No success can be expected from the haphazard throwing together of items and tests of unknown difficulty or factorial composition, a practice unfortunately too wide-spread. Only the most rigorous testing of the tests themselves, by the use of item analysis and the various other techniques elaborated for this purpose, can ensure that technical competence in test construction so absolutely essential for fruitful work, and so deplorably missing in many published tests.

- Eysenck

CONTENTS

4.1 Introduction
4.2 Study of Different Tests of General Ability
4.3 Deciding the Type of the Present Test
4.4 Age and Grade
4.5 Selection of Test Material
4.6 Guiding Points for Preparation of Test-items.
4.7 Assigning Weightage
4.8 Description of Test-parts and Types
4.9 Directions for Test Administration
4.10 Testing Material
4.1 Introduction

The purpose of the design is to guide to what one is proposing to test. Designing is an essential step in the process of test construction.

"In setting up research plan, the researcher must consider certain fundamental steps that are essentially the same regardless of the type of research design he proposes to use".  

It is often at this stage of planning that the decisions taken will differentiate a sound study from a faulty study.

The factor that most often differentiates between good and poor research is not the funds available, the size of the sample, or the sophistication of the statistics, it is the care and thought that goes into the research plan. As Burroughs puts it:

-------------------
"The hypotheses formulated act as a guide to what one is proposing to test. The purpose of the design is to show how to do it. We need to collect data in such a way that we may validly draw conclusions from them. There are many elements to be taken into consideration at this stage not all of which are compatible. It is the stage where, probably more than all others, experience counts and where technical advice should be sought".

Thus, a reliable test cannot just happen. It is not the fruit of a few hours or days. It encompasses number of operations, carried out with patience, zeal, accuracy and industriousness for months and years. For such a long process, planning demands utmost care and insight. The design of a test involves the preparation of an outline of specification of the ability to be measured, the content through which the ability could be measured, types of test items to be framed to measure the ability, arrangement of the test items, selection of the type of test, assigning weightage to the items, deciding length of the test, preparation of directions for administration of the test, the testing material that is to take shape, so on and so forth.
4.2 Study of Different Tests of General Ability

Before preparing a design for the present test some of the existing tests, both in foreign countries and in India, were reviewed with a view to selecting the base of the types of items to be included in the present test. The lists of the tests reviewed for the purpose have been given in the previous chapter.

From the review of various tests, it was observed that they contain some of the sub-tests with the ability components like (1) reasoning, (2) imagination, (3) perceptual ability (4) memory (5) spatial ability (6) information, etc. It was also observed that different sub-tests were selected to test specific function of general intelligence. The types of items were also varied. The types most common to the tests are classification, substitution, reflected image, analogy, similarities, picture reconstruction, series, progressive series, missing part, geometrical construction, absurdity, substitution table, maze etc.

4.3 Deciding the Type of the Present Test

After reviewing the tests of general intelligence, it was decided to construct a non-verbal group test of general ability that include items measuring information
(cultural) and reasoning (non-cultural). J.C. Flanagan's Tests of General Ability being prepared on the same lines were more critically studied.

Flanagan has included items that measure information (cultural) and reasoning (non-cultural) in the tests of general ability by giving two reasons, "First it appeared that these two abilities are dominant in most definitions of general intelligence. Second, a review of the literature indicated that these two abilities usually provide the best predictions of school success". 3

The information part of the tests of general ability includes the test items from various fields of culture viz., home, community, science, social sciences, nature and recreation. Flanagan states that it tests student's familiarity with the world around him through his experiences in the school, at home and in the community.

"The test items relate to the student's general knowledge of his surroundings gained through his observations, his hobbies, radio, films, field trips and conversations with other people. As regards reasoning part, it is aimed at testing student's powers of abstract reasoning.

---

This part of the test presents equal challenge to all regardless of their cultural backgrounds. The number of right answers of both the parts of the test are added together to obtain the student's IQ score.

After fixing the ability components of the test to be designed, the next step was to select the type of the test. There are two openings to this problem:

1. To adopt the Test of General Ability (TOGA) and to standardize it on the population of Gujarat.

or 2. To adopt the principle of the Test of General Ability in toto, and to construct an original test on the same lines.

In TOGA, most of the items on information part are culture fair items, based on cultural background of U.S.A. Moreover in reasoning part too, the items are too difficult to be included in the present test. Hence, it was very difficult to adopt the TOGA.

But the second idea was worth considering. As there was no test developed in Gujarat as well as in India, on

these lines for higher secondary students, it was decided to construct an original test of general ability on the same principle of TOGA and to standardize it on the population of Gujarat State.

The characteristics of the test were decided as under:

1. The test should be a non-verbal group test and the test items at all the grades should be pictorial in form.

2. Items included in the test should be pertaining to information (cultural) and to reasoning (non-cultural).

3. The test should be power cum speed test.

4.4 Age and Grade

After deciding the type of the test, it was essential to decide age-range and grade for the standardization of the test. According to Compulsory Education Act, 1964 of Gujarat State, the lower compulsory age is 6 years. It is compulsory to get the child admitted at the age of 6th year. Moreover, the children who have completed 5 years are only allowed to be admitted to primary schools. Sometimes ambitious parents prepare their children at home and ask for permission to allow them to appear at the annual examination of class I of the primary school, when the child enters 6th year of age.
Thus, if a child enters primary school at the age of 6 years, he will reach class VIII at the age of 13 years and to the class XI at the age of 16 years. But, there might be variations in the age on account of acceleration in years because of ambitious parents. There might be cases of late entry in the school and of detention for one or more years in the same class or in different classes. Hence, it is obvious that in every class there are children of different age-groups. Looking to this fact, it was decided to administer the test classwise and to standardize it on the population of classes XI and XII.

In Gujarat State, the stages can safely be recognized as (1) standards I to IV (2) standards V to VII (3) standards VIII to X and (4) standards XI and XII (the higher secondary school stage). For the present investigation, it was decided to construct and standardize General Ability Test, to measure general mental ability of the students of standards XI and XII of the higher secondary schools of Gujarat State.

4.5 Selection of Test Material

To decide the components of general ability as basis for the selection of different types of items for the test, is the crux of the problem. After a critical study and careful observation of the components that contribute to
the measurement of general ability, selection of the ability components and the types of items that can best measure the ability was to be done. It is advised by most of the psychologists to measure only the most important abilities that contribute to 'g' factor. It is here that several points require due consideration. The first point is how many abilities are to be measured? The second is whether psychologists have an exhaustive list of separate abilities, and if so, is it agreed upon by all? The third point is whether it is necessary to include maximum number of abilities in the test or to include minimum required abilities.

Looking to the existing tests, the minimum number of ability components vary from two to ten. Freeman opining on this point states, "The new technique is to reduce the number of sub-tests and to improve them so that the smaller number has as much predictive value as the larger".5

At the time of selection of ability components the following views of Flanagan6 were found worth considering:

"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 differences in general ability which are inherited and affect the individual's performance throughout life.

2. Acculturation refers broadly to general (or out of school) learning experiences. This includes learning for which the family, early home environment, and other general cultural factors are largely responsible.

3. Specific school learning includes the development of the natural capacities of the individual through reading and other formal school learning experiences.

Flanagan believes that the third factor viz., specific school learning, should not be included in the tests of general ability because they are meant to measure individual's potential ability to learn. TOGA, therefore, included two types of items. One is reasoning type item designed to measure intelligence with as little influence from acculturation as possible. These reasoning items are intended to measure the child's ability to develop concepts from series of drawings. It is hoped that the student's ability to perceive the rule involved in a series of figures will be relatively independent of both school learned skills and acculturation factors. The other type of items in TOGA
measures the child's acquisition of information, vocabulary, and concepts. Much of this information is from home, family or community environment rather than from academic knowledge.  

It was decided to follow the principle of Flanagan to measure general ability and to select ability components and types of items as shown in the following table. The content validity and construct validity were established by consulting reputed psychologist.

Table 4.1

<table>
<thead>
<tr>
<th>Test Ability Part component</th>
<th>Type of item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information 1. Recognition of a pictured object when its name is given.</td>
<td></td>
</tr>
<tr>
<td>2. Recognition of a pictured object when a classifying characteristic is given or implied.</td>
<td></td>
</tr>
<tr>
<td>3. Selection of a pictured object, person or action that represents a given quality or symbol.</td>
<td></td>
</tr>
<tr>
<td>4. Selection of a picture that is an example of a given abstract concept</td>
<td></td>
</tr>
<tr>
<td>5. Selection of a pictured object, the use of which involves a given principle or abstract concept</td>
<td></td>
</tr>
</tbody>
</table>

---

7. Ibid., p. 6.
Table 4.1 contd.

<table>
<thead>
<tr>
<th>Test Part</th>
<th>Ability component</th>
<th>Type of item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Reasoning</td>
<td>6.</td>
<td>Selection of a pictured object that illustrates the same implied principle as a given principle</td>
</tr>
<tr>
<td></td>
<td>7.</td>
<td>Selection of a picture that depicts an element essential to an idea or social institution.</td>
</tr>
<tr>
<td></td>
<td>1.</td>
<td>Concepts involving characteristics of simple lines or figures</td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>Concepts involving simple relations between lines and figures with one distracting factor.</td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td>Concepts involving simple relations between lines and figures with two or more distracting factors</td>
</tr>
<tr>
<td></td>
<td>4.</td>
<td>Concepts relating to artistic effects and assembly of lines and figures.</td>
</tr>
</tbody>
</table>

4.6 Guiding Points for Preparation of Test-items

(A) For Information Part

1. The items should test individual's ability to grasp meanings, and to recognise relationships and underlying principles of natural and social environment.
2. The information items should include simple factual types of information, absorbed from surroundings.
3. The items should test ability to systematize and relate new information, recently acquired to knowledge that the testee already possesses.
4. The test items should include as far as possible, general (out of school) experiences.

5. The information items should be based on various environments like home, community, nature and recreation, science and social science.

6. Items based on Indian culture should be included in the information part of the test.

7. All the items in this part should be multiple choice items, pictorial in form, involving recognition or selection of a picture out of a row of five pictures in an item.

8. Clarity in language of the problem to be read before the class should be carefully considered.

(B) Reasoning Part

1. The items included should measure the testee's ability to develop concepts from series of line drawings.

2. The items should include series of figures that will be relatively independent of school learned skills and acculturation factors.

3. The items should include student's ability to understand relationships from line drawings and figures.
4. All the items should be multiple choice items. In each item, four of the figures to be constructed on the basis of a specific rule and the remaining fifth figure should be different, to which rule should not apply.

For both the Parts

1. The items should be constructed keeping in mind the different types shown in the Table 4.1.

2. Span of experience of pupils and level of different classes should be kept in mind while framing the items.

3. While framing multiple-choice test items, care should be taken to employ random occurrence of correct responses in the items.

4.7 Assigning Weightage

The next essential point that was to be considered, was regarding weightage to be assigned to (1) each part of the test and (2) each type of the items in every part of the test.

For that, the expert opinions were taken from various teachers of psychology, experts in test construction and psychologists.
As to the weightage to be given to both the parts of the test viz., information part and reasoning part, it was the opinion of all of them that almost equal weightage should be given to each of the parts. They opined that looking to the age and grade level of the students to be tested, there should be variation in the weightage to be given to each type of items in every part of the test.

The following tables 4.2 and 4.3 show the weightage determined by various expert consultants.

Table 4.2
Statement showing weightage given by Experts to Different Types of Items of Information Part

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Information Item : Types</th>
<th>Weightage in percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ability to recognise a pictured object when its name is given.</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Ability to recognise a pictured object when a classifying characteristic is given or implied</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>Ability to select a pictured object, person, action or interaction situation that represents a given quality or symbol.</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Ability to select a picture that is an example of a given abstract concept</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Ability to select a pictured object the use of which involves a given principle or abstract concept</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Ability to select a pictured object that illustrates the same principle implied as a given principle.</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Ability to select a picture that depicts an element essential to an idea or social institution.</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 4.3

Statement showing weightage given by Experts to Different Types of Items of Reasoning Part

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Reasoning Item:Types</th>
<th>Weightage in Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Concepts involving characteristics of simple lines and figures</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>Concepts involving simple relation between lines and figures with one distracting factor</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>Concepts involving simple relations between lines and figures with two or more distracting factors</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>Concepts relating to artistic effects and assembly of lines and figures</td>
<td>2</td>
</tr>
</tbody>
</table>

4.8 Description of Test Parts and Types

As stated in the foregoing pages of the chapter, the General Ability Test consists of mainly two parts viz. (1) Information Part and (2) Reasoning Part

The Information Part

The information part of the test consists of items measuring ability to grasp meanings, recognise relationships and understand basic concepts and underlying principles of natural and social environment. It provides an index of the student's intellectual curiosity and inquisitiveness by sampling his understanding of general phenomena and the
simple factual types of information he has acquired from his surrounding environment. It also measures his ability to systematize and relate new information he has acquired to knowledge that he already possesses.

The information items are classified into seven types.

The examples of the seven types of items are as follows:

Type 1: Recognition of a pictured object when its name is given.

* Problem: Find the one that is located in Delhi.

Type 2: Recognition of a pictured object when a classifying characteristic is given or implied such as function, source, form, appearance etc.

* From the rows of five pictures, the testee has to select the picture denoting correct answer in case of types 1 to 7 in Part I.
Problem: Find the one that is used most often by a detective police-man.

Type: 3 Select a pictured object, person, action or interaction situation that represents a given quality or symbol.

Problem: Find the picture that shows an urban environment.

Type: 4 Selection of a picture that is an example of a given abstract concept.

Problem: Find the one that would move through the greatest arc.
Type 5: Selection of a pictured object, the use of which involves a given principle or concept.

Problem: Find the apparatus through which chemically pure water is obtained.

![Diagram with options a, b, c, d, e]

Type 6: Selection of a pictured object that illustrates the same implied principle as a given principle.

Problem: Find the one that shows capillary action.

![Diagram with options A, B, C, D, E]

Type 7: Selection of a picture that depicts an element essential to an idea or institution.

Problem: Find the one who would be most helpful in a matter of arbitration.

![Diagram with options A, B, C, D, E]
The information items have also been classified under five broad areas relating to content. These include home, community, nature and recreation, science and social science.

The Reasoning Part

The reasoning part consists of items testing the ability to understand relationships and to form concepts. In each item, four of the figures are constructed on the basis of a specific rule. The remaining figure is different; the rule does not apply. These items test the ability to derive concepts of various types which involve a wide range of difficulty. The concepts the students are required to understand in these items may be classified into four principal types:

Type: 1 Concepts involving characteristics of simple lines or figures.

Included are concepts of curvilinearity, number of sides and elements, shading, shape, area, length, type of lines, size of angles.

In this example, the concept of curvilinearity is crucial.
Type: 2 Concepts involving simple relations between lines and figures with one distracting factor.

Included are concepts of shape, parallelness, similarity, perpendicularity, symmetry, position, orientation, intersection etc.

In the following example the concept of shape, similarity, symmetry and orientation is involved. Arrangement of smaller to bigger figures are the same in all but one of the figures.

Type: 3 Concepts involving simple relations between lines and figures with two or more distracting factors.

In the following example, the position of the figures is crucial. The direction and the repetition of two small figures at the ends with shades are distractors.
Type: 4 Concepts relating to artistic effects and assembly of lines and figures.

Included are concepts of shading, shapes, perspective etc.

In this example, shading and shape are the distractors. Shading at the base ends is crucial.

4.9 Directions for Test Administration

Along with the selection of test material and test items, special attention was given for preparing directions for the administration of the test to maintain its objectivity.

This being a non-verbal test, directions to testers for administering the test were prepared. The directions consist of general instructions and specific instructions for the teachers. In general instructions, methods of using test booklets and answer sheets, method of reading specific instructions, technique of introducing practice items, etc, have been clearly explained.
While in specific instructions, the preliminary work of filling up personal particulars of the testees, the method of reading problem-statements of information part, explanation of reasoning items, assigning time to administer the test-parts etc., have been clearly stated. It is planned to prepare a manual of directions along with the standardized test for public use.

4.10 Testing Material

The General Ability Tests are to be constructed on the design discussed in this chapter and to be standardized for measuring individual differences in general ability of pupils studying in Standards XI and XII of the higher secondary schools of Gujarat State.

Each student to be tested will require one test booklet and one answer-sheet. The test administrator will need directions for giving the tests, scoring key and ready reckoner for obtaining IQs.

Thus, the following testing material is planned to be developed along with the construction and standardization of the test:

1.
1. Test Booklets
2. Answer Sheets
3. Scoring Keys
4. A Manual containing:
   i. Directions for Administering the Test
   ii. Ready Recknor for obtaining IQs and PRs.
   iii. A Table for classification of Intelligence.