Intelligence tests are commonly criticized, most commonly by persons who have little understanding of the way in which they are used. They are blamed for failing to measure things which they are not intended to measure, character, for example, and artistic talent.

- Angus Macrae

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2.1 Introduction

Very early in the history of psychological measurement, psychologists became interested in assessing general ability to deal with and manipulate the domain of ideas and relationships among ideas. Though the interest was motivated in part by a scientific concern to understand and describe intellectual functioning; it was motivated in part by very practical needs to identify children with intellectual deficits that would make it difficult for them to progress normally in school, or at a more severe level, individuals who would have difficulty in meeting the basic intellectual demands of life, in an extreme case people who wouldn't have 'sense enough to come in when it rains'.

Tests designed to assess the level of general cognitive functioning have been called general ability tests or intelligence tests in the psychological literature. However, psychologists have never been able to agree very precisely on a definition of "intelligence" or on exactly what it does and doesn't include.

Before we consider numerous definitions and descriptions that have been offered, it will be advisable to clear away one or two common pre-conceptions that can hinder
the understanding of "intelligence" and of a kind of concept it exemplifies.

The grammatical form itself can be misleading. "Intelligence" is a noun, and nouns often refer to things or objects. Even when we know perfectly well that intelligence is not a 'thing', but a sophisticated abstraction from behaviour, we may sometimes half consciously endow it with a kind of shadowy existence, distinct and separate from the intelligent organisms which alone give it meaning, or more insidiously, think it is a 'thing' that these organisms 'have' rather than a description of the way they behave. It is better, therefore, to think of the adjective 'intelligent' as more basic (and less dangerous) than the noun, and perhaps of the adverb 'intelligently' as still more basic.

Often we heard in educational circles that the school should assist each pupil to achieve the maximum of which he is capable. But behind that well-meaning phrase there arise so many problems. How do we know what a person's capabilities are? Can we define capacity? Can we measure capacity? Does a person have a general capacity to acquire knowledge, or are there many different capacities, each specific to a given type of knowledge? Is capacity constant over time? If not, what conditions affect capacity? These are all relevant questions.
Unfortunately, psychologists do not agree with all the answers. "For the past 75 years psychologists have been using various labels such as capacity, intelligence, potential, aptitude, and ability to identify a construct that appears to be useful in helping to predict various kinds of behaviour". The tests that have been designed to measure this construct (or set of constructs) vary considerably because test authors may not define a construct the same way or indeed may be talking about different constructs. As a result, different terminology prevails to denote general ability in the sphere of measurement in psychology and education. Lyman has tried to put in nutshell the various usages of the terms of general ability.

"Intelligence has many pseudonyms: mental maturity, general classification, scholastic aptitude, general ability, mental ability, primary mental abilities, etc. They all mean about the same as intelligence although they may differ somewhat in emphasis or application". The terms "intelligence", "general ability", "mental ability", "mental maturity", "learning potential", "School-and-college ability" and "educational ability" are used to designate essentially

the same type of test. In the psychometrician's vocabulary, these terms are synonymous and interchangeable.  

Looking to all these points, the investigator has used the word "general ability" in her study as all the words are synonymous and interchangeable.

Modern diagnostic tests do obtain useful information about distinct aspects of ability. In Binet's time, though, one of his great contributions was to replace the idea of separate functions with the concept of general intelligence. Having started with the idea that some children were bright and some dull, he found quickly that those who were best on tests of judgement were also superior in attention, memory, vocabulary, etc. In other words, the tests were correlated. The correlation shows that there must be some underlying unity among these mental tests when psychologists refer to general mental ability, they refer to the characteristic that accounts for the correlation among mental tests.

Binet refined his idea of intelligence by trial and error. "If color matching does not correlate with other estimates of mental ability, it must not be influenced by

the common factor. If knowing certain information correlates with the tests of reasoning, both must measure intelligence. 4

The term intelligence test is being replaced by such terms as test of general mental ability or test of general scholastic ability.

J.C. Flanagan, the director of Science Research Association (SRA) in U.S.A. has developed the Tests of General Ability (TOGA) for KG and for Grades I to XII. He accepted the fact "that General Ability Test is an IQ Test or Intelligence Test". 5

Since there is no concurrence of opinion among all psychologists, all well known psychologists have defined general mental ability in their own ways. Some of the more common definitions are as follows:

2.2 Definitions

The psychologists have sought to define intelligence exactly, in order that understanding of this fundamental concept may be clarified. A variety of definitions has come up.


Some of them which have been appeared during study are as follows:

Binet:
"... the capacity to judge well, to reason well, and to comprehend well".6

Terman:
"... the ability to think in terms of abstract ideas".7

Thorndike:
"... power of good response from the point of view of truth or fact.

Cyril Burt:
"... power of readjustment to relatively novel situations by organizing new psychological combinations.

Stern:
"... general capacity of an individual consciously to adjust his thinking to new requirements.


Pinter:
..... ability of an individual to adopt himself adequately to relatively new situation of life.

Thurstone:
..... a capacity to make impulses focal at their early unfinished stage of formation.

Hazlitt:
..... the problem solving organization of the mind.

Woodworth:
..... ability to see the point of the problem set and to adopt what he has learned to the novel situation.

Warren:
..... capacity of certain organisms to meet a novel situation by improving a novel adaptive response.

Wechsler:
..... the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment. 8

Dearborn:
..... a capacity to learn and profit by experience.

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Goddard:

"the degree of availability of one's experiences for the solution of immediate problems and the anticipation of future one's." 9

Wells:

"means precisely the property of so recombining our behavior patterns as to act better in novel situations". 10

Stoddard:

"ability to undertake activities that are characterized by difficulty, complexity, adaptiveness to a goal, social value, and emergence of originals; and to maintain such activities under conditions that demand a concentration of energy and resistance to emotional forces". 11

Buckingham:

"ability to act effectively under given condition". 12


Patterson :
..... "a biological mechanism by which the effects of a complexity of stimuli are brought together and given a somewhat unified effect in behavior".\textsuperscript{13}

Garrett :
..... a set of abilities demanded in the solution of problems which require the comprehension and use of symbols i.e. words, numbers, diagrams, equations, formulas.

Freeman :
..... "Capacity to reorganise one's behavior patterns so as to act more effectively and more appropriately in novel situations".\textsuperscript{14}

Rex Knight :
..... the capacity of relational constructive thinking, directed to the attainment of some end.

Spencer 4
..... the ability which each individual has of guiding or controlling his adjustment to an ever-changing environment by combining his impressions and organising his reactions.


As a matter of fact the definition should be clear and pin-pointed to state the entire connotation of general mental ability. But a study of several definitions reveals that in some respects they differ with each other. However, for the purpose of study they can be classified into several groups.

2.3 Classification of Definitions

Intelligence, like so many other terms in psychology, is intuitively meaningful to most people but difficult to define precisely. Of the many definitions proposed, several appear repeatedly: the ability to learn, adaptability to new situations, (abstract) reasoning ability, and facility in the use of symbols. Some writers broaden the definition to include other than purely intellectual capacities for example, Thorndike's use of the terms abstract, mechanical, and social intelligence and Vernon's distinction between verbal-educational and concrete-mechanical intelligences. Other writers and many test developers prefer the well-known operational definition: intelligence is what an intelligence test measures. This latter definition, rather than being a tautology, emphasizes that an intelligence test is a signal, that it points to the nature of the domain being measured, and thus the test and testing procedure defines the concept being measured.
Rather than becoming bogged down at this point in arguments about the definition of the term intelligence, let us look to the classification of various definitions.

According to Mehrens and Lehmann\(^\text{15}\), the definitions of intelligence generally fall into one or more of the three categories: the capacity to:

* think abstractly,
* learn, or
* integrate new experiences and adapt to new situations.

One group of definitions lays stress on the ability to carry on abstract thinking. The definitions given by Binnet, Terman, Garrett, Rex Knight, Hazlitt, etc., more or less contain this view. According to this concept, the levels of general ability can be measured from effective use of concepts and symbols in dealing with situations.

Another group of definitions places emphasis upon adjustment or adaptation of the individual to his total environment, or to limited aspects of it. The definitions of Freeman, Wells, Burt, Woodworth, Pinter etc., seem to belong to this group. According to the definitions of this

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Type, intelligence is general mental adaptability to new problems and new situations of life; or, otherwise stated, it is the capacity to reorganize one's behaviour patterns so as to act more effectively and more appropriately in novel situations. Thus, the more intelligent person can more easily and more extensively vary his behavior as changing conditions demand; he has numerous possible responses and is capable of greater creative reorganization of behaviour.

The third group of definitions states that intelligence is the ability to learn. The definitions of Buckingham, Thorndike, and Dearborn illustrate this view. According to this definition, in the broadest sense, a person's intelligence is a matter of extent to which he is educable. The more intelligent the child is, the more readily and extensively is he able to learn; hence, also, the greater is his possible range of experience and activity.

It should be apparent that the three foregoing categories of definitions are not, and cannot be, mutually exclusive. For the most part, their authors differ in emphasis.

"Obviously, ability to learn must provide the foundation for adjustment and adaptation to changing or new conditions. And a person may be expected to have learned more
or less from situations he had encountered and to which he had previously made adjustments. Learning ability, in the sense only of acquisition of information and knowledge, is not a sufficient criterion for the evaluation of a person's intelligence, but a person who can reorganize and apply what he has acquired for the purpose of dealing with varied and novel situations is more intelligent. Thus, a definition of intelligence as the capacity to behave appropriately and effectively in new situations and a definition of intelligence as the ability to learn represent in fact, two aspects of the same process.¹⁶

The definition of intelligence in the light of abstract thinking is also inseparable from the other two. A child learns abstractions - principally verbal and numerical - through experience, through contact with and perception of the objects, events, qualities, or relationships for which the symbols stand. Furthermore, if it is to be said that an individual has fully learned to deal with the symbols of abstraction, then it must be true that he understands that the word is not the thing or the quality for which it stands. The words and numbers are abstractions that represent objects, events, qualities, or relations, but which, can be dealt

with as if they were the things themselves. This aspect of intelligence 'the ability to use symbols' is itself the result of an individual's development and learning. Ability to carry on abstract thinking, contributes to a person's ability to adjust or adapt to changing or new situations, because through the use of symbols we are enabled to think through a problem without spending time and effort on trial and error in action. In other words, through the use of symbols and abstract thinking, man is able to enlarge his range of behavior, to extend his horizons, and to transcend the immediate concrete and specific situation.

Two, rather comprehensive definitions have appeared in more recent years. One of them is given by Wechsler, whose contribution and recent tests will be referred in the next chapter. The other definition is of Stoddard. A few new aspects are implied in Wechsler's definition. Wechsler believes that an individual's intelligence is revealed by his behavior as a whole (global) and that intelligence involves behavior toward a goal. He also presents drive and incentives in the definition. Stoddard has not only included the ideas of all the three groups of definitions, but he has gone beyond that and included several attributes of intelligence not included in the earlier definitions. He has discussed each of the attributes at length.
"Degree or level of 'difficulty' is implied in all definitions; but Stoddard's contribution here lies in the fact that he rightly insists we must, in testing, distinguish between true differences in degree of difficulty and differences that only seem to exist, as between two or more test items, whereas, in fact, there are no inherent differences in difficulty". 17

Some psychologists believe that several kinds of intelligence should be distinguished from one another. E.L. Thorndike divided intelligent activity into three types: 18

1. Social intelligence, or ability to understand and deal with persons; i.e. social adjustment.

2. Concrete intelligence, or ability to understand and deal with things, as in skilled trades and scientific appliances.

3. Abstract intelligence, or ability to understand and deal with verbal and mathematical symbols.

Out of the three kinds of abilities enumerated above, abstract intelligence has received great impetus in current tests of intelligence.


In the light of the discussion on the classification of definitions, Flanagan's observation from the prevailing tests is worth noting. Flanagan observes,

"All tests of general intelligence include items which measure general ability developed through the influence of the following factors:

1. Heredity refers to the genetic constitutional individual differences in general ability.
2. Acculturation refers to general learning experiences, and
3. special school training". 19

2.4 Classification of Ability Tests

As discussed in the next chapter, the Stanford Binet Scale and Wechsler Bellevue Scale are administered to one person at a time i.e., it is an individual testing. But the mass testing began during the world war I with the development of Army Alpha and Beta for use in the United States Army. The former was a verbal test designed for general screening and placement purposes. The later was a nonlanguage test for those who could not read.

Hence ability tests, developed or going to be developed could be classified as follows:

i. Individual test versus Group test

ii. Verbal test versus Non-verbal test.

(a) Individual Test

S.B. Test and W.B. Test are called individual tests, because they can be given to one person at a time. The individual tests are good for diagnosing purpose. They are mostly used in clinical setting. Performance tests are said to be individual tests. Individual tests are time consuming and require a highly skilled examiner in administering a test, in interpreting responses, and in evaluating the subject's behaviour during testing.

(b) Group Test

To overcome the difficulties in the individual testing, the mass testing program is evolved. The tools for mass testing are called the group tests. They can be administered simultaneously to as many persons as can be fitted comfortably into the available space. By providing the printed items and simple responses that can be recorded on a test booklet or answer sheet, the role of examiners is minimized. The children are allowed to work at their own rate or the examiner directs them when to start and stop.
For uniformity and objectivity of scoring, present day test consists of multiple choice items. Group tests have been widely used in school, industry and civil services.

ii(a) Verbal Test

Most of the widely used mental ability tests, to some degree, depend on language and include tasks presented in verbal terms. S-B test and Army Alpha Test include the tasks testing the vocabulary by identifying the meaning, synonym, autonyms, completion of the sentences etc. The tests in which this type of items are included are called the verbal tests.

(b) Non-Verbal Test

Tests which require no reading and writing activity on the part of the subjects are described as non-verbal tests. The children's mental ability can be tested by means of pictures. This type of tests consists of all the items into pictorial form. They are valuable for better diagnosis of cases who score less on verbal tests. It is better to use terms as 'pictorial' or 'nonreading'\textsuperscript{20} rather than Non-verbal.

2.5 Theories of Ability Trait Organization

As aptitude testing presupposes, a trait-and-factor approach to the structure of abilities. According to Brown\textsuperscript{21} the intellectual functioning can be described by a number of basic dimensions, (traits or factors) and the person's standing on each dimension. More precisely, we need to know (1) the number of traits needed to (completely) describe a person, (2) the nature of these traits, (3) the relationships between these traits, and (4) the person's score on a measure (test) of each trait.

The development of a theory of intellectual structure has occupied the attention of a number of psychologists. Their attack has been both empirical and theoretical, but generally has been closely connected with intelligence testing and has utilized factor analysis as the primary analytic technique. Although research on the structure of the intellect has been proceeding throughout the twentieth century, there is still considerable controversy as to the validity of the proposed models.

Halstaed\textsuperscript{22} has characterized the theories of intelligence in terms of the number of factors or traits they postulate. But before looking into the theories developed in the twentieth century, it will be useful to peep into historical developments.

Pointing to early history of testing, Spearman summarizes the old doctrines of intelligence by classifying them into three theories, viz. (1) Unifocal or Monarchic Theories, (2) Multifocal or Oligarchic Theories, and (3) Nonfocal or Anarchic Theories.

According to Monarchic view, one ruling ability controls all capacities of the man and that ability is recognized as intelligence. Like a monarch, intelligence is considered controlling all mental activities. But it is observed that the function of intelligence is divisible into several units uncorrelated and each unit is required to be measured separately. Hence, the psychologists have not agreed with this view.

According to oligarchic doctrine, the mental ability consists not of one but of a great few outstanding powers or capacities, requiring separate measurement. The functions of the mind are divided into different powers like memory,

\begin{footnotesize}
\begin{itemize}
\item[22.] Ward C. Halstaed, Brain and Intelligence, (Chicago: University of Chicago Press, 1947), pp. 8-12.
\end{itemize}
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perception, attention, movement, invention, etc. The theory is subject to all objectives raised against faculty psychology.

Anarchic theory admits a multitude of independent elements. Any specific activity calls into play a number of these elements. The theory suggests that general intelligence is the average of abilities and is measured by sampling. Spearman criticises that the theory is not at all workable without some auxiliary hypothesis of averaging.

The formal movement in testing intelligence began in the latter part of the nineteenth century and developed in the twentieth century. Since then, several theories have been developed by psychologists to understand intelligence structure. The theories of distinguished psychologists have been stated here.

To give a flavor of the various approaches, precis of several historically interesting and currently fashionable models are presented hereafter.

(a) **Uni-Factor Theory:**

The simplest approach is to postulate a unitary ability i.e. a single general capacity. This view holds that

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although intelligence may be expressed in diverse fashions or may be directed toward a variety of activities, basically it is a single ability. Any test that provides a single score (IQ) is, at least in a broad sense, representing a uni-factor theory. However, because the empirical data frequently suggest that a more complex model is needed, the uni-factor approach is considered too simplistic by most present day theorists.

(b) Spearman's Two Factor Theory

One type of general intelligence model is that of Spearman, who was the first person to propose a theory of intellectual structure based on statistical analyses of data from psychological tests. Spearman proposed a two factor theory. The first factor was a general capacity or mental energy factor, which was basically a reasoning factor. In addition to this general factor (labeled g), each test measured skills that were specific to that particular test; hence the second component was specific intelligences. Thus, although assigning primary importance to the general factor, the theory does recognize that other specific factors (and even other general factors) must be considered. The

24. Ibid., p. 316.
implication for measuring intelligence, however, is that the best test would be one saturated with general intelligence.

Spearman considers his theory of two-factors 'eclectic', because the amount of truth in each of the three doctrines unifocal, non-focal and multi-focal view is considered. The Uni-focal view is justified if 'g' is regarded as a ruling ability, the non-focal view accepts existence of specific factors and the multifocal view regards minor faculties distinct from universal factors.

Spearman's latter method was to evaluate what are called tetrad differences. If a, p, b, q stand for abilities and $r_{ap}$, $r_{bq}$, $r_{aq}$, $r_{bp}$ are coefficients of correlations between the various pairs, then:

$$r_{ap} \cdot r_{bq} - r_{aq} \cdot r_{bp} = 0$$

Spearman calls this relation tetrad equation. Critically observing this theory in actual practice, tetrad differences generally deviate from zero. Commenting on the theory Vernon states:

"Factor analysis is an exploratory and suggestive rather than a conclusive technique. But two features of Spearman's theory are thoroughly substantiated and a third feature is definitely wrong. The feature where Spearman went
wrong was his belief in determinacy of 'g' — that would yield one and the same 'g'.

Thomson criticises the theory by arguing that the two factor theory was a possible but not a necessary inference from the statistical results. Thurstone accepts the tetrad differences method only as a historical interest and states that when more than one factor is required, tetrad differences criterion cannot be applicable. But as the practical inference of this theory, the test constructors generally select the test items, which are considered to be saturated with 'g'.

(c) Thurstone Group Factor Theory

The approach that is accepted by the largest number of American theorists is one of group factors. This approach, which assumes that the fundamental dimensions can be represented by a relatively small number of fairly broad common factors, arose out of the work of Thorndike, Kelley, and Thurstone. Particularly Thurstone, with his concept of primary mental abilities, has publicized the group factor view. Although the exact abilities (group factors) found

in any specific study depend upon several variables (e.g., the tests used, the nature of the sample tested, and the method of analysis, the following factors have appeared with some regularity and have been confirmed by several investigators:

Space: the ability to visualize geometric patterns in space.
Perceptual speed: quick and accurate noting of details
Number: quickness and accuracy in simple arithmetic computations.
Verbal Comprehension: knowledge of the meaning and relationship of words.
Word Fluency: ability to use many words.
Rote Memory: immediate recall of rote materials.
Induction: ability to extract rules.

According to Cronbach,

Thurstone's theory had great influence on all subsequent classification of abilities. He gave 56 tests to students of university of Chicago and found six predominant factors: Verbal (V), Number (N), Spatial (S), Word fluency (W), Memory (M) and Reasoning (R)\(^27\)

To measure intellectual ability, therefore, one would administer a battery composed of tests which individually measured one of the group factors. If the tests in the battery do, in fact, measure the primary mental abilities, any complex intellectual task or skill can be represented by a weighted composite of the relevant group factors.

(d) Thorndike's Multifactor Theory:

As the name of the theory indicates, intelligence is said to be constituted of a multitude of separate factors, or elements, each one being a minute element of ability. Any mental act, according to this theory, involves a number of these minute elements operating together. Any other mental act also involves a number of the elements in combination.

According to Thorndike,

"There is really no such factor as "general intelligence"; there are only many highly specific acts, the number of such depending upon how refined a classification we might wish to make and are capable of making".  

In constructing a mental test, Thorndike himself feels that his "atomistic" theory and the multitude of minute elements of ability are of less practical significance than

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29. Ibid., p. 60.
the conception that many of them operate together in any situation demanding intelligence.

(e) Vernon's Hierarchical Theories

The basic idea of this approach is that intellectual structure can be conceived of as a hierarchy, extending from one or more broad general factors through group factors to more and more specific factors. Vernon (1950) has proposed a model (see Figure 1) where general ability (g) is at the apex of the hierarchy. This general factor is subdivided into two major group factors - a verbal educational (V:Ed) factor and a practical mechanical (K:M) one. Each of these categories is further subdivided into group factors and then into more and more specific factors. At the third level of the hierarchy, which represents minor group factors, we might find a spatial factor similar to Thurstone's group factor. At the next lower level, this factor might be further subdivided into three more specific factors.

* the ability to comprehend spatial relations using the body as a point of reference,
* the ability to mentally manipulate a series of visual objects through a sequence of motions, and

 Vernons Diagram of a Possible Hierarchy of Abilities

**General** (g)

Major Group Factors

- Verbal Educational (V.E.D.)

Minor Group Factors

- Verbal (V)
- Number (N)

Specific Factors

Practical (K:M)

- Mechanical Information (K)
- Spatial (K)
- Manual
* the ability to make left right discriminations.

The hierarchical approach represents an intuitively satisfying collection of data and, since tests can be constructed to represent any level in the hierarchy, it is a useful tool for guiding test construction.

(f) Guilford's Three Dimensional Model of Intellect:

The most recent theory is Guilford's three dimensional model. Guilford conceives of intellectual functioning as having three dimensions: Operations, Contents, and Products. Operations are the processes involved in intellectual behavior - in Guilford's system, Cognition, memory, divergent thinking, convergent thinking, or evaluation. The contents of these operations may be figural, symbolic, semantic, or behavioral. And, third, the products may be units, classes, relations, systems, transformations, or implications. Thus, the model contains 120 cells (5 operations x 4 contents x 6 products), each of which represents a distinct factor that is measured by a separate test.

In Guilford's scheme, the well-known verbal comprehension factor (vocabulary) becomes the ability to cognize semantic units. From the theorist's view point, Guilford's precisely defined and integrated model has much to recommend

FIG-2
GUILFORD'S STRUCTURE OF INTELLECT MODEL

OPERATION
- EVALUATION
- CONVERGENT PRODUCTION
- DIVERGENT PRODUCTION
- MEMORY
- COGNITION

PRODUCT
- UNITS
- CLASSES
- RELATIONS
- SYSTEMS
- TRANSFORMATIONS
- IMPLICATIONS

CONTENT
- FIGURAL
- SYMBOLIC
- SEMANTIC
- BEHAVIOURAL
it, including the advantage of being able to specify in advance the nature of currently unmeasured intellectual abilities.

The various models presented are both conceptual and heuristic devices. Because their comparative validity has not been determined, whichever model a particular investigator adopts will generally be a function of his individual preferences. No test is explicit in derived s from a hierarchical theory, and Guilford's model is too new to be the basis of any widely used test.

It should be emphasized that not all test constructors have based their work on a particular theory of intellectual structure. In fact, the dominant approach has been an empirical one of attempting to predict a specific criterion with the maximal accuracy. Thus tests of general ability have been developed, not in accord with a prevailing theory of intellectual structure, but by including skills that previous research has shown to be predictive of academic success.

"Guilford claims to have demonstrated empirically that 82 of the 120 different structure of intellect factors exist."

Empirical considerations, rather than theoretical considerations, were pre-eminent.

(g) Thomson's Sampling Theory

Spearman's two-factor theory has been criticized by Thomson and Thurstone. Thomson, believes that the hierarchical order and zero tetrad differences can be explained by his sampling theory. His view is that the coefficients of correlation are the results of common samplings and combination of independent factors that are present in two tests, determine the coefficient of correlation between the two. The theory is the same as that of Thorndike except that Thomson considers practical usefulness of the concept like 'g'. Thomson believes that if several tests call upon many elementary factors in common, they will give appearance of having one common comprehensive factor. According to the theory, any performance is considered as being carried out by a sample of group factors.

"The theory does not deny the general ability, for if the samples are large, there will of course be factors common to all activities. On the other hand, it does not affect the general ability if the samples may not be so large as this and no single factor may occur in any activity".34


Thomson has become somewhat ambiguous in the explanation of his own theory.

(h) Burt's Hierarchical Group Factor Theory

According to this theory, abilities are classified into three types:

* General Ability entering into every test belonging to a certain broad genesis.

* Special Abilities, each limited to certain group:

* Individual Abilities, peculiar to a particular test.

Burt's thesis is that "the set of factors can be arranged in a hierarchical order as shown in the scheme. While recognising group and specific factor, he does not deny the 'g' factor." 35

2.6 Role of Heredity and Environment on Intelligence

Because psychologists cannot agree as to what intelligence is or how many intellectual factors there are, they obviously cannot agree as to the etiology of intellectual

differences. The score on any test of ability is a result of how well a person performs on that instrument at a particular time.

There is a question of the relative influence of heredity and environment. This controversy has raged for years with equally strong support on both sides of the argument. To a considerable degree the argument has been implemented and intensified by the development of intelligence tests.

The debate on the relative influences of heredity and environment, while often apparently useless, is nevertheless concerned with a question of fundamental importance to educators and psychologists. Obviously, if a child's capacity for accomplishment were determined solely by inherited traits or abilities, education necessarily would have quite a different outlook and philosophy than it would in a less deterministic frame of reference.

Many investigations and experiments have been made on this question from the time of Galton to the present. One method of investigation involves studies of persons who are obviously brilliant, feebleminded, or degenerate, to determine whether such traits tend to run in families. Most of these studies show that they do. Even though the question is not satisfactorily answered.
The result of studies which involves the transplanting of children from a poor environment to a good one shows equivocal: some children show general and marked improvement in intelligence and other traits, others do not.

In summary, it may be said that the heredity-environment issue is far from settled. During the last hundred years there appears to have been a gradual shift from a viewpoint strongly hereditarian to one more favourable to the environmentalist point of view. Of course there are extremists who would rule out entirely one or the other point of view, but most educators and psychologists, believing that what the individual becomes is the result of an interaction of heredity and environment.

As Noll has put it, "The great mathematician, Sir Isaac Newton, if he had been brought up among African bushmen would probably have become a remarkable bushman but he would never have discovered the laws of motion".\(^{36}\)

Without going into detail it may be said that, by far, the most popular current opinion is that there is an interaction between heredity and environment. The original

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question "which one of these factors affects an intelligence test score?" was replaced by "which one contributes the most?". This question, in turn, has been replaced by "how do heredity and environment interact to affect test scores?" If we wish to see mankind behave more intelligently, heredity or environment, or both, must be improved. Since man can manipulate environment more readily than heredity (assuming that the practice of eugenics will not be given serious consideration in the near future), control of environment is the obvious method.

While psychologists do not as yet have the complete answer to this, progress has been made in terms of the sophistication of the question asked. Intelligence test scores are not solely dependent upon either environment or heredity; both are relevant.

2.7 **Culture Fair Tests of Intelligence**

The terms culture-free and culture-fair are to some extent misnomers.

A "culture-free" test is one on which scores are completely uninfluenced by experience in a particular environment. Such a test would give a fair comparison of mental abilities in different countries and across different social classes.
The problem of cultural influences on test performance has been studied for many years. Originally, investigators attempted to develop tests that would eliminate all effects of culture and presumably measure the individual's inherent abilities and personality traits. However, it soon became apparent that because the cultural environment operates upon an individual and interacts with hereditary factors from the moment of birth (or even before), any attempt to develop a culture-free test was doomed to failure. Consequently, the emphasis in test construction has shifted to the development of culture-fair tests, i.e. those which, while not eliminating cultural effects, attempt to control certain critical variables, thus making the test equally fair to all persons.

To accomplish this, procedures must be developed to control the influence of parameters which are important determiners of test performance but they vary widely between cultures e.g. language, speed, role of competitiveness and the motivation to do one's best etc.

Regardless of the approach used in constructing a culture-fair test, its effectiveness will be determined by accumulating validity evidence. That is, unless it can be demonstrated that the test is fair and equally valid for various cultural groups, it cannot be said to have attained its purpose.
Tannenbaum\textsuperscript{37} in reviewing the \textit{Culture-fair Intelligence Test}, writes,

In essence, then, it must be admitted that the long-pursued goal of demonstrating equality among national and international sub-populations on some measure of general ability has not been reached by this test. Is it, indeed, a goal worth pursuing? Even if it were possible to devise a test so antiseptic as to clean out inequality not only among subcultures but also among other groups showing differences in test intelligence, such as those classified by sex, age, education, geographic origin, body type, physical health, personality structure, and family unity—what kind of instrument would we then have? Since such a test must perforce be so thoroughly doctored as to omit tasks that reveal these group differences, or substitute others that show "no difference", what could be possibly measure? What could it predict? Covering up group differences in this way does not erase test bias. Rather it delimits drastically the kinds of information one can gather about problem-solving strengths and weaknesses associated with groups as well as individuals.

2.8 Trait Organization In the Test

The present test includes two types of items: one is an information type of items designed to measure child's acquisition of information, vocabulary and concepts from home, community, nature and recreation, science and social-sciences; while the other is a reasoning type of items designed to measure the student's ability to perceive the rule involved.

2.9 Concept of General Ability and the Present Test

It can be realized from the preceding discussion that the psychologists do not agree as to the nature of intelligence. Some of the theoretical psychologists hold the view that there are specific factors, while some of them believe that there is also a general factor. But the practical psychologists are inclined to use the tests of general ability only because they are found predictive and very helpful.

"Due to the lack of agreement about the nature of intelligence, there are wide variety of tests that are often subsumed under the phrase 'intelligence tests'. They do not all measure the same thing. They are not even designed to do so. A rather important implication is that, when selecting and interpreting an intelligence test, one must be completely aware of how the author defines the construct he is trying to measure". 38

The study of the nature and structure of general ability has been helpful in understanding more clearly the development of tests mentioned in the next chapter. It was not attempted to accept any one of the definitions or theories stated in this chapter. However, Flanagan's analysis of the definitions has been found very useful while designing the present test. The results of the present test have been subjected to factorial analysis to estimate whether any common factor exists.