Chapter II

NATURE OF INTELLIGENCE

According to Cyril Burt (1955), the term intelligence goes back to 'intelligentia' a term introduced by Cicero. Spearman reported that the 'monarchic' view of a unitary thing called intelligence was popular as far back as fifteenth century. Both writers credit the bringing of this term into psychology to Herbert Spencer who had earlier emphasised its importance in biology. According to him life is a continuous process of adjustment of internal relations to external relations and he believed that it is accomplished by virtue of intelligence in man and by virtue of instincts in animals. More serious discussions about the nature of intelligence started after Binet, working in collaboration with Simon, constructed his first test of intelligence in 1905.

After tests had been invented to measure intelligence, quite a number of thinkers felt the urge to define it. In the famous symposium of 1921 an attempt was made to evolve an acceptable definition of intelligence. Editors of an American Journal (Rugg, et al 1921) submitted two searching questions about the nature of intelligence to leading psychologists. As the editorial letter shows the purpose of the discussion was primarily a practical one - to determine how intelligence appears to operate with a view to ascertaining what material might profitably be used in constructing the tests. The outcomes, though good theoretical discussions, were far from agreement. Different psychologists emphasised different
view points regarding the nature of intelligence.

Terman (1921) considered intelligence as the ability to carry on abstract thinking. According to Dearborn (1921) it was the ability to learn. Whereas to Colvin (1921) intelligence is the ability to adjust to the environment. Definitions given by other psychologists were nearer to one or the other of these three just mentioned. As Freeman (1955) has argued the three definitions do not, and, in fact cannot be exclusive. The only difference which seems apparent is that their authors seem to have laid more emphasis on different aspects of intelligence. One can be derived from the other. They are, thus, not independent of each other. But this could not be of much help to test constructors as there was no agreement on the behaviour through which it was manifested best.

One serious weakness of most definitions of intelligence is that they contain undefined or often undefinable terms.
The realisation of this weakness paved the way to what is called operational definition which contains referents in the real world or must point unambiguously to something that points to referents in the real world. The behaviours or operations through which intelligence is manifested should be listed in as clear and comprehensive manner as possible. Instead of asking "What is intelligence?" or "What does intelligence really mean?" One may ask, "How do you measure intelligence?" or "What operations are involved in testing intelligence?" It is
often said that intelligence is what intelligence tests measure. This type of interpretation may not tell us what test items are good ones but it certainly tells us what we are measuring by applying a particular test of intelligence. This approach seems to be fundamentally sound and a great improvement on the traditional search for "What intelligence really is?".

With Binet's heroic success in developing tests which stood the test of time in measuring intelligence, psychologists started attempting to offer more scientific explanations of the nature of intelligence with the help of mathematical models. There was a remarkable parallel, during the first several years of this century between the work of Binet in France and Spearman in England. Binet and Spearman stressed the importance of a general factor of intellectual ability. But Binet was more pragmatic in his approach. As he was commissioned by French Government for identifying in schools mentally deficient children who could be benefitted from remedial instruction, he turned from investigating the elements of human ability to investigating the use of a global measure of intellectual ability or 'intelligence'. Spearman, on the contrary, was more concerned with understanding human abilities than just measuring them. He asserted the presence of general factor 'g' hypothesis to be tested. He invented factor analysis to suit his mathematical models for proving his hypothesis and gave his famous two factor theory - general factor 'g' and the factor 's' specific to the test. Later on, Spearman had to
recognise that something in addition to 'g' is helping to produce correlation coefficients and this something is a different additional component in different groups of tests; hence he recognised 'group' factors.

Thurstone and Guilford felt that general intelligence was too vague and heterogeneous a construct to be worth measuring. They thought of breaking it into components and measure each individual's profile of factors. They supported their thinking by conducting factor-analytic studies.

Thurstone in thirties undertook several studies to understand the human abilities on college and school students. In one, undertaken on large scale, he employed 60 tests most of which were developed for the purpose. This consisted of 1,154 eighth grade children from 15 schools. The factor analysis was carried out by centroid method. Inspection of the rotated factorial matrix showed seven factors (primary abilities): memory, induction, verbal comprehension, word fluency, number, space, perceptual speed and three less easily identifiable factors. No general factor as distinct from primary factors was found but the second order general factor was identified which they preferred to name as Spearman's independent general factor.

Since the monumental work of Thurstone emphasis shifted at least in America, from general intelligence to aptitudes. Many aptitude tests were consequently developed during 1940s. Up through 1950, it could be reported that there were as many as 40 well established factors of abilities. French (1951)
gave detailed description of these factors. Even after this long list of factors based on French's survey, number of factors has continued to grow. In recent times the work on human abilities by Guilford (1965) and his associates is of supreme importance.

Although each factor is sufficiently distinct to be detected by factor-analysis, it has become apparent that factors themselves can be classified because they resemble one another in certain ways. One basis of classification is according to the basic kind of process or operation performed. This kind of classification gives major groups of intellectual abilities.

A second way of classifying the intellectual factors is according to the kind of material or content involved. The content may be figural, symbolic or semantic. With these three kinds of content well supported, a fourth kind of content 'behaviour' was added purely on theoretical basis to represent the general area sometimes called 'social intelligence' as originally proposed by Thorndike (1927).

When a certain operation is applied to a certain kind of content, as many as six general kinds of products may be involved. As such they may serve as basic classes into which one might fit all kinds of information psychologically.

The three kinds of classifications of the factors of intellect can be represented by means of a single solid model, in which each dimension represents one of the modes of variation of the factors (Guilford 1959, 1966).

Eysenck (1966) finds this model inadequate on the ground that it fails to reproduce the essential hierarchical nature of
The one outstanding fact which recurs again and again in all analysis is the universality of positive correlations among all relevant tests, and the positive correlations between different factors (McNemar 1964). Bysenck (1967) has preference for his own model of intellect which he presented in 1953. He compares his 'mental processes' with Guilford's 'operations', his 'test material' with 'contents', so far there is agreement. Instead of Guilford's third dimension of 'products' he prefers 'quality' in which he wants to incorporate concepts of mental speed and power. He maintains that this would provide retention of 'g' concept in a hierarchical structure in which the major source of variation is mental speed, averaged over all processes and materials. Primary mental abilities would then emerge at a lower level of generality, and be related to different processes and different materials used.

Followers of Spearman have held tenaciously to the 'g' factor, but they have given relatively more attention to group factors. As the newly discovered factors increased in number, the need for putting them into some kind of logical interrelationship became a recognised problem. Cyril Burt (1949) was one of the first to attempt this kind of exercise.

He conceived of a hierarchical type of model. The model applies to the whole of the human mind, with the first major dichotomy between intellectual characteristics or 'g', and 'practical' or behavioural characteristics. Among the practical abilities he places psychomotor abilities and abilities for dealing with space and mechanical affairs.
Burt (1949) conceived of an ideal hierarchy with dichotomies, each subdivision of a higher factor to give two immediately lower. The various levels of bifurcation he identified as "relations" at the highest level, "association" at the second level, "perceptions" at the third, and "sensation" at the fourth. In fitting group factors into the model, however, Burt had to depart from strict dichotomization, for many subcategories contain more than two factors.

Vernon gave in 1950 his hierarchical conception of aptitude factors. Under 'g' are two major factors, v: ed, for verbal educational on the one hand and k: m on the other. The later is called "practical", as in the Burt model. The former v: ed, subdivides into verbal and numerical, while the latter, k: m, subdivides into three ways, spatial ability, manual ability, and mechanical information. Beyond these are specific factors, each of very narrow scope and considered by Vernon to be of trivial importance. Presumably, many of what Burt recognises as small group factors belong in this category.

Brief account of factor analytic studies about the nature of human abilities shows that there are two main rival schools with equal vigour. One side denied the existence of any genuine group factors, the other proposed to discard the general factor. Both seem to have taken the extreme stands although experimental data do not support these extreme positions.

As mentioned earlier Spearman had to recognise that additional component in different groups of tests was necessary to explain the correlations between them. He thus recognised
'group' factors. Spearman never gave much importance to the group factors however, although the group factors that he identified and interpreted psychologically appear to bear much resemblance to some of the multiple factors found by other factorists.

With Thurstone's primaries also the trouble arises because any of these can be endlessly fractioned depending upon the number and variety of tests and, according to Vernon, on the homogeneity-restriction in the range of 'g' in the population tested. McNemar (1964) criticised the multiple factorists fragmentation of ability, into more and more factors of less and less importance. He was favouring 'g' when he remarked that substantial positive intercorrelations are found when any cognitive tests are applied to a fairly representative population.

Many investigators, notably Brown (1933), Thomson (1939), and more recently Thurstone (1947), have argued that, if we accept the existence of group factors or primary abilities, we can dispense with the hypothesis of a general factor by assuming that the group factors overlap. But this solution has proved unworkable in theory and in practice (Burt 1955). When a general factor accounts for much more of the variance than any single group factor or indeed than all the group factors put together, there is no theoretical gain in closing one's eyes to its presence.

Brown (1933) ultimately acknowledged that "the evidence for a general factor now seems conclusive". Thomson (1939)
himself has contracted numerous booklets for testing intelligence. And Thurstone (1947) has proposed a scheme of second-order factors which shall expressly include a 'general factor'.

While advocating the presence of 'g' Burt (1955) admits that well over a dozen of factors which he prefers to call supplementary factors, seem to have been plainly established. These showed varying degrees of generality, and almost every one appeared to be divisible into more specialised factors. Thus the whole set of factors could perhaps be arranged in a rough hierarchical scheme.

Bernyier (1958) prefers a compromising approach and says that despite certain differences in analytic technique and interpretation of factors the hierarchical model and the multiple factor model are fundamentally in agreement. It is just legitimate to start, as it were from the bottom upwards - that is to extract primaries - and from their intercorrelations calculate the second order factors and if need be a third order factor, corresponding to our major group factors and 'g'. He has shown that the two approaches can yield almost identical results.

McNemar (1964) apprehends that it may take, a long time before the question of primaries and 'g' is finally and scientifically solved. Till that time he suggests that we may have to turn to the criterion of social usefulness as a basis for judging whether it is wise to discard general intelligence. Much of our heritage in this area is that earlier workers, from Binet on had as their motivation the solution of social
problems, and currently many in the area have a similar motivation.

It would probably be recognition to the reality in the field of cognitive abilities if we admit the presence of a general intelligence factor so strongly advocated by Galton, Spearman, Burt, Vernon and McNemar and less willingly admitted by Thomoson, Brown and Thurstone. But at the same time intelligence has many aspects which can usefully be represented, as Thurstone did, in terms of partially distinct though overlapping factors. This approach would well meet the criterion of social usefulness too.
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