae."

(vi) **View of Gates and Others** : "Intelligence is a composite organisation of abilities to learn, to grasp broad and subtle facts especially abstract facts."

General Criticism of these Definitions :

(i) **Incomplete definitions** : All the above mentioned definitions (whether they convey the ability to adjust or ability to learn or ability to carry on abstract thinking) are incomplete.

(ii) **Emphasis on one aspect** : All these definitions emphasise only one aspect and neglect others.

(iii) **Fail to clarify scope** : These definitions fail to clarify the full scope of intelligence.

It must be noted that it is very difficult to separate all these definitions into three separate categories. In fact a definition of intelligence as the ability to adapt or adjust and ability to learn are two aspects of the same process. Similarly individual's ability to carry on abstract thinking contributes to a person's ability to adapt or adjust to new and changing situation.

Comprehensive Definitions of Intelligence :

1. **Wechsler's definition** : "Intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with the environment." According to this definition,

intelligence is the global and aggregate capacity with three important dimensions. They are (1) Purpose, (2) Rational thinking and (3) Effectiveness in the environment. This definition seems to combine and extend the above three groups of definitions.

2. Stoddard's definition : "Intelligence is the ability to undertake activities that are characterised by (1) difficulty, (2) complexity, (3) abstraction, (4) economy, (5) adaptiveness to a goal, (6) social value, and (7) the emergence of originals, and to maintain such activities under conditions that demand a concentration of energy and resistance to emotional forces." This definition is very comprehensive and seems to be better with wide scope.

What Intelligence is Not ?

1. Not knowledge : Intelligence is not knowledge, though it is related to it. The amount of knowledge, one can acquire is limited by one's intelligence.

2. Not talent : Intelligence is not the same as talent. Talent involves two things : (1) Native capacity and (2) Practised skill. Intelligence is native capacity.

3. Not memory : Intelligence is not memory even. It has been observed that sometime persons with low intelligence have very good memory.

4. Not skill : Intelligence is different from skill. Skill is acquired through practice and can be perfected by more practice. But intelligence cannot be enhanced by practice.

Types of Intelligence :

(1) Hebb's view :

D.O. Hebb classified intelligence into (1) Genotype intelligence, (2) Phenotype intelligence.

1. Genotype intelligence : It represents an innate, inborn or native capacity which depends entirely on the biological or neurological system of an individual. Hebb calls it *intelligence A*.

2. Phenotype intelligence : It develops on the basis of interaction between genotype intelligence and environmental influences. Phenotype intelligence is the result of environmental and cultural forces particularly during childhood and adolescent period. Hebb calls it *intelligence B*.

(2) Cattell's view :

Cattell classified intelligence into (1) Fluid intelligence and (2) Crystalized intelligence.

1. Fluid intelligence : It is the inherited potentiality of an individual.

2. Crystalized intelligence : It is based on environmental factors.

(3) Thorndike's view :

Thorndike suggested three broad categories of intelligence :

1. Abstract intelligence : Abstract intelligence is the ability to understand and manage ideas and symbols, such as words, number, chemical or physical formulas, legal decisions, scientific principles and the like. In the case of students this is very close to scholastic aptitude. Generally, scholars, executives in business and government, and scientists possess high abstract intelligence.

2. Mechanical intelligence : Mechanical intelligence includes the ability to clean, to understand and manage things and mechanisms, such as a knife, a gun, a moving machine, a boat, a lathe, an automobile, etc. Mechanics, builders, expert carpenters and plumbers possess high mechanical intelligence.

3. Social intelligence : Social intelligence is the ability to understand and manage men and women, boys and girls to act wisely in human relations. High social intelligence is found in politicians, sales people and leaders in society.

A successful civil engineer presumably possesses high abstract as well as high mechanical intelligence ; the successful criminal lawyer possesses abstract as well as social intelligence.

Characteristics of Intelligence :

1. Innate : Intelligence is an innate, natural power and not acquired.

2. **Varies** : Power of intelligence differs from individual to individual.
3. **Helpful in learning and adjustment** : It helps the individual in learning things and making adjustments.
4. **Helpful in solving problems** : It helps the man to face and solve the complicated and difficult problems and situations.
5. **Influenced by heredity** : Heredity exercises a good deal of influence on intelligence.
6. **Influenced by environment** : Environment, training or education affect intelligence. Studies by Freeman and Holzinger, Freeman and Flory, Terman and Merrill, Tudenhem, Kephart and Schmidt illustrate this point.
7. **Influenced by socio-economic factors** : Socio-economic and cultural factors as well as racial differences affect intelligence tests scores.
8. **Not influenced by sex** : There is no difference in intelligence due to differences in sex.
9. **Average intelligence** : Intelligence tests have proved that generally children are of average intelligence and ability.
10. **Ceases** : Development of intelligence ceases towards the middle of adolescence.
11. **Relationship between intelligence and knowledge** : There is close relationship between intelligence and knowledge. Knowledge that may be of practical use in life may be termed as intelligence. With the help of intelligence knowledge can be acquired but with knowledge it is not possible to develop greater intelligence. In the words of Ross, wisdom is the goal and knowledge is only the means of reaching it."

Marks of Intelligent Behaviour :

Woodworth mentions the following marks of intelligent behaviour :

1. **Use of past experience** : An intelligent man makes more use of his past experience to seek a goal. Utilizing past experience is a mark of intelligence.
2. **Adaptation to a novel situation** : An intelligent person can easily adapt himself to a novel situation. He can master a complex situation. Capacity to master a novel situation is a mark of intelligence.
3. **Seeing the point** : Intelligence consists in seeing the point or finding out the essentials of a problem or insight into the key of the situation.
4. **Viewing actions from a broader point of view** : An intelligent person takes a broad view of a situation and adapts his actions to it. He has a foresight. He is able to see the situation as a whole. He finds out the key to the situation. A stupid person cannot take a broad view of a situation. His perspective is narrow. He follows a fixed routine in his actions.

Curve of Development of Intelligence :

The following points highlight the intellectual development curve :

- (1) The development of intelligence is very rapid for the first six years.
- (2) Then the development of intelligence is slow for the next two years.
- (3) About 90% of the development of intelligence takes place by the time an individual is ten years.
- (4) The development of intelligence reaches its maximum by the 16th year, though some psychologists believe that intelligence goes on growing into early twenties. They probably confuse intelligence with the achievement.

Pinter believes that the chronological age at which an individual reaches his full mental maturity varies from 14 to 22 years. As a result of his work with Binet tests, Terman set 16 years as the limit of mental growth.

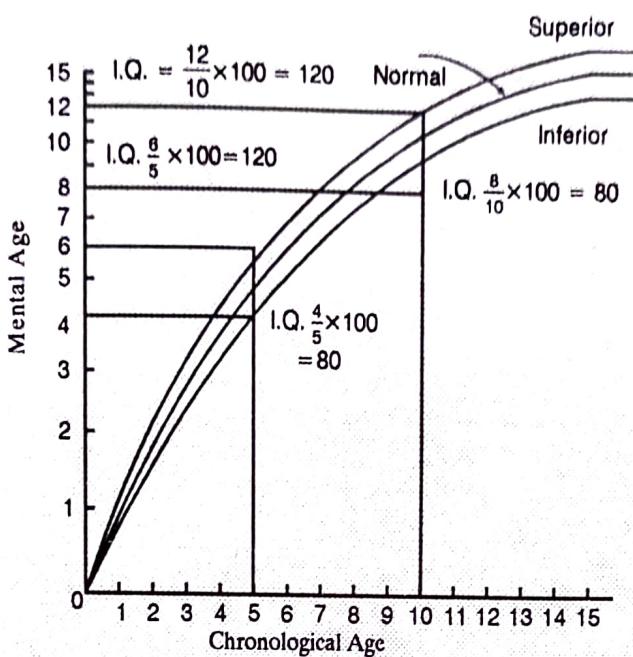


Fig. Showing Hypothetical growth which gives a Constant I.Q.

It should be noted that the rate of growth of intelligence is not the same in the case of superior, average and inferior children. Children of superior intelligence start at a higher level and continue to be higher throughout the entire period of growth. Children of inferior intelligence start lower and stay lower upto maturity. Children of average intelligence lie in between.

(B) DIFFERENCE BETWEEN CREATIVITY AND INTELLIGENCE

1. **Different basis** : Convergent thinking is the basis of intelligence and divergent thinking forms the basis of creativity. In convergent thinking, an individual has the tendency to find out the one most appropriate idea or response whereas divergent thinking allows as many responses as possible. Thus, in intelligence tests, where usually one correct response is required, convergent thinking is being tested whereas creativity emphasizes more on testing divergent thinking.

2. **Emphasis on different aspects** : In intelligence tests emphasis is placed on speed and accuracy of the cognitive behaviour. In creativity tests emphasis is placed on novelty, originality and flexibility.

3. **Relationship** : It has been observed that highly creative persons are usually found to possess intelligence to a high degree but it is not essential for an intelligent person to be creative. One may possess high intelligence without having creative abilities. It is not surprising that the highly creative and the highly intelligent persons may be taken as of similar abilities. Research studies have shown that even though the creative individuals are of above average intelligence, yet the abilities of highly creative and highly intelligent persons are so different that they can easily be discriminated. Many abilities are related to creativity while many others are related to intelligence. *Mckinnon* concluded that it is not true that more intelligent persons are necessarily more creative. *Nunn* found that creativity which is measured by creativity tests is independent of intelligence but the creativity which is being evaluated by the teacher is necessarily related to the intelligence.

What Intelligence Tests Measure :

Intelligence tests normally measure the following four abilities :

- (1) Ability to learn.
- (2) Ability to apply one's knowledge to new problems.
- (3) Ability to perceive relationships to identify.
- (4) Ability to reason.

Limitations :

(1) According to this theory a man who is intelligent in doing one task will also be intelligent in doing other tasks because intelligence is the all round capacity of the individual. For example, Newton was a great scientist. According to this theory he could be a great poet if he wished. But this is not true.

(2) There cannot be mentioned any single factor which means intelligence.

(2) OLIGARCHIC THEORY OR GROUP FACTOR THEORY :

This theory is sometimes known as sampling theory of intelligence. This theory was put forward by Prof. Thomson. According to this theory intellectual abilities belong to certain groups which are not related to each other. But there is close relationship between the abilities belonging to the same group i.e. they have got positive correlation. So according to this theory a child who is intelligent in one group of knowledge may not be intelligent in the other group. But he may be equally intelligent in the various subjects of that very particular group.

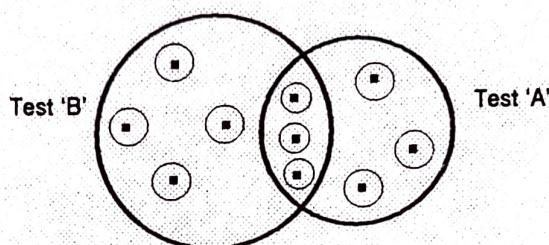


Fig. Thomson's Theory of Sampling.

For example, a person who is intelligent in science group may not be intelligent in humanity group because there is no significant correlation between science group and humanity group. But a person who is intelligent in physics or chemistry, can be equally intelligent in other branches of science which belong to that group because there is high correlation between them. Similarly a person who is intelligent in humanity group may not be intelligent in science group. But he may be equally intelligent in the various subjects which belong to humanity group.

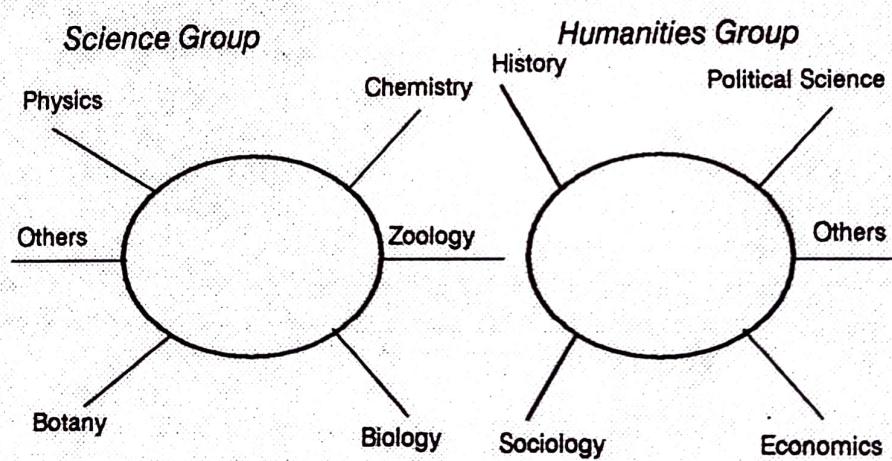


Fig. The Oligarchic Theory.

(3) THORNDIKE'S MULTIPLE FACTOR THEORY :

This theory was put forward by Thorndike. It is also known as *anarchic theory* of intelligence. According to him, intelligence is composed of highly particularised and independent faculties. There is

no significant relation between them. According to this theory, from man's ability to do one activity in one sphere we can not infer anything as to his ability to do another kind of work. For example if, any individual is intelligent in mathematics, we can not judge anything about his ability to study literature.

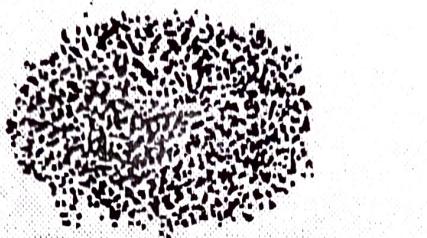


Fig. Multiple Factor Theory.

According to Thorndike, there is no general intelligence. Thorndike's theory is atomistic theory of intelligence. He distinguished four attributes or aspects of intelligence :

(i) **Level** : It refers to the degree of difficulty of a task that can be solved. It determines our level of intelligence. Level is an important aspect of intellect but we cannot measure it alone.

(ii) **Range** : Range or width refers to a number of tasks at any given degree of difficulty that we can solve. Range of intellectual growth is determined not only by level but also by breadth of experience and by opportunity to learn. In intelligence tests range is represented by items of equal difficulty. We cannot measure altitude without range or width.

(iii) **Area** : Area in a test means the total number of situations at each level to which the individual is able to respond. Area is summation of all the ranges at each level of intelligence possessed by an individual. It is in general highly correlated with altitude.

(iv) **Speed** : By speed we mean rapidity with which we can respond to test items. Speed and altitude are positively correlated. The coefficient comes to $\cdot 50$.

Every intelligence test consists of these four attributes. When we test a person, we give him a certain number of tasks (area) and these tasks vary in difficulty (altitude) and there are certain number of items at each level of difficulty (range) and they are responded in a given time (speed). Emphasis on the aspect of these attributes varies from test to test.

Thorndike has also given three types of intelligence :

(i) **Abstract intelligence** : It consists in ability to solve problems presented in form of symbols, words, numbers, formulae and diagrams.

(ii) **Concrete intelligence** : It consists in ability to deal with things as in skilled trades and appliances.

(iii) **Social Intelligence** : It consists in ability to understand and deal with persons. It is the capacity to behave effectively in social situations. Socially intelligent persons make friends easily. They quickly understand social relations.

Educational Implications of Thorndike's Theory of Intelligence :

1. **Knowledge of types of intelligence** : Thorndike's theory of intelligence provides knowledge about three types of intelligence : (1) abstract, (2) mechanical and (3) social intelligence of the students to guide them in the right direction. An analysis of student's abilities by the guidance worker can suggest a reliable base on which future learning could be used.

2. **Causes of slow progress** : Thorndike's theory of intelligence is useful in finding out the causes of unsatisfactory performance of the students inspite of their adequate intelligence.

3. Implications in curriculum : Thorndike's theory of intelligence suggests that curriculum should provide opportunities for development of abstract intelligence and social intelligence. Modern school curriculum has been diversified and broad-based.

4. Implications in methods of teaching : Abstract, mechanical and social abilities of students are developed by using modern technology of teaching.

5. Focus of attention : As Thorndike's theory has advocated three types of intelligence, it enables us to find out whether we are paying proper attention to each of them. If not, how can improvement be made. Development of abstract, mechanical and social intelligence and development of abstract, mechanical and social skills should be our focus of attention.

6. Enrichment programmes : Thorndike's theory guides the teachers to devise enrichment programmes for the gifted, the creative and the backward students. The theory suggests new ideas for school practice.

7. Basis of future learning : Abstract, mechanical and social aspects of intelligence are involved in different specialisation process – both academic and professional. We therefore need a priori knowledge about the specific type of intelligence of each student to place him in the right direction. Knowledge of (1) level, (2) range, (3) area and (4) speed proves very useful for this purpose.

8. Remedial teaching : When some students with abstract, mechanical and social intelligence fail to learn effectively in related areas, corrective or remedial teaching in that case requires an accurate assessment of his abilities, and some concrete steps for his utilising his strengths and developing him where he is weak.

9. Basis of guidance : Knowledge of abstract, mechanical and social intelligence provides the basis of giving educational and vocational guidance to the student.

(4) SPEARMAN'S ECLECTIC THEORY OR TWO (NOW THREE) FACTOR THEORY :

This theory was advocated by *Spearman*. According to him intelligence consists of two factors – one is "g" factor and the other is "s" factor. The "g" factor stands for the general ability and the "s" factor stands for the specific ability. Every individual has one "g" factor and some "s" factors (or Specific abilities). The "g" factor is always the same for the same individual and the "s" factor varies from task to task. Different individuals differ both in their "g" as well as "s" factors. For doing any activity, "g" factor is always involved and some of the "s" factors are also involved.

Characteristics of 'g' Factor :

1. **Universal ability :** It is universal ability i.e., it is found in case of all human beings.
2. **Inborn ability :** It is innate, natural or inborn ability. It is obtained by human beings from birth. Modern psychologists believe that it is fixed at the time of the conception of an individual.

3. **General mental ability :** It is general mental ability or common ability.
4. **General mental energy :** It is also regarded as general mental energy of an individual.
5. **Used in every activity :** It is used in every life activity of human beings. It is essential for all the activities. No activity can be performed without its involvement.

6. **Constant :** It is constant in the sense that for any individual in respect of all the correlated abilities it remains the same and unchanged.

7. **Varies from individual to individual :** The amount of 'g' differs (varies) from individual to individual.

8. **No influence of learning :** It is not influenced or modified by the effect of learning or habitual training.

9. **Responsible for success :** The 'g' factor is responsible for success of a human being in life.

10. **Extent of success :** The greater the amount of 'G' factor in an individual, the more successful he will be in life.

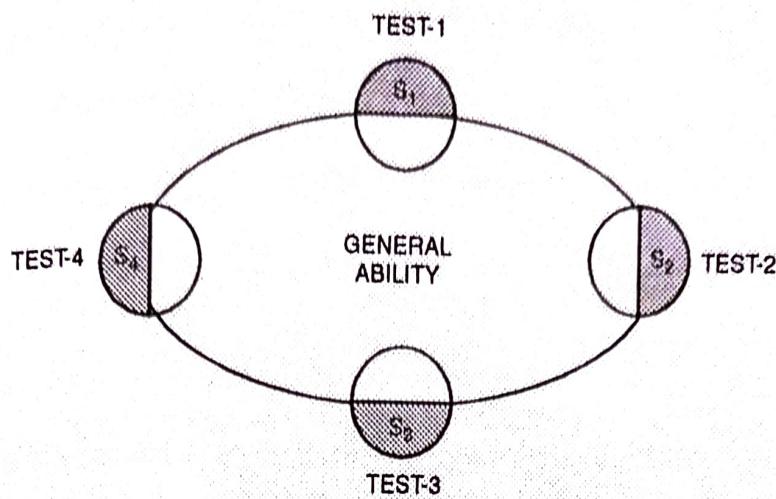


Fig. Showing Spearman's correlation between general and specific ability.

Characteristics of 's' Factor :

1. **Special ability** ; 's' factor is called as the specific or special ability of an individual to perform an intellectual activity.
2. **Specific activities** : It is involved only in specific type of activities which human beings undertake. It is not involved in all the activities.
3. **Learned** : 's' factor is learned or acquired in the environment. It is not innate or inborn. It is influenced and modified by learning and habitual training.
4. **Varies from activity to activity** : It varies from activity to activity or task to task in the same individual. Different 's' factors are used by the individual in different types of activities. Thus the amount of 's' factor is not constant in the case of a particular individual.
5. **Varies from individual to individual** : Individuals differ in amount of 's' ability. The number of 's' factors also differs from individual to individual.
6. **Many 's' factors** : 's' factor is not one but there may be many 's' factors in case of one particular individual. Different 's' factors are used by the same individual while performing different tasks.
7. **Specific mental energy** : 's' factors are considered to be the specific mental energy possessed by an individual.
8. **Success in particular field** : 's' factor is responsible for the success of an individual in a particular field.
9. **Amount of success** : The greater the amount of 's' factor in an individual, the more successful will be the individual in a particular field.

Some tasks require more of "g" factor and other tasks require more of "s" factors. For example in solving a mathematical problem more of "g" is required whereas in painting or music more of "s" factor is required. Those persons who possess more of "g" factor and less of "s" factor do fairly well in life. Spearman showed that there is always good deal of positive correlation between "g" and "s" factor.

Spearman later on added another factor which is known as "*Group factor*." Group factors are less general, wide-spread and homogenous than "g" factor and more general, wide-spread and homogenous than "s" factor.

Educational Implications of Spearman's Theory of Intelligence :

1. **Knowledge of general and specific ability** : Spearman's theory of intelligence provides knowledge about the general and specific "g" and "s" factor of intelligence of students to guide them in the right direction. An analysis of "g" factor, "s" factor and group factor by the guidance worker can suggest a sound basis on which future learning can be based.

2. Causes of slow progress : Spearman's theory of intelligence is useful in finding out the reasons of slow or unsatisfactory performance of the students inspite of their adequate intelligence. Thus this theory has diagnostic value.

3. Enrichment of curriculum and methodology : Spearman's theory of intelligence states that for understanding human learning and mental processes of memory, thinking, reasoning, problem solving and creativity, etc. suitable modifications are required in our theory of curriculum construction and methods of teaching.

4. Attention to intellectual abilities : The theory explains intelligence in terms of "g" factor, "s" factor and "Group" factor and this enables us to know whether we are paying adequate attention to each of them. If now, how to improve.

5. Enrichment programme : Spearman's theory of intelligence guides us to devise enrichment programmes for the gifted, the creative, the backward or slow learners, etc.

6. Focus of attention : The theory emphasises that "g" factor, "s" factor and "Group" factor should be our focus of attention.

(5) THURSTON'S GROUP FACTOR THEORY OF INTELLIGENCE :

Different Names :

Thurston's Group Factor Theory of Intelligence is also known as *Theory of Primary Mental Abilities*, *Multiple Factor Theory of Intelligence*, and *Factor Analysis Theory of Intelligence*.

The term '*Group Factor*' was suggested for the factors not common to all of the intellectual abilities, but common to certain activities comprising a group.

Thurston's Theory of Intelligence is a midway between Spearman's Two Factor Theory and Thorndike's Anarchic or Multiple Factor Theory of Intelligence. According to Thurston, intelligence is neither the projection of general ability nor of specific factor. He does not recognise the existence of 'g' or 's' factor. He talked about primary mental abilities in mental activities.

In 1938, Thurston gave his theory of intelligence after using 56 different tests ranging from 2 to 20 minutes in duration to 240 students of Chicago University. On the basis of factorial analysis, he found that intelligence is comprised of seven primary mental abilities. Thurston concludes that certain mental operations have a *common primary factor* that gives them psychological and functional unity and also differentiates them from other mental operations. These mental operations constitute a group. A second group of mental operations has its own *unifying primary factor*, and so on. In all, there are seven such groups which cover the entire range of mental abilities. Each of these primary factor is independent of others.

Seven Primary Mental Abilities :

According to Thurston, seven primary mental abilities which constitute intelligence are :

✓ 1. **Verbal comprehension (V)** : It is the ability to understand and use verbal relations, words and ideas. In other words it is the ability to use words in planning, thinking and communication.

2. **Numerical ability (N)** : It is the ability to do numerical calculations quickly and accurately.

3. **World fluency (W)** : It is the ability to express in words or to find the words at appropriate time.

4. **Memorising ability (M)** : It is the ability to memorise quickly and accurately.

5. **Spatial ability (S)** : It is the ability to manipulate an object imaginatively in space.

6. **Perceptual ability (P)** : It is the ability to perceive objects accurately.

7. **Reasoning ability (R)** : It is the ability to see relationships in situations described in symbols. It may be inductive or deductive type of reasoning :

(i) **Inductive reasoning ability (IR)** : It is the ability to draw inferences on conclusions on the basis of specific instances.

(ii) **Deductive reasoning ability (DR)** : It is the ability to make use of generalised results.