CHAPTER III
DEFINITIONS OF INTELLIGENCE

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DEFINITIONS OF INTELLIGENCE

Introduction

Of all forms of intellectual assessment none has aroused more controversy than the intelligence tests. Some people do really believe that intelligence tests measure intelligence but according to many others, they are nothing but monkeytricks. Intelligence is undoubtedly one of the most mysterious, elusive, confused, and controversial word in the English language. Perhaps no term other than intelligence in psychology is so generally used with functional meaning by young and old, literate as well as illiterate and yet, it is the very term which is found difficult to define with exactness by psychologists. We are unable to define intelligence not because we are ignorant of the right answer but because of the fact that intelligence is a very complex ability.

The definition of intelligence has so far defeated the intelligence of psychologists. They have been trying to give a clear definition of intelligence but all do not meet on a common ground. Almost every writer on the subject has put forward his own definition of intelligence and some, in the fullness of time, have even offered more than one and have not been constrained by consideration of compatibility.
The difficulty seems to arise from the fact that the social scientists look for an image of intelligence in a perfectly pure form in the same manner as physical scientists look for the term 'a gramme' or 'a centimeter.' But even in science it is also not possible to define each and every trait which can be measured. Wechsler has given the example of electricity. We know the existence of electricity and measure it. But we do not know its exact nature.

An eminent neuro-physiologist, Claud Bernord, maintained that theories are not true or false, but merely fertile or sterile and same could be said of scientific concepts or definitions. He has given examples from physics. Physics has made use of 'aether' in its attempts to explain the transmission of radio waves, atomic particles to explain the structure of matter and it still employs two incompatible theories of light, namely the wave and the corpuscular theories, as each is fruitful of ideas in different ways.

It is expected that the test maker should always make it clear what his instrument will measure. For that, first of all, the he should be clear about its concept. Rex Knight remarks that for the practical purpose of measuring intelligence it may well be that full knowledge of its nature is unnecessary (Knight, p. 5).
Terman also declared that "it is quite unreasonable to demand, as critics of Binet method have sometimes done, that one who would measure intelligence should first present a complete definition of it." (Quoted in Burt, 4, p.145)

Though psychologists cannot give a concise definition of intelligence, the results of different intelligence tests agree with each other to a considerable amount and hence, no such attempt, however modest, on the part of the test maker is necessary. Such a view is also supported by Freeman, who remarked that "though psychologists started with different definitions, they emerge with tests having considerable similarity." (Freeman, p.68) However, the same author favours a theoretical study of the concept of intelligence in the following words:

First the student should be familiar with the thinking of psychologists in this field, as a back-ground of his better understanding of the tests themselves. Second, it is through the interaction of the theoretical and applied that improvement and advance will be made. Third, it is possible that one or more of these theories will have increasing influence, in the future, upon test construction, testing, practice, and test interpretation.

(Freeman, p.180)

The present investigator has adapted the Wechsler preschool and primary scale of Intelligence for Gujarati population and has not to contribute any original point
of view as to the nature of intelligence, but guided by the foregiven reasons he has thought to discuss a few ideas about intelligence. In the present chapter some definitions and descriptions of intelligence, different theories of intelligence and models of intelligence are discussed.

**Origin of The Concept**

According to Cyril Burt, the term intelligence goes back to intelligentia, a term introduced by Cicero. Spearman reported that the monarchic view of unitary thing called intelligence was popular back as far as the fifteenth century. Herbert Spencer's definition of intelligence which he used in biology was perhaps the first attempt to explain the concept of intelligence in modern psychology. Spencer defines intelligence as "the mental adjustment of internal relations to external relations." (Spencer as cited by Desai, p.17) Afterward the psychologists differentiated between man and animal with the help of this term. Spencer believed that adjustment is achieved by virtue of intelligence in man and by virtue of instincts in lower animals. Thus the notion of intelligence was a gift to psychology from biology through Herbert Spencer.
Definitions of Intelligence

Psychologists have so far failed to give a compact definition of intelligence. Hence they have started to describe it in a comprehensive way rather than define it in a compact form. These attempts have resulted in reducing the differences but not in removing them completely. The note-worthy attempts to define intelligence comprehensively are those of Stoddard, Wechsler, Piaget, Thorndike and Hebb; last two of course, describe types of intelligence. Those by the first two are discussed in the following paragraphs.

Stoddard's Definition

Stoddard describes intelligence treating it as a theoretical composite whose elements may be operationally tested. He defines intelligence as follows:

Intelligence is the ability to undertake activities that are characterised by (1) difficulty, (2) complexity, (3) abstractness, (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 a resistance to emotional forces.

(Stoddard, p.4)
There is hardly any doubt about the aspects presented by Stoddard. He has rightly included all the aspects of intellectual thinking in his definition. Most of the available tests have reflected these aspects. However, the inclusion of the last two characteristics in the definition of intelligence, viz., 'social value' and the 'emergence of originals and to maintain such activities under conditions that demand a concentration of energy and a resistance to emotional forces,' are doubtful propositions. The social value is merely ethical or moral or a matter of subjective evaluation. That means that intelligence and social values do not necessarily go together.

As regards emergence of originals, there is no doubt about its being one of the most important aspects of intelligence, but the only difficulty is about its measurement. If it is measured it loses its characteristics of being original. About the later part of the definition which emphasises the concentration of energy and a resistance to emotional forces, they are the non-intellective aspects of one's personality which are definitely affected by intelligence but are not strictly its resultant.
Wechsler's Definition:

In the preface of the fourth edition of his work, published in 1958, Wechsler writes that his views on the nature of intelligence have not changed radically but that he has become increasingly convinced that intelligence is most usefully interpreted as an aspect of the total personality. (Wechsler, 1, p. VII)

He defines:

Intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment.

(Wechsler, 1, p. 7)

According to Wechsler intelligence is a global capacity because it characterizes the individual's behaviour as a whole; it is an aggregate because it is composed of elements or abilities which, though not entirely independent, are qualitatively differentiable. By measurement of these abilities, we ultimately evaluate intelligence. But intelligence is not identical with the mere sum of these abilities, however inclusive. Wechsler gives three reasons for this: (1) The ultimate product
of intelligent behaviour is not only a function of the number of abilities or their quality but also the way in which they are combined, that is upon their configuration. (2) Factors other than intellectual ability, for example, those of drives and incentives, enter into intelligent behaviour. (3) Finally, while different orders of intelligent behaviour may require varying degrees of intellectual ability, an excess of any given ability may add relatively little to the effectiveness of the behaviour as a whole.

In Wechsler's definition of intelligence the inclusion of phrases 'to act purposefully' and 'to deal effectively' specify that 'drive' and 'incentive' enter into intelligent behaviour. Wechsler clearly emphasizes these aspects by supporting Alexander's findings, which include a reference to such non-intellective aspects. (Wechsler, 1, p. 14)

Though Wechsler has not included the measurement of those non-intellectual traits in his scales, the expert examiner can evaluate subjectively the non-intellectual traits as Freeman has commented. He writes:

This is not to say that in assessing an individual's intelligence and personality as a whole we should ignore
'drive', 'incentive', 'interest', for the competent psychological examiner does evaluate these and other non-intellectual traits in presenting his test results.

(Freeman, p. 152)

Wechsler, too seems to have been quite conscious of this. In the preface to the 1958 edition of his work, he writes:

I look upon intelligence ... ... as a resultant of interacting abilities non-intellective included. The problem confronting psychologists today is how these abilities interact to give the resultant effect we call intelligence. At this writing it seems clear that factorial analysis alone is not an answer. Probably a new statistics involving field theory and non-linear differential equations will be required. In the mean time, I remain a reformed but unchastened spearmanite.

(Wechsler, I, p. VII)

Three Kinds of Intelligence:

Intelligence is thought to be constituted of different kinds and hence psychologists are of the opinion that they should be distinguished. Thorndike has suggested three-fold division in to (a) Abstract (b) concrete, and (c) social.
Abstract:

This is the ability to respond to symbols of various sorts such as words, numbers, letters and the like. We can consider Verbal tests as tests of abstract intelligence. At the highest level, abstract intelligence is seen in the reactions of the student and philosopher dealing with the relations of things symbolized in words or numbers or mathematical formulas.

Concrete:

Here we test the ability to respond to things themselves. It is the ability to comprehend actual concrete situations and react adequately to them. This kind of intelligence is measured by means of performance tests.

Social:

It is also called ability to understand and deal with persons. It does not include the feelings or emotions aroused in us by other people, but merely our ability to understand others and to react in such a way towards them that the ends desired should be attained.

This is merely a convenient scheme of classification of intelligence. It can also be divided as verbal and
non-verbal intelligence or in some other way. Abstract intelligence is measured by most of our present day group-verbal tests. Concrete intelligence is measured by performance tests and to some extent by tests involving pictures rather than words. As Freeman observes, even tests that present the subject with 'things' rather than with ideas and symbols are not devoid of demands upon ability to conceptualize and make abstractions, although testees need not necessarily state this in the form of language and number (Freeman, p. 158).

The Two Meanings of Intelligence:

Vernon has rightly concluded that now all earlier work on the nature of intelligence has been put in the shade by Piaget's recent books and by Hebb's "The organisation of behaviour". (Vernon, 3, p. 292) There are many who would hold that D.O. Hebb, Professor of Psychology at McGill University, has had more influence on the course of psychological thought than any other single psychologist since the second world war. Hebb's concept of intelligence was particularly important in that, just as Burt linked studies of intellectual behaviour with those of inheritance, Hebb linked them with neurological functioning and early experiences.
He complained that earlier concepts of intelligence were limited in their usefulness as they failed to take into account the recent findings of neurology, the rapidly developing science of the nervous system. His concept of intelligence was more complicated, in that it involved two definitions emphasizing different aspects of the situation. These he labelled intelligence 'A' and intelligence 'B'.

He describes the intelligence in the following way:

One is (A) an innate potential, the capacity for development, fully innate property that amounts to the possession of a good brain and a good neural metabolism. The second is (B) the functioning of brain in which development has gone on, determining an average level of performance or comprehension by the partly grown or mature person.

(Hebb, p. 294)

Few would contest that our ultimate level of intellectual functioning is limited by mechanical efficiency of nervous system. An individual who is unfortunate enough to be born with a brain lacking the normal number of convolutions, and, therefore, nerve cells, is likely to be severely subnormal in his level of intellectual functioning. Hebb put forward the hypothesis that the level of functioning of any
individual will be limited by the innate or inborn potential of his nervous system to develop complex patterns of operation. This he called intelligence 'A'. Hebb further adds that to develop this 'potential', the individual must be continually stimulated by his environment and he put forward, as the second part of his definition, intelligence 'B'.

Theories of Intelligence:

The discussion so far done, is meant to understand the human ability in its functional character that is, how it operates. It is also necessary to study the structural pattern of it. Different psychologists have studied it in their own ways and have concluded and put forth their views in the form of theories. This is just like the blind people trying to understand the shape of an elephant. They touched the different parts of the elephant's body and described the elephant in their own ways. The psychologists have been talking about intelligence in the same way and describing it as they find it to be. The major theories of intelligence with their exponents are as follows:

- The Unifactor Theory
- The Two factor Theory
- The Sampling Theory

Stern
Spearman
Thomson
All these theories are discussed in brief in the following paragraphs.

The Uni-factor Theory

The Uni-factor theory which has been also known as General Capacity theory was introduced by Wilhelm Stern in 1911. According to this theory intelligence is a general or unitary ability, which can be labelled as 'G'. Stern considered that all persons are endowed with G, though in unequal amounts. It is applied to any problem solving situation, efficiency of which depends solely upon the environment. Thus, stern's Uni-factor theory is the simplest one. This theory is almost parallel to the "Unifocal or Monarchic View" discussed in "Abilities of Man" by Spearman, as both the theories cannot one and something. Hence, this theory is in contradiction to the theory and practice of current mental tests which clearly show that "the function of intelligence is divisible into several units more or less uncorrelated and therefore each needing a separate measurement of its own. (Desai, p. 21)
The Two Factor Theory:

Charles Spearman proposed his two factor theory in 1904. According to him measurements of different abilities satisfy the tetrad-equation, there must be in each of these abilities a general factor, which is confined to the particular ability. Thus, Spearman's two factor theory postulated that every test which satisfies the criterion of proportionality contains two factors, 'g' and 's'. His 'g' factor is general factor common to all intellectual tests. The 's' factor is specific to each test and represents that portion of the reliable variance of a test which does not correlate with other tests.

Instead of stabilizing his ideas, Spearman continued to refine his correlation techniques and methods and later on, improved his two factor theory. He recognised five group factors which were named as Verbal ability, numerical ability, mechanical ability, attention and imagination.

G. H. Thomson was Spearman's most active critic in Britain. But his criticism, however, was directed against Spearman's first proof of the two factor theory. The two factor theory was long attacked by Thorndike,
but later on, he too abandoned his former view and searched for a "unitory factor" or general factor underlying various intellectual abilities, this change being obvious from his publication "The Measurement of Intelligence" in 1927.

Guilford feels that the group factors that Spearman identified and interpreted psychologically appear to bear much resemblance to some of multiple factors found today. He, of course, adds that Spearman never gave much credit to group factors. (Guilford, 4, p. 56)

Spearman's theory enables a test maker to device satisfactory tests of 'g' on logical ground and this can be done, as Vernon observes, by selecting tests which have been proved by correlation analysis, to have high 'g' loadings; and because the 's' factors are, by definition, independent, the various S's will cancel out, leaving us with a pure measure of 'g'. (Vernon, 1, p. 13)

Wechsler pays due tribute to Spearman, saying:

Spearman's demonstration of the existence of at least one pervasive factor in all performances requiring intellectual ability remains one of the great discoveries of psychology.

(Wechsler, 1, p. 9)
The Sampling Theory:

This theory was proposed by G. H. Thomson who was also the critic of the two factor theory. According to his views the coefficient of correlation is determined by the number of common independent factors utilized by the tests. He says, "Each test calls upon a 'sample of bonds' which the mind can form and that some of these bonds are common to two tests and cause their correlation."

The sampling theory, as Thomson has emphatically stated, is not a rival of the theory of two factors. He believes each activity to be a sample of many factors and calls his theory to be atomistic. Thomson goes to the extent of saying that the two theories can be identical if perfect hierarchical order among correlation coefficients is a fact. The sampling theory does not deny the general ability, though Thomson differs in the description of it by saying that general ability possessed by different individuals would not be identical in nature. (Brown and Thomson, pp. 189, 194-97)

Thomson believes that the appearance of a general factor and specific factor is a chance. He also thinks that zero tetrad is no reality but only a tendency. He further adds that hierarchical order is also the most probable one expected on sampling theory.
Thomson concludes the controversy by reference to the fact pointed out by Mackie that simultaneous belief in "bonds" and "specifics" is absurd psychologically and hence, we must either give up the factors of the two factor theory or the bonds of the sampling theory as realities. We cannot keep both as realities though we may employ either mathematically. (Thomson, p. 53)

The Multifactor Theory:

E. L. Thorndike propounded his multifactor theory, on neurological basis as well as through statistical procedures. In his theory as the name indicates intelligence is said to be constituted of a multitude of separate factors or elements which he did not name but which he indicated could be referred to the neurological processes. Each one of the separate factors is a minute element of ability. This theory is called representing extremity in the interpretation of mental structure. The positive correlation between performance on two mental tasks is ascribed to common elements involved in the act. Hence, in Thorndike's view, the concept of general intelligence is not tenable. But Thorndike himself admits that in constructing a mental test his 'atomistic' theory is
of less practical significance than the conception that many of the specifics operate together in any situation demanding intelligence. This is illustrated by his scale, known as CAVD test. Thorndike does not claim that four sets of items encompass the entire range of abstract intelligence, they represent only certain parts.

The Group Factor Theory

The group factor theory which is intermediate between theories of Thorndike and Spearman was propounded by L.L. Thurstone. It was found by him that each and every test had not necessarily a common factor 'g'. In his article "Primary Mental Abilities" he gave analysis of 56 tests administered to 240 college students, the analysis having been done by the centroid technique. This resulted in a complete break with Spearman, for it revealed no g at all, but a series of distinct multiple factors. "The analysis and interpretation of Thurstone and others led them to the conclusion that certain mental operations have in common a primary factor that gives them psychological and functional unity and that differentiates them from other mental operations. These mental operations then constitute a group." (Freeman, p. 164)

Thurstone's work resulted in the construction of a set of measures called tests of primary mental
abilities. Each test has its own primary factor, giving the group a functional unity and cohesiveness. Each of these factors is said to be relatively independent of the others. He found out six primary factors emerging clearly enough for identification and use in the test construction. Though primary mental abilities were originally said to be functionally independent, actually it was found that they are positively and significantly intercorrelated. This means that primary mental abilities are not sufficient factors at work in the mental activities required by tests. Thurstone, therefore, concluded that in addition to the primary abilities, there is a second order general factor.

Thurstones also stated in their earlier test manual. "If further studies of the primary mental abilities should reveal this general factor it may sustain Spearman's intellective factor."

(Thurstones as quoted by Freeman, p. 165)

While discussing the theories of intelligence, Freeman concludes. "As is so often the case in scientific problems—especially in the relatively new ones—divergent theories in time tend to come into closer agreement that some group factors should be posited to explain test findings; but emphasis is still laid upon the g factor. Perhaps the Spearman's theory may
now be renamed "The General Factor-Group Factor Theory" and the other be renamed "The Group Factor General Factor". The narrowing of differences between the two theories represents significant scientific progress." (Freeman, p. 168)

**The Models of Intelligence**

The picture of the concept of intelligence would remain rather incomplete if the models of intelligence of Burt, Vernon and Guilford are not considered here for brief review. Any serious investigator, in basic science or in technology, finds a good frame of reference very helpful. The one which is close to a scientific theory is most useful to the investigator of some particular domain such as intelligence. A good frame of reference for an investigator's responses has three specifications that is, it should be systematic, comprehensive and empirically based. In the following paragraphs the intelligence models of Burt Vernon and Guilford are discussed in brief.

**The Burt Model**

According to Cyril Burt, the mind is organised on what may be called a hierarchical type of model, which is like an inverted tree, as shown in figure 1.
Figure 1: Burt's conception of idealized hierarchical model.
The model shown here applies to the human mind, with the first major dichotomy between intellectual characteristics or g and 'practical' or behavioural characteristics. Each subdivision of a higher factor gives two immediate lower ones. The various levels of bifurcation he identified as 'relation' at the higher level, association, at the second level, 'perception' at the third and 'sensation' at the fourth. Many subcategories contain more than two factors and hence Burt had to depart from strict dichotomization.

As Guilford writes, "in fitting group factors into the model, however, Burt had to depart from strict dichotomization, for many subcategories contain more than two factors." (Guilford, 4, p. 57)

The Vernon Model

The Vernon model of intelligence also falls in the category of hierarchical model. This model is presented by Vernon himself (Vernon, 2, p. 22) as shown below in figure 2.

![Diagram of the Vernon Model]

Figure 2. P.E. Vernon's Hierarchical Conception of Human Abilities.
The British psychologists have always tried to prove the importance of 'g' factor. During such trials, in eight analysis 'g' was found to cover more than twice as much variance as all group factors combined. The tables of results showed the characteristics of mental structure, namely hierarchy. Under 'g' are two major factors

1) V : ed, for verbal-numerical-educational and (2) K : m, for practical-mechanical- spatial-physical. That fall into two main groups. The verbal-numerical educational on one hand and the practical-mechanical-spatial physical on the other hand. The former V:ed subdivides three ways, into space ability, manual ability and mechanical information, only if analysis is sufficiently detailed. Beyond these are specific factors, each of very narrow scope and considered by Vernon to be of a great importance. Many of what Burt recognize as small group factor belong to this category.

The Guilford Model

The most recent development in the factorial analysis of intelligence comes from the long range research of J.P. Guilford and his associates at the university of Southern California. He has developed a unified theory of human intellect, which organises the known, unique or primary intellectual abilities into a single system called the
Figure 3.3 The structure of the model with three parameters
"Structure of Intellect." According to Guilford, the factors can be classified in three different ways: Content, Operation and Product.

In content, he recognised three distinct categories and termed them as figural, symbolic and semantic. Afterwards he added a fourth kind of content which termed as behavioural. These four contents can be easily compared with three kinds of intelligence of Thorndike. The first content figural parallels with concrete intelligence. The second and third one symbolic, and semantic together can be compared with abstract intelligence and the remaining one, behavioural, goes with social intelligence.

According to basic kind of process or operation performed, the intellectual factors can be categorised into five major groups which are cognition, memory, convergent thinking, divergent thinking and evaluation.

"A third way of looking at the abilities and a third way of classifying them come to view more slowly. It came about because of the need for taking into account the parallels that appeared across both the content and the operational categories." (Guilford, 4, p.62) When a certain operation is applied to a certain kind of content, a certain kind of product may be involved. The six kinds
of product, according to Guilford, are: units, classes, relations, systems, transformations and implications. Figure 3 shows a single solid model called "the structure of intellect model" or shortly the SI model by means of which the three kinds of classifications of the factors of intellect are represented. Along one dimension various kinds of operations are shown; along a second one are the various kinds of product, and along the third are various types of contents.
The structure of intellect is a theoretical morphological model that predicts as many as 120 distinct abilities, if every cell of the model contains a factor.

The conception of the structure of intellect model as a frame of reference for the intellectual abilities has served heuristic function of generating hypothesis regarding new factors of intelligence. Additional factors were found in the literature and were readily given logical places within the model. The position of any factor in the model, is determined by its unique properties, its operation, its content and its product.

The position of factors in the SI model becomes a guide line in construction of tests. Thus it has served well its purpose of guiding research. Its conception can add considerable new meanings and significance to old and new psychological findings by other methods.

The Present Experiment

Since the present investigator is adapting the tests, the question of test construction based on any particular
model or theory does not arise. The whole discussion was presented with a view to mentioning the latest developments and viewpoints in explaining the structure of human abilities. Later-on while interpreting the factors that the present investigator has got through factor analysis, he will try to evaluate them in the light of the SI model.