CHAPTEr - VII

ACD DIVERSES IN GF AND Co
In most of the early studies of age differences the common practice had been to add together scores obtained from diverse kinds of intellectual tasks to get a single score to represent, operationally, a concept of general intelligence. If the diverse kinds of sub-tests used in these tests do not form a functional unity, then the studies of age differences in the scores obtained by these tests can be quite misleading. Indeed, there is enough evidence (Anastasi, 1958; Burt, 1949; French, 1951; French, Ekstrom, and Price, 1963; Guilford, 1959; Guilford and Merrifield, 1960; Tyler, 1956; and Vernon, 1950) to suggest that the diverse tasks used in the tests of general intelligence mostly lack functional unity. The mixtures of these distinct functions in the widely used tests of intelligence vary from one test to another and also in the same test for different age levels (Gayley, 1955; 1957; Horn, 1963). The relationship between age and the level of intelligence would depend upon the particular mixture of kinds of intellectual tasks included in the test of general intelligence.

In a few other sophisticated studies (Hofstaetter, 1954; Horn, 1965; Jones, 1959; Kamin, 1957; Schae
Rosenthal and Herlmann, 1953) an attempt has also been made to find the effect of aging on some primary abilities. Their findings suggest that the primary abilities represented in tests of general intelligence do indeed have different patterns of relationship to aging. In most of these studies mental abilities have been estimated with a score obtained on a single kind of task for each ability. Horn and Cattell (1966b) maintain that a single kind of task, whether specifically chosen to measure a common factor or not, is due to more than one factor, i.e., tasks are rarely, if ever, common-factor pure. The impurity in these measures would permit wrong inferences.

This confusion, however, can be cleared up by accepting Cattell's (1963a) classification of fluid and crystallized intelligence and measuring each one of them by a large number of tests. Such an attempt was made by Horn and Cattell (1966b).

The present study is also on the lines of Horn and Cattell (1966b). Here, four measures of fluid and seven measures of crystallized intelligence are used. The growth patterns of these abilities have been expressed by comparing the mean performance of different age groups on different measures of fluid and crystallized ability.

The following hypotheses as stated earlier are proposed:
1. The means for different age levels for the measures of Gf would not increase in adulthood, but instead would usually decrease from the late teens onwards.

2. The means at different age levels for measures of Gc would continue to increase in adulthood.

3. Ability tests, which have a variance split up mostly between Gf and Gc, would show a variable relationship to aging.

METHOD

Tests

The tests used in this study are (1) Cattell (1962) Culture-Fair-Intelligence Test Scale 3, Form A. (2) Jalota (1960) Group Test of General Mental Ability. A brief description of the tests follows.

Cattell Culture Fair Test, Scale 3, Form A

The test is meant for high school students and for adults. It consists of 50 items divided into sub-tests, i.e., series, classification, matrices, and topology. As in case of Scale 2 each sub-test is separately timed. The test items pose new problems and are unassociated with early learning.

The authors (1959) have reported a test-retest (long-time) reliability to be of the order of .78 and
Homogeneity Coefficients (as a split-half, corrected to full length) ranging from .82 to .91 for different samples. Similar results have been reported from some other samples. The mean correlation of this test with general achievement as reported is .61 (N = 53, 191 and 155). High correlation between four sub-tests and 'g' have also been reported. Studies in India (Hundal and Gupta, 1967; Jerath, 1970; Sidhu, 1969; Sudhakar, 1969) also show that this test is a dependable measure of the intelligence of Indian students.

**Group Test of General Mental Ability**

It is a verbal group test in Hindi designed to measure the General Mental Ability of adults, with seven sub-tests of Analogies, Number Series, Classification, Inferences, Following Directions, Opposites, and Synonyms. In all there are a hundred items arranged spirally in an ascending order of difficulty. It is a widely used test in India. Studies quoted in the manual of the test (Jalota, 1964) show that it is a fairly reliable and valid test for measuring intelligence of the Hindi knowing college students and adults. The test items are associated with formal and informal learning in school and society. As such it can be regarded as an instrument for measuring crystallized intelligence (Gc).

**Subjects**

Five hundred and sixty six subjects were randomly
drawn from the schools of Haryana State to provide the data for this study. Only those subjects were included in the sample who had their roots in the rural areas of Haryana State and belonged to middle and lower middle socioeconomic strata. Teacher as well as student samples were taken from the same schools.

For the purpose of analysis, the subjects were divided into eight groupings. The early period (14-21) considered as the period of intellectual growth was divided into four age groups, i.e., 14 to 15 years (N = 119), 16 to 17 (N = 85), 18 to 19 (N = 72), 20 to 21 (N = 72). The other groupings are 22 to 23 (N = 62), 24 to 29 (N = 94), 30 to 39 (N = 48), 40 to 54 (N = 47). Thus, in each age group there are enough subjects to yield reasonably stable statistics.

The administration and scoring of the test was the same as in first study except for the fact that in case of teachers, the groups were rather small (varying from 5 to 10 subjects).

RESULTS AND DISCUSSION

The means at eight age levels for each test of Gf and Gc are reported in Table 25. The salient features of these results are also depicted graphically (Figs. 4 and 5).
<table>
<thead>
<tr>
<th>Sub-test</th>
<th>14-15</th>
<th>16-17</th>
<th>18-19</th>
<th>20-21</th>
<th>22-23</th>
<th>24-29</th>
<th>30-39</th>
<th>40-54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Se.</td>
<td>4.0</td>
<td>4.3</td>
<td>4.7</td>
<td>5.3</td>
<td>5.1</td>
<td>4.6</td>
<td>4.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Cf</td>
<td>3.1</td>
<td>3.3</td>
<td>3.5</td>
<td>4.0</td>
<td>4.2</td>
<td>3.6</td>
<td>2.8</td>
<td>2.4</td>
</tr>
<tr>
<td>M</td>
<td>2.8</td>
<td>3.0</td>
<td>3.1</td>
<td>3.4</td>
<td>3.2</td>
<td>3.0</td>
<td>2.7</td>
<td>2.2</td>
</tr>
<tr>
<td>T</td>
<td>3.0</td>
<td>3.1</td>
<td>3.7</td>
<td>4.1</td>
<td>4.1</td>
<td>3.9</td>
<td>3.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Mean</td>
<td>12.9</td>
<td>13.7</td>
<td>15.0</td>
<td>16.8</td>
<td>16.6</td>
<td>15.1</td>
<td>13.4</td>
<td>11.3</td>
</tr>
<tr>
<td>N. S.</td>
<td>9.0</td>
<td>9.3</td>
<td>9.4</td>
<td>10.5</td>
<td>11.0</td>
<td>11.2</td>
<td>10.0</td>
<td>9.2</td>
</tr>
<tr>
<td>Ana.</td>
<td>6.2</td>
<td>6.5</td>
<td>6.9</td>
<td>7.9</td>
<td>8.1</td>
<td>8.3</td>
<td>8.2</td>
<td>8.0</td>
</tr>
<tr>
<td>C_v</td>
<td>8.2</td>
<td>9.2</td>
<td>9.9</td>
<td>10.8</td>
<td>10.9</td>
<td>11.0</td>
<td>11.2</td>
<td>10.5</td>
</tr>
<tr>
<td>Inf.</td>
<td>3.5</td>
<td>3.8</td>
<td>4.2</td>
<td>5.2</td>
<td>5.2</td>
<td>5.3</td>
<td>5.3</td>
<td>5.1</td>
</tr>
<tr>
<td>FD</td>
<td>3.3</td>
<td>3.5</td>
<td>3.5</td>
<td>3.8</td>
<td>3.9</td>
<td>4.2</td>
<td>4.4</td>
<td>4.0</td>
</tr>
<tr>
<td>Opp.</td>
<td>5.1</td>
<td>5.1</td>
<td>5.5</td>
<td>6.0</td>
<td>6.2</td>
<td>6.5</td>
<td>6.5</td>
<td>6.2</td>
</tr>
<tr>
<td>Sy.</td>
<td>4.9</td>
<td>5.0</td>
<td>5.1</td>
<td>5.7</td>
<td>5.7</td>
<td>6.1</td>
<td>6.0</td>
<td>5.7</td>
</tr>
<tr>
<td>Mean</td>
<td>40.2</td>
<td>42.4</td>
<td>44.5</td>
<td>49.9</td>
<td>51.0</td>
<td>52.6</td>
<td>51.6</td>
<td>48.7</td>
</tr>
<tr>
<td>Grand Mean*</td>
<td>53.1</td>
<td>56.1</td>
<td>59.5</td>
<td>66.7</td>
<td>67.6</td>
<td>67.7</td>
<td>65.0</td>
<td>60.0</td>
</tr>
</tbody>
</table>

* Means of all the Gf and Gc measures have been combined to get the grand mean.
PERFORMANCE AS FUNCTION OF AGE: $G_f, G_c, G_f + G_c$

FIG. G
PERFORMANCE AS FUNCTION OF AGE: CRYSTALLIZED ABILITIES

FIG. 5

Following Direction (FD), Opposites (Opp), Analogy (NA), Classification (Clc) and Inferences (Inf)

Number series (NS) and Synonyms (Syn)
PERFORMANCE AS FUNCTION OF AGE: FLUID ABILITIES.

SERIES (ST), CLASSIFICATION (CF), MATRICES (M), Tопология (T).

PERFORMANCE AS FUNCTION OF AGE: FLUID ABILITIES.

FIG. 4
Here, following a technique suggested by Horn and Cattell (1966b), the means for four tests of Gf and seven tests of Gc at each age level are expressed as a proportion of their respective means for the age group scoring highest (on the average) on Gf or Gc tests. The age variations on the sub-tests are thus expressed on a common scale and the sub-test comparisons become more meaningful. In Figure 4, for example, the sum of means for the four tests of Gf is higher for 20-21 years age group than for any other age group, so the means for all other groups are then expressed as a proportion of the mean (on a given Gf test) for the 20-21 years group.

The results indicate that:

The abilities classified as "fluid" have a different pattern of association with age than have the abilities classified as "crystallized". It is apparent that the fluid abilities do not reach full development until 21 - 22 years of age but a steady decline begins thereafter, whereas crystallized abilities improve up to the age of 30 to 39 on most of the tests. This confirms our first and second hypotheses.

The rate of decline in the performance on tests of Gc as indicated by the slope of the curves, is very slow when compared with that of Gf measures. It is also clear
that the rate of growth as expressed by the steep gradient of the curves also differs for Gf and Gc measures. The difference becomes far more marked after the age of 16 years.

Further, the rate of growth or decline among the sub-tests of Gc as also among the sub-tests of Gf differs somewhat. In the case of "Number Series" the peak performance is between 24 - 29 years, whereas the performance on "Following Direction" and "Classification" goes on increasing upto 39 years or beyond. The decline is steep in the case of "Number Series", whereas it is slow in the case of all other tests. The average performance on the "Classification" test of Gf continues to increase upto the 23 - 24 years age level, whereas on all other tests in this category the peak performance is reached at the age of 21 - 22 years. Further, the rate of decline in "Classification" test of Gf is much faster as compared with other tests of Gf.

For checking the third hypothesis the grand means obtained by combining the scores on the Gf and Gc measures for each of the eight age groups were computed (Table 25) and expressed graphically as a proportion of the highest mean (Fig. 6). It is evident from the trend of the graph that the mean scores of the combined Gf and Gc tests continue to grow upto the 20 - 21 years age level,
virtually remains constant till the 24 - 29 years age level, and declines slowly thereafter. It seems that intelligence neither grows nor declines from 21 to 29 years of age. This, however, is an artifact of combining the scores from Gf and Gc tests. Over this period the decline in Gf is compensated by the increase in Gc. Thus the tests that measure a mixture of fluid and crystallized intelligence show a varying relationship between aging and intelligence in adulthood. If fluid tests predominate, decline is indicated. If crystallized intelligence is well represented, then there is no apparent decline.

The results from this investigation clearly confirm the findings of Horn and Cattell (1966b). They also explain that the contradictory results from previous studies were due to the lack of distinction between Gf and Gc. In most of the earlier studies the investigators had employed tests containing a mixture of Gf and Gc. The pattern of growth or decline in such studies was determined by dominance of Gf or Gc saturation in the test battery. When the ability test composed largely of Gf or single primary sub-test with most of its variance in Gf is used, then the decline of intelligence with aging will very likely be found. Results of this kind have been reported by Foulds and Raven (1948) and Raven (1948), each using the matrices sub-test as a measure of intelligence and by
Coren and Rosner (1953), Kettel (1958), Wechsler (1944), and others, employing measurements such as those given by the so-called performance sub-tests of the Wechsler scales. On the other hand, if the mental ability test is composed largely of Cc primaries, studies using this test will show that intelligence improves in adulthood. This is the kind of interpretation implied by studies in which vocabulary alone has been taken as a measure of intelligence and by studies such as those of Hayley and Oden (1955), Bradway and Thompson (1962), and Evans (1953), in which Cc saturated tests have been used. But the present investigation has shown that when past results are organized in accordance with the principal of two major intelligences, fluid and crystallized, the apparent contradictions between outcomes largely disappear. Whether or not intelligence declines or improves or does not change in adulthood depends upon whether one is concerned primarily with Cf, with Cc, or with some combination of the two.

The inferences are based upon averages computed for the eight age levels and as such may not at all represent the development of a particular individual and need not indicate that change is intrinsic to an aging process. The decline could as well be due to hazards of living which would impair the central nervous system more frequently in the samples of older individuals.