CHAPTER III

APTITUDES AND APTITUDE TESTING

The term "aptitude" is generally used loosely both by laymen and by vocational psychologists and counsellors. Its meaning varies not merely from one user to another, but even from one time to the other in the speaking or writing of a given psychologist or educator.

Unfortunately, there is no definition of "aptitude" found acceptable in toto by all psychologists.

In the Dictionary of Education[1] aptitude is described as a "pronounced innate capacity for or ability in a given line of endeavour, such as a particular art, school subject, or vocation." In the same volume, capacity is defined as,

> the potentiality of a person for a given function as conditioned by the total pattern of causes; partly hereditary and partly environmental.

Ability is defined as "the actual power present in an organism to carry to completion any given act or to make adjustments successfully."

According to H.C.Warren[2] in the Dictionary of

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1 Good, C.V., editor, "Dictionary of Education", McGraw-Hill Book Co., New York, 1945.

2 Warren, H.C., "Dictionary of Psychology", Houghton Mifflin, Boston, 1934.

Psychology, aptitude is,

> A condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some (usually specified) knowledge, skill, or set of responses, such as the ability to speak a language, to produce music, etc.

It should be noted that nothing is said in this definition as to whether the "condition or set of characteristics" is acquired or inborn. This is quite proper. Too often it has been implied that the term "aptitude" has a reference to a person's native endowments only. Bingham[1] remarks,

> Tests of aptitude, according to this mistaken view, should undertake to disclose the natural bent, the strength of the different dispositions, tendencies, and capacities inherent in the individual's original constitution, without regard to modifications in these capacities which have occurred in the course of experience. But this cannot be done. At least it is not possible with means at our disposal to-day. Even if it were, the resulting information would not be what is needed in individual counselling. We want the facts about a person's aptitudes as they are at present: characteristics now indicative of his future potentialities.

The same author[2] continues,

> When appraising aptitudes, we are on the alert for symptoms of "ability to

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1 Bingham, W.V., "Aptitudes and Aptitude Testing", Harper & Brothers Publishers, New York, p. 17.

2 Ibid., p. 18.

> acquire" a genuine absorption in the work, as well as a satisfactory level of competence. Indeed, a person who cannot develop a liking for an occupation along with proficiency in it, cannot properly be said to have an aptitude for it because he lacks the necessary drive.

Using Warren's definition as his starting point, Bingham[1] in 1937 defined aptitude as,

> A condition symptomatic of a person's relative fitness, of which one essential aspect is his readiness to acquire proficiency - his potential ability - and another is his readiness to develop an interest in exercising that ability.

It is clear, therefore, that Warren's emphasis on ability to acquire "with training" some specified knowledge, skill, or set of responses should be qualified by mentioning that the training need not necessarily be formal or overt; it may be self-imposed practice or even undirected experience.

With these interpretations, the definition of aptitude as given above corresponds to both technical and general usage.

Super[2] points out that both Warren's and Bingham's definitions imply,

> That an aptitude is not necessarily an entity, but rather a constellation of

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1 Bingham, W. V., Op.Cit., p. 18.

2 Super, D.E., "Appraising Vocational Fitness", Harper & Brothers, New York, 1949, p. 59.

> entities; the set of characteristics which enables one person to learn something may even be different from that which enables another person to learn the same thing.

Seashore and Van Dusen, as quoted by Super[1], have attempted to define the term more rigidly, saying that,

> An aptitude is a measure of the probable rate of learning, which results in interest and satisfaction, and is relatively specific and narrow.

Super[2] favours the use of the word aptitude,

> To convey the idea of a discrete, unitary characteristic which is important, in varying degrees, in a variety of occupations and activities.

Super's point of view makes for precision in defining aptitudes, but the same precision is not found in measures of aptitude.

A more general definition of aptitude has been proposed by Hahn and MacLean. They point out that,

> Aptitudes are correctly referred to as latent potentialities, undeveloped capacities to acquire abilities and skills and to demonstrate achievements.[3]

Aptitudes, thus, may be briefly regarded as potentialities which can be trained into special skills.

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1 Super, D. E., Op.Cit., pp. 59-60.

2 Super, D. E., Op. Cit., p. 58.

3 Hahn, M.E., & MacLean, M.S., "Counselling Psychology," McGraw-Hill Book Company, Inc., New York, 2nd Ed., 1955.

An analysis of these definitions reveals the use of seemingly conflicting terms like natural or acquired, innate capacity or ability, potentiality or actual achievement, and hereditary or environmental. These definitions and terms necessitate some decision regarding four fundamental considerations in defining the nature of aptitudes. These are as follows.:

(a) Whether aptitudes are innate or acquired.

(b) Whether aptitudes are unitary or pluralistic.

(c) Whether aptitudes are constants or variables.

(d) Whether aptitudes are distributed "normally" or multifariously.

(a) Current research supports the thesis that both factors - innate and acquired - interact and contribute to the development of aptitude.

(b) Modern research supports the thesis that aptitudes are pluralistic rather than unitary. In an early study, Kelley identified seven factors. Thurstone's list included 8 factors, Shartle's 11, and Guilford's as many as 28.

(c) While the evidence is conflicting, the trend seems to be in the direction of assuming that aptitudes are more constant than variable for an individual, and are affected within limits by educational and environmental influences. A

tremendous amount of research is still needed to clarify this issue.

(d) According to Hull[1] the bell-shaped distribution is so characteristic of all forms of human behaviour that it should be considered at least approximately true in the case of any aptitude unless there is definite evidence to the contrary. Most present day workers in the field will accept this point of view.

A detailed study of all the above discussed definitions enabled the present test-constructor to come to the conclusion that the definition given by Bingham might be accepted for the purpose of the present test-construction. The test-constructor feels, he is justified in accepting Bingham's definition of an aptitude as it tries to give an eclectic solution of all the views expressed. The definition accepted may be repeated below:

"Aptitude is a condition symptomatic of a person's relative fitness, of which one essential aspect is his readiness to acquire profieiency - his potential ability - and another is his readiness to develop an interest in exercising that ability"

ASSUMPTIONS IMPLIED IN THE CONCEPT OF APTITUDE

The concept of aptitude carries within it certain assumptions. The facts of human nature, as also the three generalisations of differential psychology, justify them.

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1 Hull, C.L., "Aptitude Testing", Yonker, N. Y., World Book Co., 1928, p. 26.

These assumptions are:

(a) Individual Differences: The trait is constant; the individuals differ in the amount of it possessed by each.

(b) Trait Differences: It should also be considered how the various traits or talents possessed by an individual differ in amount. Here the individual is constant, but the magnitudes of his various traits differ.

(c) Many of these differences are relatively stable: They tend to persist. Any changes subsequently taking place in an individual's potentialities occur within limits imposed by his present constitution.

A. Individual Differences:

The subject of individual differences has been investigated very extensively for many years. As a result a great deal is known about this phase of differential psychology.

Because all human beings have a common biological nature, they have some characteristics in common. Within a given culture, certain other characteristics are quite typical as a result of customs and patterns of training. Individual differences occur because of variations in heredity and environment and the interaction between these factors. -

Individuals, therefore, differ widely in any given personality trait - ability, achievement, interest. In each measurable trait, the scores or ratings of individuals tend to be distributed according to the normal curve.

Another important result which has come from the investigation of individual differences is an indication as to the magnitude of the differences which may exist in a given trait between the best and the poorest individuals in a normal population. Hull[1] writes,

> We shall probably not be in great error if we conclude that among individuals ordinarily regarded as normal, in the average vocation the most gifted will be between three and four times as capable as the poorest.

B. Trait Differences:

Individuals rarely rank consistently high or consistently low in all traits. Instead, they usually show some degree of variation in their rankings in different areas of aptitudes, achievements, interests, and other traits. That there are usually wide inequalities among an individual's various talents can scarcely be questioned. There need be little argument on this point.

To distinguish these differences from individual differences, they are termed as "trait differences" (within the individual) or "intra - individual differences". Despite

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1 Hull, C. L., Op. Cit., p. 36.

the fact that trait differences have received scant attention in works on differential psychology, it can be shown that they are for the masses of mankind of far greater significance than individual differences.

The question really of importance is only as to the size of these trait differences. By what amounts do an individual's best and worst capacities differ from his own average?

Hull[1], after reviewing the evidence on this point, arrived at the conclusion that ,

> The best person in a normal group is between three and four times as efficient as the poorest. If the variability within the individual is 80 per cent as great as that, then the average individual's best vocational potentiality must be between two and one-half and three times as good as his worst.

Another point about trait differences that needs clarification is about the nature of the distribution of the trait magnitudes within the individual. Regarding this question again Hull[2] says,

> The indication is clear that the distribution of talent within an individual follows the normal law much as do the distributions of individual differences.

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1 Hull, C. L., Op.Cit., p. 49.

2 Ibid., p. 46.

Bingham[1] utters a word of caution against accepting Hull's conclusions in toto. He says,

> Such quantitative estimates are necessarily very tentative. Only a sampling of the numerous distinguishable vocational aptitudes have as yet been measured with any degree of precision.....But even if Hull's estimate should turn out to be somewhat too large, the fact would nevertheless remain that a person's chances of satisfactory occupational adjustment are notably heightened when he comes to realise what his different abilities are and prepares for an occupation in which his best potentialities may find full scope.

C. Are these differences persistent?

The theory of aptitude implies that a person's potentialities are fairly stable.

If behaviour or success is to be predicted, the entity upon which the prediction is based should be relatively stable. An aptitude which varied irrationally from one day, month, or year to the next would not provide a sound basis for predicting achievement at some further date. To put it statistically, an aptitude which is itself unreliable could be neither reliably measured nor significantly correlated with anything else.

About the constancy of traits Super[2] writes,

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1 Bingham, W. V., Op.Cit., p. 32.

2 Super, D. E., Op.Cit., p. 61.

> Whether largely innate or largely acquired, the aptitudes, about which we know something appear to become crystalized in early childhood and that after that they are relatively constant.

Bingham[1] in concluding the discussion on constancy of traits, remarks,

> A theory of aptitude must not assume that each of the factors determining a person's traits is constant in the sense that it will not alter, more or less, with time. We must, however, assume - if the concept of educational and vocational aptitudes is to have any meaning at all - that the changes which undoubtedly do take place in the relative potency of these factors are seldom sudden, and that they occur within limits which can often be ascertained in advance.

The investigator feels that Bingham's views regarding constancy of traits are plausible and may be accepted as far as the present work is concerned.

From the above discussion, it can safely be concluded that (i) individuals differ from one another, (ii) an individual differs within himself and (iii) these differences are, within limits, constant. These findings enable one to measure aptitudes.

APTITUDE TESTING

It is upon differential psychology that aptitude testing mainly depends. Besides, the invention of the method

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1 Bingham, W. V., Op.Cit., p. 33.

of computing the correlation coefficient came at a most opportune moment for the development of aptitude testing. Pearson's formula enabled the investigators to state in definite and objective terms for any given set of data not only that correlations existed, but exactly how strong the tendency was. Wissler's study was one of the first important investigations to utilise the new tool. Without it, the science of aptitude testing in its present form would have been inconceivable.

An aptitude test is a test designed to discover what potentiality a given person has for learning some particular vocation or acquiring some particular skill. Or in other words, aptitude tests measure abilities and interests. In Bingham's[1] words,

> They ascertain what an individual actually does in certain standardised situations, and from these measurements the estimate of capacity for future accomplishment is an inference - a statistical probability, not a certainty. Moreover, tests cannot sample all the important aspects of behaviour, nor plumb the depths of vocational purpose. Even with full data at hand, an inquirer's questions regarding his aptitudes can rarely be answered precisely and with positive assurance.

The main function of standardised tests of aptitudes is, therefore, to help in estimating the probabilities that a person would be able to follow successfully an occupation he is considering.

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1 Bingham, W. V., Op.Cit., p. 11.

A test of aptitude samples certain abilities and characteristics of the individual as he is to-day. It helps to find out what he can do now and how well he can do it. The responses he makes under specified conditions are ascertained - specimens of his performance when motivated in prescribed ways. By such means, data are secured as to what the person actually does under the circumstances imposed by the test. His behaviour is measured. From these symptoms, any estimate of his future possibilities of accomplishment is an inference.

Aptitude tests may be divided into alternative groups from a number of different points of view. One of the most important of these alternatives relates to the specificity of the aptitude aimed at. On this basis, the tests may be divided into two parts: (i) those designed to detect specific or particular aptitudes and (ii) those designed to detect general or average aptitudes.

There is hardly an aptitude test composed of a single test unit in use at the present time. Batteries are practically the universal form of aptitude test.

NEED OF APTITUDE TESTING

It has been found through researches that the aptitudes crystalise quite early in life, almost by the time the boy or girl reaches the age of 15+. During the school stage, therefore, it is possible to know the aptitudes of a boy or a girl through his or her participation in various activities and

through the aptitude tests which the psychologists and education -al workers have evolved.

If a person's capacity could be measured or at least estimated before he begins a course of training, much wasted effort could be spared. Many young men aspire to be engineers, doctors or professors but many of them fail miserably even during the early years of studies. The more accurately their capacity for such professions is known in advance of their taking up such studies, the better for all concerned. Some students do not have sufficient capacity to complete college work; if they could be spotted before college entrance and advised to follow another line, much time, money and effort would be saved.

Aptitudes are, thus, very important for a person's choice of vocation and his efficiency in the job. If a person chooses a vocation befitting his aptitudes he proves successful in his job and he gets chances of promotion. Success in the job in turn has a great influence on the individual's personality. If an individual proves inefficient in his job, it has an adverse effect on his emotional life, and he is likely to be maladjusted. Thus aptitudes play a very important part in the development of an individual's personality.

At all times, it is vital that each young citizen be adequately prepared to fit into the world of work. If the wrong youngsters aspire to particular skilled trades, society is wasting its human assets. A wrong placement of an individual in any trade, thus, causes a huge waste of time, money and

labour to both the employers and the employees and ultimately to the society. Society needs to save or at least reduce, this loss of human productivity and its attendant crushing of the human spirit. Through aptitude testing, and thereby through right placement of personnel in different vocations, much of this loss might be saved. The importance of aptitude testing cannot, therefore, be questioned in any way. The need of aptitude testing is above discussion.

HISTORICAL BACKGROUND OF APTITUDE TESTING

The conception of specialised aptitudes and the desirability of having tests of behaviour, which will indicate in advance latent capacity, is very ancient. As quoted by Hull,[1] it appears repeatedly in Plato's Republic.

> Plato seems to have regarded it as of considerable importance in the conduct of an ideal state. Plato proposed that persons being considered for the military profession should be given "actions to perform" which would test the retentiveness of their memories, their power of resistance to deceptions, of resistance to timidity and fear in terrifying situations, and to the seductions of pleasure.

Plato, thus, sketched forth very definitely a set of tests for military aptitude. Some twenty three hundred years later the dream conceived by the Greek genius was realised in the United States army mental tests.

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1 Hull, C. L., Op.Cit., pp. 5-6.

Really speaking, the past fifty years have seen the birth, childhood and coming of age of objective aptitude tests as devices for personnel selection. Tests of this sort came into prominence at the time of World War I.

Just as World War I provided the impetus for large numbers of group intelligence tests, so World War II stimulated the production of aptitude batteries. The prewar Primary Mental Abilities batteries were followed shortly after the war by the General Aptitude Test Battery (G.A.T.B.), the Differential Aptitude Tests (D.A.T.), and the Guilford-Zimmerman Aptitude Survey.

The following other important aptitude test batteries are published also.:

(1) Roeder and Graham's Aptitude Tests for Occupations.

(2) Segel and Raskin's Multiple Aptitude Tests.

(3) Holzinger-Crowder Uni-Factor Tests.

(4) Flanagan Aptitude Classification Tests.

(5) Factored Aptitude Series (by Joseph King).

(6) Scholastic Aptitude Tests.

To conclude this discussion, we may quote Green,

Jorgensen and Gerberich.[1] They write,

> Münsterberg's aptitude tests for telephone girls and street-car motormen in 1913 were followed by tests of mechanical aptitude, musical aptitude, art aptitude, clerical aptitude, and aptitude for various subjects of the high-school and college curricula prior to 1930.

Aptitude tests for teaching are discussed in the next chapter.

FORECASTING ABILITY OF AN APTITUDE TEST

The ultimate purpose of using aptitude tests is to estimate or forecast aptitudes from test scores. A test which does this with a slight error is a good test. A test which does this with much error is a poor test.

As Hull[2] says,

> The simple and natural percentage concept of test efficiency is closely related to the correlation coefficient .....when the correlation is known, the forecasting efficiency of a battery may be calculated at once.

The formula is:

$$E = 1 - \sqrt{1 - R^2}$$

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1 Greene, H.A., Jorgensen, A.N., & Gerberich, J.R., "Measurement and Evaluation in the Secondary School", Longmans, Green & Co., New York, 1955, p. 31.

2 Hull, C. L., Op.Cit., p. 268.

Where

E = the percent of perfect forecasting efficiency of a test battery in predicting its aptitude criterion.

R = coefficient of correlation between the test battery and the criterion.

Or in other words, the significance of a coefficient of correlation between the test-battery and the criterion is judged by its predictive value.

Hull[1] gives the following table to readily translate the correlation values into equivalent forecasting-efficiency values.

TABLE NO. 2

SHOWING THE RELATION OF THE CORRELATION COEFFICIENT (R) TO THE PER CENT OF FORECASTING EFFICIENCY (E)

R	E
0.10	0.5%
0.20	2 %
0.30	5 %
0.40	8 %
0.50	13 %
0.60	20 %
0.70	29 %
0.80	40 %
0.90	56 %
0.95	69 %
0.98	80 %
1.00	100%

Correlations between single test units and important

1 Hull, C. L., Op.Cit., p. 273.

aptitudes rarely run higher than 0.45 or 0.50. Test batteries rarely correlate with aptitudes higher than 0.65 or 0.70.

It can, thus, be seen that the best test-battery having a coefficient of correlation 0.70 with the criterion has the forecasting efficiency of about 29 per cent. This indicates how much useful is even the best aptitude-test-battery in predicting success in the vocation concerned. It may, therefore, be inferred that an aptitude test-battery would not be much reliably useful in vocational selection or vocational guidance. But this situation should not sound a note of disappointment. It is better to know a person's capacity to the extent of even 30 per cent and give him guidance rather than guide him on sheer guessing and on purely subjective decisions as to his capacity.