CHAPTER I
INTRODUCTION

The most debated question in Psychology is "What Intelligence is?" (Howard, 1993). There is much dispute and controversy over the definition of intelligence (Sternberg & Detterman, 1986) and exactly what things could be termed "intelligent" (e.g. Schull, 1990). Such definitional controversies go back a long way, examples being the 1921 Journal of Educational Psychology symposium (Ryle, 1949; and Miles, 1957). Recently, some researchers have said that the term is vague and means so many things that it has limited scientific value in the study of mental abilities. (Howe, 1988, 1989, Mackintosh, 1987).

Before the technical discourse, ordinary connotation of the term "intelligence" may be presented. The term is singular rather than plural, hence, whatever intelligence is it must be one thing rather than many things. It may be construed as a measure of the ability to acquire knowledge. It must "partly" be construed as independent and different from achievement and what is actually learned. Thus, intelligence should not be fixed or invariant characteristic of a person. Rather, it should be
modified as a result of experience. It also implies that measures of intelligence ought to be different and independent of those assess knowledge. (Brody, 1985).

There are three approaches to view description of the intelligence, the traditional (pragmatic), the factor-analytic (psychometric/structural) and the cognitive (componential). Here a brief description of all the three approaches is provided.

THE TRADITIONAL APPROACH

The traditional approach to define intelligence is heavily loaded with functional and pragmatic characteristics. The main objectives of the followers of this approach was to construct or devise use and interpret the intelligence tests. Galton, (1869) 'Cattell, JMCK, (1890), Binet and Simon, (1905), Terman, (1916), Wechsler (1939) (Review by Jenkins and Patterson, 1961) were among the workers of historical significance. Little emphasis was given to describe the construct. However, it was assumed as a capacity or potential.

Binet with his pragmatic approach to the nature of intelligence implicitly acknowledged the presence of 'g' through his willingness to obtain psychometric sum of the measures of tests and in scales of intelligence. The mental age (MA) does
not tell whether the child is fast or slow for his age. There was a need for another measure of rate of growth of intelligence. William Stern (1912) suggested the I.Q. as such a measure, Terman (1916) devised the formula to account for the I.Q. by the ratio of MA and CA assuming 100 score for perfect average child. Wechsler, (1939) defined intelligence and devised the test to measure it. For him intelligence was an aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment. It is aggregate or global because it is composed of elements or abilities (features) which, although not entirely independent are qualitatively differentiable.

In traditional approach by the content analyses of test items the construct of intelligence could possibly, but subjectively described. However, assuming intelligence as capacity or potential in itself created a problem. For example, whether the capacity or potential is congruent with measurement operation as well as with the scores of intelligence test.

Whatever be the status of the construct of intelligence and its measures, the traditional approach did not deviate from intelligence as such a single entity or ‘g’.
COGNITIVE APPROACH

In recent years, attempts have been made to define intelligence in terms of fundamental cognitive operations/processes. The representative definition with this approach can be referred to Sternberg (1985) that intelligence consist of those mental functions that one uses intentionally when one adopts to shape and select the environment to live and function. The fundamental unit of analysis in most cognitive theories is the information processing component. The component is a unit of process, just as the factor is a unit of structure. Das, (1972); Das, Kirby and Jarman, (1975); Dass and Molloy, (1975); Jarman and Dass, (1977) perceives intelligence as the ability to use information obtained through the simultaneous and successive transformation procedures in order to plan and structure behaviour effectively for goal attainment.

Several components of cognitive ability have been identified along these lines, e.g. Carroll (1976, 1981) has identified tentative list of ten types of cognitive processes with five meta cognitive processes of importance. Sternberg, (1980, 1985) distinguishes among three different kinds of information - processing components; ten meta components; three
performance components; three knowledge acquisition components. In fact, the current trend in cognitive psychology is toward emphasis on domain-specific abilities.

**FACTOR-ANALYTIC APPROACH**

Factor-analytic approach is based on the inter-correlations of various measures of individual differences. Some of the prominent users of this approach are represented as Spearman (1904, 1923, 1927) Thurstone (1938), Guilford (1961, 1967, 1985) Cattell, (1963) Horn (1965) etc. It is noteworthy that Spearman's (1904) factor-analytic construct of intelligence antedated the first actual intelligence test of Binet and Simon (1905). Humphreys (1985) has concluded that for the last 80-85 years of factor-analytic research is concerned with the conversion of Spearman's specific to common factors and ignoring construing the 'g'.

Spearman, who was trained as an engineer, thought about psychological problems more mathematically than do most psychologists. He developed a mathematical method known as factor analysis, which proved to be his major contribution to the behavioral sciences. Factor analysis is mathematically much too involved to explain here. The important point is that it
enabled Spearman to 'Extract' the 'g' from all the inter-correlations among a collection of diverse tests, and to show precisely the correlation between each test and this hypothetical general ability factor. The correlation of a given test with the 'g' factor common to all tests in the analysis is termed the test's 'g' loading.

Spearman originally hypothesized that each test measures only g plus some specific ability, S, which is tapped only by the particular test. This theory that any given test score is composed only of g+S, as well as measurement error, was soon refuted by the finding that there are other common factors besides 'g'. However, they are not general factors, because they do not enter into all tests, as does 'g' but enter only into certain group of tests.

Spearman used 'g' to identify the quality of allround general superiority or inferiority which show up in most test correlations. But he uses 'S' to account for specific influences which reduced these correlations considerably below 1.00. Spearman thought that people differed by heredity in 'g' just as they differed in height or weight. In the same way, when he found that several tests of intellectual performance correlated closely, he postulated a hypothetical general and purely
quantitative factor underlying all cognitive performances of any kind. This was what he meant by 'g' and this is still the correct usages for the term.

Spearman hoped that research would some day find a measure of brain function which corresponded to 'g' but this was not essential to his analysis. Spearman (1923, 1927) describes 'g' as the mental energy i.e. the energy available in cortex for functioning of a group of neurons or a potential.

Subsequent to Spearman's factor analytic research led to the belief in other group factors of different degrees of generality. Efforts were made to see whether they could be logically related. The first efforts of this kind resulted in a model of a hierarchical nature, as proposed by Burt (1949); Vernon (1950). These models were alike in placing Spearman's 'g' at the apex. They differed otherwise. In Vernon's model, immediately below 'g' were two broad abilities V;ed (Verbal educational) and K.M. (Spatial and Practical) under V;ed were verbal and numerical abilities and under K.M. came spatial and mechanical abilities.

J.P. Guilford (1961, 1967, 1985) has presented a three dimensional model of intellect on the basis of factor analysis
of several intelligence tests. Guilford proposed that performance on any cognitive test can best be understood by analyzing it into kinds of mental operations or processes performed, the type of content or test material on which the mental operation is performed and the resulting product of performing a particular operation on a certain type of test content. Guilford said that every intellectual ability is characterized by mental operations, contents and products. Guilford (1961, 1967, 1985) speculates that there may be 150 such factors, yet these performances are not truly independent of one another and correlation of the factor scores lead us back to Spearman's 'g' and the idea that people tend to be superior, average or inferior in most if not on all intellectual tasks.

Cattell (1963) has proposed an alternative to Spearman's g + S and distinguished between two kinds of intelligence crystallized and fluid. Fluid intelligence is the form of general intelligence which is largely innate and which adapts itself to all kinds of material regardless of previous experience with it. 'Crystallized' intelligence is a general factor, largely in a type of ability learned at school, representing the effects of past application of fluid intelligence and amount and intensity of schooling it appears in such tests as vocabulary and number
of ability measures. Tests of Vocabulary and general information and other tests that requires the recall of previously acquired information or skills are said to measure crystallized intelligence or crystallized 'g' symbolized gc. The inferential processes involved in the original acquisition depend upon fluid intelligence gf. For persons from similar educational and cultural backgrounds tests involving gc and gf are highly correlated that is, persons who score high on gc tests, like vocabulary also score high on gf tests, like matrices or figures analogies and other novel reasoning problems.

Jensen, (1970, 1980) suggested two major classes of mental abilities: associative (level I) and cognitive (level II) Associtative ability involves rote learning and short-term memory. Cognitive ability involves reasoning and problem solving. Little transformation of input takes place within level I, whereas, level II processing involves a conscious manipulation of the stimulus input in producing the correct output.

Horn (1982a, 1982b) has given a model which is mainly concordant with human abilities. He considered a broad organisation of several main intellectual functions, among them
ten major capacities have been identified. These ten factors also indicate the basic capacities of general intelligence in some one's theory.

In the model, there is hierarchy of functions. The ten intellectual functions from top to bottom are: $G_f$ (fluid ability), and $G_e$ (Crystallized ability), $G$ (broad visualization) $G_s$ (Clerical speed), TSR (long term shortage retrieval), SAR (short-term acquisition retrieval), VSD (visual sensory detectors) and ASD (auditory sensory detectors).

With the above three approaches to define general intelligence, it is clear that cognitive as well as factor analytic/structural approaches stem from the traditional approach. However, the distinction in three approaches does not lead to contradiction; As Stern (1985) has stated that psychometric and cognitive approaches to study intelligence are complementary and mutually beneficial. It is fruitless to claim that either a factor or a component is more basic, because it is possible to do factor analysis of identified components of human intelligence; on the other hand it is also possible to do componental analyses of identified factors of human intelligence.
Description of the three approaches does not lead to contrive the notion of general intelligence, rather to consolidate the notion. Jensen (1986) advocates that even the structure and approaches of factor analysis with its three methods confirm the 'g'. Hierarchical factor analysis generates the apex of hierarchy as 'g' as above the three dimensions of GDO of Guilford and g of Cattell, what will be derived? Similarly the first principal components of a principal components analysis and the first factor of a common factor analysis will be 'g'. However, Jensen (1986), further concluded that despite the evidences independent and dependent of both psychometrics and factor analysis, the scientifically satisfactory theory of 'g' will probably have to be formulated in terms of brain physiology as envisaged by its inventor, Spearman.

Several attempts have been made to relate intelligence to performance in laboratory settings with respect to their implications for understanding the validity of the intelligence tests. Hendrickson (1982a, 1982 b) has reported the results of a series of studies relating evoked potential measures derived from the E.E.G. response to auditory stimuli as measures of general intelligence. Blinkhorn and Hendrickson (1982) reported
that the correlation between the EEG measure and the Raven's test was .47. Moreover, there has been some difficulty in replicating some of the claims of a relationship between EEG measures and intelligence (Ett and Schofer, 1969; Rust, 1975). Eysenck (1982) has argued that Hendrickson's measures are more fundamental and more accurate indices of general intelligence than standard psychometric tests. They prove to be consistently correlated with psychometric indices of intelligence are privileged and are to be constructed as pure measures of 'g' that are more fundamental and unbiased than more psychometric indices.

Attempts have also been made to define intelligence in a conceptual framework. Eysenck (1988) argue that intelligence is a scientific concept and it contains three major related concepts I.G., Biological and Social intelligence. Jensen (1987) reported that the word intelligence labels, three different major concepts 'g', the sum of the individual knowledge and skill and the specific mental abilities important in a given culture. Recently, Howard (1993) argued that there are three major concepts, each with several variants into which most researchers concepts seems to fit. Each concept is represented in a somewhat
idealized form, holds some what different categories but all concepts are related, because they derive from the same starting point, individual differences in a adaptive behaviour.

Intelligence I is Howard’s (1993) first concept and this is basically Spearman’s ‘g’ quite close to Cattell’s ‘fluid and g’ and Enneck’s intelligence ‘A’. The main idea is of a biological differences between people which correlates with performance on virtually all mental tests.

Regarding what information does the concept contains; Howard argued that it holds the knowledge of defining feature’s and some metaphors. Defining feature-relates to a property that human brains have in varying degrees. Researchers who holds this concept have different versions of this feature; some appears to see it as a Predominantly Physiological feature. Enneck (1988) said that ‘g’ is a kind of ‘neural’ efficiency (some brains works better than others) Jensen (1987) it appears to conceive of ‘g’ as mental speed. Sternberg (1985) holds that ‘g’ includes a set of information processing component.

Referent category of intelligence I as stated by Howard are human brains and mathematical abstraction/numbers. The first category is of a property of human brain in which brains differs
e.g. by weight. Some brains fall at high g end and some at the low g end. The second category relates to results that emerge from a given table of inter-correlation of performance on various mental tasks. Much of the controversy regarding intelligence will be resolved if researchers make a clear mention of the referent category, e.g. if one ask a question does 'g' exist? It is easy to question whether there is a biological difference (i.e. 'g' as a property of the brain) but it is hard to dispute the existence of mathematical abstraction.

Intelligence II is the second concept of Howard (1993). By intelligence II Howard (1993) means that it is not a thing in a head but a characteristic of behaviour analogous to an object's colour. Red or not Red. As Anastasi (1986) has said that intelligence is a quality of behaviour but not an entity with in the organism. Estes (1982) argues that intelligence refers to the adaptive behaviour of the individual. Intelligence II represents the category of behaviours. However, there is dispute over the boarder intelligent and non intelligent behaviours.

Howard's third concept of Intelligence, is that intelligence is a set of abilities. Jensen (1987) labels it the
sum total of all mental abilities and the entire repertoire of a person's knowledge and skills. The general cognitive-science conception of intelligence is based on this definition.

Regarding the category to which intelligence III represents, Howard said that these are things with abilities, what things with abilities? is again a source of controversy in researchers. Some researchers (e.g. Gardner, 1983) include only humans while some other include animals. A current perspective in comparative psychology sees intelligence as the set of abilities possessed by a given species (Mackintosh, 1987).

Vividness and multiple of components of intelligence skill does not lead to believe that Spearman's concept of intelligence as a single entity is substantially false. Because measurable components of task performance are highly correlated with general intelligence, it is expected that a correlation matrix of such measures would have a general factor. Therefore, componential approach to intelligence permits the rediscovery and redefinition of Spearman's general factor albeit with greater precision of understanding of some of the components of general intelligence. It should be recognized that in the
component approach the individual differences in general intelligence may be due to differences in underlying components and not necessarily the same components, for same level of 'g'.

There are individual differences in average ability to profit from various types of instructions and to acquire knowledge under conditions in which instructional procedures are less than optimal. And it is this general ability that defines general intelligence. Thus intelligence is both many different things, indeed, even idiographically presents within an individual and is also in a coherent and meaningful sense, one thing.