

CHAPTER II

MEASUREMENT OF INTELLIGENCE: A LOOK BACK

Measurement of intelligence in its crude form is very old. Ballard has rightly said, "Mental tests are as old as human race."¹ In Sanskrit literature we find many types of puzzles and completion tests. In the Vedas, there are many discussions, that resemble intelligence tests. In Ashramas, students were tested before admission. In the kings court, the learneds from different places used to set many puzzling problems requiring mental gymnastics. Time-limit was given just by way of challenge to the individual. Of course, all such tests were almost entirely empirical. Thus the roots of measurement lie in antiquity. It is from such attempts that our mental testing tools have been evolved and as such, an attempt to describe the history of measurement of intelligence will not be out of place.

Physical Measures of Intelligence

The earlier experiments of measuring intelligence

¹ Ballard, P.B.: Mental Tests, University of London Press, 1949, p. 2.

consisted of physical measurement. It was believed that the form and size of the brain was indicative of intelligence. There was a belief that the outward manifestations of the brain and therefore of intelligence, are depicted in the bodily structure. Facial features and expressions were thought to be the measurable manifestations of the mind as it was not possible to measure the mind. Below is given a brief history of such attempts made for measuring human intelligence.

(a) Physiognomy

In 1772, Lavator published his essay on Physiognomy. He tried to judge the dispositions and capacities of the mind by an examination of facial features and expressions. He concentrated on the particular branch of Physiognomy viz. Osteology; the science of bony structure. He believed that a man's fighting quality depended upon the size and structure of the nose. The Roman nose was supposed to be indicative of an aggressive attitude.

(b) Sarcology

Thinking the bony structure to be too rigid a material for measuring the intellectual capacities of the dynamic mind, a more elastic material from the body was tried next. In 1806, Bell discarded Osteology and accepted

Sarcology, according to which, the fleshy part of the face was an indication of ^{the} mind and emotions in particular. The changes in the mobile and the plastic covering of the face were taken as the signs of the prevailing modes of thought and feeling.

(c) Phrenology

In 1807, Gall, a Frenchman put forth his theory of mental measurement. He declared that the head was an index of the brain and the brain an index of the mind. He did not go so far as to say that a big head meant a big mind. He believed that the relative proportions of the skull and the configuration of its surface would, when measured exactly, give an exact indication of the mental powers. He studied the development of 26 complex faculties of mind in relation to the different parts of the brain from their supposed external manifestations, namely the prominence of the different parts of the skull. This method gained popularity and many people made their fortunes out of it.

(d) Anatomical Stigmata

Lombroso in 1876, gave a new turn to these attempts. He, being a criminologist, maintained that criminal tendency could be judged by carefully noting some visible mal-formations of the body and more particularly of the head. It

was believed that the deformation of the mind was due to defective mind. Small, misshapen or asymmetrical skulls; low, narrow and bossed foreheads; broad and depressed or upturned noses were some of the peculiar mal-formations noted by the exponents of this theory.

But every one of these theories came to be discredited as the approach to this problem became more scientific. As Dr. Cyril Burt says,

Psychologists are nowadays agreed in distrusting all snapshot judgments based upon an inspection of the face and head.²

Professor Karl Pearson, from an examination of 5000 school children and 1000 undergraduates, concluded that no reliance was to be placed on such vicarious measurements of the ^{and} mind/that no prediction of intellectual qualities could be made from physical features. He has said,

We cannot tell a criminal by looking at him; we cannot tell a genius by the shape of his skull; and we cannot tell a fool by the length of his ears.³

It was by means of correlation coefficients that Pearson decided that the amount of correspondence between

2 Psychological Tests of Educable Capacity (Board of Education), p. 4.

3 Ballard, Op. Cit., p. 6.

intelligence and the size and shape of the head was extremely small. The attempts to measure intelligence indirectly by means of static measurements of the body were definitely discredited.

Sensory Tests

The next stage in the history of mental measurement was characterized mainly by the use of brass instruments in the laboratory. Psychologists began to try in another direction as the idea of static measures for measuring intelligence failed. There was a belief that all individuals possess sense organs of almost the same physiological limits and, therefore, if there was any difference in the sensory discrimination of different individuals, it must be attributed to the power of attentive analysis, which they equated with intelligence. Thus a difference in mental capacity could be depicted in the sensory discrimination.

Galton tried to devise certain tests with an implicit belief in the above theory. He gave, to his subjects, graded weights with small differences. The accuracy in discriminating these differences, was taken as an index of mental ability. He tried his test on the Fellows of the Royal Society and found that they possessed a delicate sensory discrimination. He, therefore, concluded that those who were clever were good at sensory

discrimination, and conversely those that were good at sensory discrimination ought to be intelligent.

The instrument used for testing the sensitivity of the skin was known as aesthesiometer. The sensitivity was to be taken as an index of intelligence of the person. It was believed that the sensitivity of the skin, as indicated by the threshold, was indicative of the acuteness of the mind; that if a man was thick-skinned, he was thick-headed as well. The theory could not be proved because McDougall and Rivers showed that the savages on the shores of Torres Straits had more discriminative skins than the Europeans. Thus the aesthesiometer was, after all, merely an aesthesiometer and not a phrenometer. It measured sensitivity and not sensibleness.

When tests of the higher senses were tried it was found that the powers of discriminating shades of brightness and distinguishing the pitch of musical notes did correspond to some extent with the amount of intelligence; but such tests failed to provide the simple index of mental calibre which was sought. Tests of bodily powers, or motor-tests came as a reaction from the exclusive reliance of traditional psychology on sensation and intellect.

Motor Tests

It was thought that, since the mind co-operates in

the activity of the body, a dynamic measurement might succeed where a static one had failed. Various instruments for measuring bodily powers were devised: the dynamometer measured the power of grip; the ergograph, the strength and endurance of the middle finger and the tapping machine, the number of taps that could be made in a minute. Reaction times too were determined, giving the interval of time that elapsed between a stimulus and a response. But none of the motor tests was found to correlate highly with the intelligence of the subjects.

Mental Faculties

Although much valuable work was done in these directions, the main objective was not attained by the measurement of the body or its powers. Psychologists next turned their attention to the so-called 'faculties' or powers of mind, tests of memory, attention, association and so forth. The scientific study of memory began with Ebbinghaus, who was first to study memory in its simplest form. He made use of the nonsense syllables, to study recall, retention and forgetting. But a severe blow, indeed, was given to the work on faculties by the negative results of the famous experiments on transfer of training by William James. It was found by Dr. James that training memory by one type of task, for example poetry, is not

transferable to another task of different type, for example, prose, i.e. a person who trains memory by poems may not have strong memory for prose passages. So far, then, from such tests of the faculties being found to correlate with intelligence, it was found that different tests of the same faculty did not even correlate highly with one another. Galton devised methods to judge the vividness of visual imagery. For determining an individual's predominant type of imagery, Galton's questionnaire method is still being used. But still the single criterion of mental ability was not forthcoming.

In all the attempts previously mentioned, we find that psychologists tried to measure so complex a concept as intelligence, by measuring its most remote and indirect manifestations, namely, the simplest mental functions such as sensory discrimination or simple movements of the body. As a result of this, many wrong and contradictory inferences were drawn by the earlier investigators. Thus the notion of mental testing temporarily came to be regarded as a fictitious pursuit. Opponents of mental testing used to say, "We can measure sticks and stones, but we cannot measure ideas. We can fathom the depth of a well, but we cannot fathom the depth of an emotion." The other side is concisely put by Thorndike, "Everything that exists, exists in some amount and if it exists in some amount, it

can be measured."

Early American Attempts

Mental testing in America was the direct outgrowth of European work upon individual differences. One of the pioneers in this field was Cattell. Cattelle prepared a series of 10 tests in 1890. He applied the tests to students of Columbia University. Later on a committee presented a long list of tests, which were simply elaboration of Cattelle's list. Wissler reported the results of these tests in his monograph in 1901. The list of traits or abilities which were measured in the Columbia Tests is as follows:

- (1) Length and breadth of head;
- (2) Strength of hand;
- (3) Fatigue as measured by the dynamometer;
- (4) Acuity of vision;
- (5) Colour vision;
- (6) Acuity of hearing;
- (7) Pitch discrimination;
- (8) Weight discrimination;
- (9) Spatial threshold;
- (10) Pain sensation;
- (11) Perception of size;

- (12) Colour preference;
- (13) Reaction time;
- (14) Rate of perception and reaction as measured by the rapidity of crossing out a's in a test;
- (15) The rapidity of naming colours;
- (16) Rate of movement as measured by dotting in one centimeter squares with a pencil;
- (17) Accuracy of movement as measured by striking dots with a pencil;
- (18) Perception of time as measured by the ability to follow rhythm, one second after the sound has ceased;
- (19) Association as measured by free association to nine words;
- (20) Imagery as measured by the imagery test of Galton;
- (21) Memory as measured by four simple memory tests.

The tests were selected for measuring intelligence and individual differences. It was believed that they could be given in one hour. They are, more or less, the tests either of accuracy of sense discrimination or the rapidity of movement. The last three tests were somewhat more complex in nature than the others. The results of these tests, were reported by Wissler, in his monograph in 1901. Wissler tried to find the correlation between the various

tests themselves and the correlation between the standing in the tests and college marks. The low correlations obtained were probably due to the fact^{that} the tests measured chiefly the sensory and motor processes.

Cattell discovered that there were characteristics differences in the reaction time of different persons. This called his attention to the need of studying individual differences and stimulated his later experimentation with mental tests in the United States. Thus we find the origin of the above tests in the study of individual differences.

Early European Attempts

A group of European psychologists was experimenting with tests during 1890-1900, which paralleled in the main the experiments of American psychologists. The most prominent of these Europeans was the French Psychologist Alfred Binet. Binet's earlier work was apparently of the same nature as that of the American Psychologists. In 1895, he proposed a list of tests. Some of the tests were as follows:

- (1) To study memory for geometrical designs, for meaningful material and for digits.
- (2) To study the character of an individual's mental images.

- (3) To measure attention.
- (4) To measure suggestibility.
- (5) To measure comprehension.
- (6) To study aesthetic feeling.
- (7) To study moral sentiments.

Though, Binet prepared these tests, he had not developed a technique to measure some of the functions which he listed. He also devised some simple tests, to measure attention and adaptation. He gave these tests to two groups of children, six being the poorest from the class of thirty-two, and five being, the best. He selected these two groups in order that he might determine which tests served to differentiate the bright from the dull pupils.

We can say from the early American attempts and the Binet tests described above, that the psychologists were as faraway from the goal as they were before. They knew the kind of test to be applied, but there was no scale. They could test but they could not measure. It was left for Binet to discover the scale.

Binet - Simon Scale

The credit of first providing the world with a workable series of intelligence tests goes to Alfred Binet.

Confronted with a problem of diagnosing in children the degree of backwardness which constituted mental deficiency and warranted removal to a special school, he began his work in collaboration with Simon by trying simple sensory and motor tests; but he soon found that he was on the wrong track. Something more complex, approximating more closely to actual intellectual operations, was needed. So he rejected the brass instruments and prided himself in requiring "no apparatus except pen, paper and a little ink". His labours resulted in the famous Metric Scale of Intelligence. For constructing this, he collected a large number of questions of a simple, conversational type, varying in character and involving only information which would be readily picked up by the ordinary child. When he applied the scale to large numbers of children he found that there was a minimum age at which most children could answer the various questions satisfactorily. He, therefore, classified his questions as 'belonging' to the various years of childhood. A question, for example, which could be answered by most children of six years but by very few of five was considered to be a suitable test for six-year-olds. In this way he was able to construct sets of questions for each year of school life. His 1911 scale consisted of fifty-four questions and tasks, five for each year from the third, the eleventh, thirteenth, and fourteenth years being omitted owing to a difficulty in finding tests that clearly belonged to them.

Binet was the first to introduce the concept of 'mental age' - the age, the test of which a child can perform. Thus a child had the mental age of seven if he could completely get through the tests for the age seven; if, in addition, he passed any of the tests of the higher age group, he was allowed one-fifth of a year for each. Binet solved his problem of diagnosing mental deficiency by saying that in the case of a child below nine a retardation of two years indicated deficiency; if he was above nine a retardation of three years indicated deficiency. Binet distinctly marked off intelligence from information acquired in school or in a good home.

Some Salient Features of the Scale

- (i) He constructed for the first time a metric scale with age standards, for measuring intelligence.
- (ii) For the first time he discarded the tests measuring sensory discrimination, rapidity of tapping etc. He was the first to design the tests measuring the higher mental processes. He measured general intelligence and abandoned the faculty psychology.
- (iii) His tests cleared off the confusion, regarding the nature of tests, to be used for measuring intelligence. Formerly, all types of tests were used because nobody was clear.

(iv) His tests were simple and practical. They gave a reliable index of pupil's ability to profit by education.

Limitations of the Scale

Despite all the good points discussed above, the scale is not free from limitations. Certain limitations of the scale are as under:

- (i) The test is time consuming because every individual is to be tested singly.
- (ii) The tests were originally prepared for the mentally defective, their utility for selecting geniuses is very doubtful.
- (iii) The criterion for mental defect is some what arbitrary; a retardation of two years at the age of eight is clearly less serious than that at the age of four.
- (iv) All the tests are not equally satisfactory.
- (v) The scale is largely an "all-or-none", 'pass-or fail' business. A child of six, for example, is not regarded as having a mental age of six unless he can pass all the tests for age six, regardless of what he can do for

later years. Partial credit is not given in any test.

- (vi) The tests are predominantly linguistic in character. They do not suit illiterates.

As Ross aptly puts it:

Had Binet lived, however, there can be no doubt that he would have continued his constant revision of the scale, probably on the lines pursued since his death, by other workers.⁴

Revisions of Binet-Simon Scale

The following are some of the revisions of the Binet-Simon scale:

- (1) The London Revision - By Cyril Burt

In London, Cyril Burt translated the tests and modified them to suit English children. He re-allocated some of the items to ages different from those allocated by Binet.

- (2) The Vineland Revision - By Goddard

This is the earliest translation of Binet-Simon scale by Goddard, which was largely used in America till it was replaced by Stanford Revision.

⁴ Ross, J.S., Ground Work of Educational Psychology, London, George Harrap and Co.Ltd., 1961, p. 228.

(3) The Stanford Revision - By Terman

Terman of Stanford University was the first to standardize a test. Terman's scale known as the Stanford Revision or Stanford-Binet appeared in 1916, together with a most complete manual, "The Measurement of Intelligence". But its norms were exclusively based on the children of the State of California and so a thorough revision of it was done in 1937 which corrected the weakness of the first. Merrill assisted Terman in this job and hence the name became Terman Merrill Test. There are two limitations of the test. Firstly, the tests are highly linguistic and secondly they are individual.

(4) The Bombay Karnatak Revision - By Kamat

Kamat has adapted and standardized the Stanford Revision of the Binet's scale, in both Marathi and Kanarese. It was a pioneering attempt in this field and the tests are widely used for measuring intelligence.

In some revisions, the original tests have merely been translated, in others they have been adapted to local conditions, in some only age assignments have been shifted.

Attempts in India

The pioneering work in intelligence testing was done in India by Herbert Rice of Lahore who adapted the

Binet scale into a Point Scale and prepared the tests in Hindustani in 1922. Norms are given for 1488 boys. Next came an attempt by the Government of India, and this was published in Government of India Pamphlet No.28, entitled as "Revised series of Mental Tests for Indian Scholars".

By far the best known Indian Revision of Binet-Simon Scale was the 1935 Revision by Kamat. His Revision is called "Bombay Karnatak Revision". The test have been translated into Kanarese and Marathi and some materials in them have been amended or even replaced to suit Indian conditions.

Several other revisions of Binet scale have recently come into the field. They are associated with the institution in which they were applied^{e.g.} Pal's Stanford Revision in Bengali, Stanford Hindustani Revision Patna Training College, Stanford Revision in Tamil and Telugu, L.W.T.C. Madras, Gupta's adaptation of Binet Test in Hindi, Khajua and Maiti's Adaptation of the Stanford Revision (Bengali) Calcutta University.

In the field of verbal group tests of intelligence adapted to Indian conditions, pioneer work was done by Menry of E.C.College, Allahabad. He published his "Preliminary Classification Test" in 1927 in English, Urdu and Hindi. In 1933, Lajja Shanker Jha standardised the Hindi adaptation

of C.A. Richardson's "Simplex Mental Test", by administering it to over 1000 subjects. Jha also adapted Terman "Group Test of Mental Ability" to Indian conditions. In 1936-37, Jalota of the D.A.V. Collage, Lahore, prepared a Group Verbal Test for college students in Hindi, Urdu and English. In 1941, Sohanlal, Chief Psychologist, Ministry of Defence, Government of India, constructed and standardized a Group Intelligence Test for 11+ children of the Province of U.P. This has been a belated beginning and un-co-ordinated too in the direction of Group Tests of Intelligence. Since the inception of the Bureau of Psychology in 1947 in U.P. at Allahabad, an organized effort is being made to prepare the group verbal tests. Group tests of intelligence for 12+, 13+, 14+ and for adults have already been prepared there and they are being standardized under the able guidance of Bhatia, the present Director and it is expected that the work will soon be completed, with the help of its District Psychological Centres. Group Tests of 12+, 13+ and 14+ have been standardized on the boys of U.P. schools. The norms are available.

Some sporadic attempts have also been made in the direction of Non-verbal Individual or Group Tests of Intelligence. At present, the only reliable Non-verbal Individual Test (Performance Test) known to the author, is the Bhatia Battery of Performance Test standardized by

Bhatia on 999 boys of U.P. But attempts to construct or adopt the Non-verbal Group Tests, have been made by several persons. It is worthwhile to mention the name of Menzel, the author of the book "Suggestion for the use of new type tests in India" who standardized the "Draw-a-man" Test of Goodenough of America on Indian boys. Norms are given both for age and school placement based on 2600 examinations. He also standardized Oliver's General Intelligence Test for Africans on Indian boys. Besides these, there are a few more like the Madras Non-verbal tests for General Intelligence on the junior level (ages 9-13) by Christopher U.C.T.College, Non-verbal Test of Mental Ability by Philip. This last one consists of 3 subtest series standardized on 1500 High School boys.

Shukla tried to see if the scale adapted by Kamat could be applied to Gujarati speaking children. He concluded that some changes were essential before the test could be applied to Gujarati children. He, therefore, translated Kamat's scale with some necessary changes and standardized it for Gujarati children. The test gives satisfactory results.

Desai in 1954 prepared a battery of tests for measuring intelligence of Gujarati children. The battery comprises of the following subtests:

- (i) Following directions,
- (ii) Opposites,
- (iii) Jumbled sentences,
- (iv) Logical inferences,
- (v) Proverbs,
- (vi) Number series,
- (vii) Analogies,
- (viii) Similarities,
- (ix) Story completion,
- (x) Memory tests.

The test is meant for the pupils of age-group 12 to 18 and gives fairly good results.

The Faculty of Education and Psychology of Baroda under the project on Educational and Vocational Guidance standardized a verbal group test of intelligence under the guidance of Lele. Phatak of the Faculty of Education and Psychology has prepared a Draw-a-Man Scale. The scale is a measure of general ability. It was administered to about 8,000 boys and girls of Gujarat. Premalatha of Educational and Vocational Guidance Bureau, Bangalore, has standardized A Non-verbal Group Test of Intelligence with special reference to the Mysore State. The test was prepared for the age-group 7 to 13. The test was administered to 7,841 children.

In India there are 179 languages and 544 dialects.

In a country of many languages and dialects, non-verbal tests are much to be preferred especially since many pupils may be examined in a language not actually their mother tongue. Besides this, it should be noted that quite a good number of children are poor readers and hence they are much handicapped in any mental test that requires more than simple kind of reading. The verbal tests should be used with a great caution below the High School standard.

The present work is one more addition to the existing stock of intelligence tests in India. This test is the first of its kind in Gujarat. As stated before, in Gujarat, there are a number of verbal tests, group as well as individual, and there was a need for a test of this kind. Such a test will be of immense use to guidance officers, teacher counsellors, researchers and others who are interested in helping children.

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