CHAPTER-IV
DESIGN AND METHODOLOGY

It is clear from the preceding discussion in Chapter I (Introduction) and Chapter II (Historical resume) that variation in intelligence are caused by genetic and environmental factors. It is also clear from this discussion (Chapter I and II) that if subjects differ in their genetic endowment then they will score differently on standard measures of intelligence.

The present investigation is a family study. In this study an attempt has been made to investigate the relationship between genetic similarity and intelligence. For this a family study design was adopted.

Table I : Shows the Design and Number of Subjects in Each Group.

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biologically related group</td>
<td>Mixed/Random group</td>
</tr>
<tr>
<td>35 pairs of parent-offspring (2x2) and siblings</td>
<td>35 random pairs of men/women-Boys/Girls (2x2) and Boys-Girls</td>
</tr>
</tbody>
</table>

Design for sample varying in inheritance.

<table>
<thead>
<tr>
<th>Expected inheritance</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.50</td>
<td>0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample description</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
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<td>Mixed/random group</td>
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<td></td>
</tr>
</tbody>
</table>
SAMPLE:

Present study was conducted on a total no. of 280 subjects selected from Rohtak City. Subjects were selected by a non random (purposive) sampling procedure. The total population of the city was divided into four geographical regions out of which two were randomly selected and from these two selected regions this sample was drawn. Subjects were equated on age, socio-economic status, educational level and residence i.e. urban.

Table II : Mean, S.D. and CR of the difference between the SES Scores of the Two groups.

<table>
<thead>
<tr>
<th></th>
<th>Biologically related Group</th>
<th>Mixed(Random Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>188</td>
<td>186</td>
</tr>
<tr>
<td>SD</td>
<td>25.56</td>
<td>20.19</td>
</tr>
<tr>
<td>C.R.</td>
<td>.3633</td>
<td>(p&lt;.05)</td>
</tr>
</tbody>
</table>

The SES of both the groups was determined using the SES scale of Kulshretha and Day (1972). The SES scale was given to the parents and offsprings and on the basis of the information filled in their SES was determined (biologically related group). In case of the mixed/random group the men and women as well as the boys and girls were asked to fill in the information in the SES scale and the SES score obtained by the men/women and Boys/girls, were added and average scores were taken as a measure
of their SES. And this was compared with the SES of the biological group, (Table-II). The mean and standard deviations of (Table-II) the SES scores were 188 and 186 with SD of 25.56 and 20.19 respectively for the biologically related group and mixed/random group. The difference between non random and randomly selected pairs were found to be non significant (CR = .3633 NS).

Table III: Mean, SD and CR of Scores (age in years) of the two groups:

<table>
<thead>
<tr>
<th></th>
<th>Biologically related group</th>
<th>Mixed/Random Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>Father</td>
<td>35</td>
<td>49.54</td>
</tr>
<tr>
<td>Mother</td>
<td>35</td>
<td>45.77</td>
</tr>
<tr>
<td>Son</td>
<td>35</td>
<td>20.43</td>
</tr>
<tr>
<td>Daughter</td>
<td>35</td>
<td>20.80</td>
</tr>
</tbody>
</table>

In biologically related group the mean age of Father was 49.54 years with an SD of 3.45 and for mothers was 45.77 years with an SD of 3.55 (Table-III). The modal educational standard of fathers was B.A. to M.A. and 10th to M.A., for the mothers. The mean age of Son, was 20.43 years with an SD of 2.54 and the daughters was 20.80 years with an SD of 2.34. The modal educational standard of sons and daughters was 10+2 to M.A.

For the mixed/random group the mean age of Men was 49.71 years with an SD of 3.24 mean age for the group of women was
45.37 years with an SD of 3.37. The modal educational standard of men was B.A. to M.A. and women was 10th to M.A. The mean age of boys was 20.37 years with an SD of 2.17 and the girls was 20.11 years with an SD of 1.02. The modal educational standard of boys and girls was 10+2 to M.A. The mean age scores (years) for the two groups are found to be non-significant Table III.

**INSTRUMENTATION:**

To carry out this study the following tests and instruments were used.

1. *Raven's Standard Progressive Matrices (SPM)*

Standard Progressive Matrices (Raven, 1960) is a non-verbal culture fair test of reasoning ability. This is a test devised with the aim of assessing a person's intellectual development and capacity at the time of test to apprehend meaningless figures - presented for his observation. Spearman (1923, considered *education process* as the essence of intelligence. This test (SPM) was devised for measuring this education process as completely as possible. The S.P.M. covers the widest possible range of reasoning ability and to be equally useful for person's of all ages 6 years children to superior adults. It is a test based on seeing certain systematic
relationship among previously acquired information. In several studies S.P.M. has been found to have high loadings on 'g' general factor of intelligence, when it is factor analyzed among a large and diverse battery of cognitive ability tests, whether they are verbal, non verbal or performance tests. Hence, it is considered as a good measure of general intelligence.

The SPM consists of 60 matrices divided into five sets of twelve each and in each set the first problem is very simple. The item in each set becomes progressively more difficult. Each set involves different principles of varying the matrices pattern. Therefore, after every twelfth item the subject is always confronted with a very simple item. The five sets provide five opportunities for grasping the method and five progressive assessment's of a person's capacity for intellectual activity. In each set, every item has one "cell" missing out of the total matrices, and the subject must select the best one of the multiple choice alternatives to fill the empty cell. This test requires very simple instructions which are very easy to understand even for a 6 year old subject. Being a power test, it is generally given with a liberal time limit. Generally it requires 60 minutes and only negligible gains results by allowing more time.
A number of studies conducted on SPM provides a good account of the test's validity and reliability. Test-retest reliability in groups of older children and adults varies between 0.83 to 0.93. It's internal consistency is reported to be close to 0.90 in several studies. It correlates 0.86 with the Terman - Merrill scale, and has been found to have a 'g' saturation of 0.82. Correlation with verbal and performance tests of intelligence range from 0.50 to 0.75.

2. Jalota's General Mental ability test (GMAT)

General mental ability test in Hindi (Jalota, 1976) was first developed in 1951. It is a group test consisting 100 items divided into 5 sub-tests of 20 items each viz, vocabulary, classification, number series, reasoning and analogy test. The author revised the test in 1972 with certain modifications. This revised test has 100 items. These seven sub-tests are similarity, opposites, classification, number-series, best answers, reasoning and analogies having 10, 10, 20, 20, 10, 10 and 20 items respectively. These 100 items were mixed according to an estimated order of difficulty, from minimum to the maximum difficulty of about 20 percent success. It is a group
administered speed test with a strict time limit of 20 minutes. This test has been found to be useful for the age range of 12 to 18 years.

The standardization study of this test was conducted on one thousand students of the three classes i.e. 8th, 9th and 10th of various school from rural and urban areas. The spilt-half reliability co-efficient for different classes, were found to be 0.879, 0.932 and 0.979 for 8th, 9th and 10th class respectively, the validity of the revised test has been reported on the basis of factor analysis of inter-element scores, which gave a pattern of three centroid factors. Further, a construction of V, N, R (Vocabulary, a number series and reasoning) sub-tests of the total scores of the final version have also been reported. Multiple correlation between V, N, R and total scores for a group of 363 students of 10th class were reported to be 0.683, 0.599 and 0.874 for total score and V, N, R sub tests. And for 9th class these were reported to be 0.9033, 0.8004 and 0.8565 for total score and V, N, R sub test respectively.

3. Socio-Economic Status Scale (Kulshrestha and Day (1972))

Social status is the position of the individual within the social relationships. It is that specific position of the
individual in his relationships with other individuals by virtue of which he derives respect and prestige and whereby he exerts influence it being known by the symbols or signs and actions of the respect tendered to him. The status in a group may be inherited but in modern society, the status are achieved. They are achieved on the basis of occupation, membership of certain associations and organizations, type of house in which a person lives, the area in which the house is situated, the ownership of various house, materials e.g. Radio, T.V., Machines, Car etc. education, type of schools in which studied, type of newspapers subscribing, caste, and prestige acquired by the individuals. The economic factors play an important part in determining social status, which includes the total income of the family, savings, capacity to collect money in emergency etc.

The term 'Socio Economic Status', we mean, any group of persons coming closer to each other on the continuum of Occupation, Education, Income, Caste and Culture. Chapin (1928) has offered most widely used definition of Socio-economic Status as "the position that an individual or family occupies with reference to the prevailing average standards of cultural possessions, effective income, material possessions and participation in group activity of the community".
In India Kuppuswamy (1962) Rahudkar (1960), Pareek and Trivedi (1964), Varma (1962), Pandey (1966), Singh (1967), Lewis and Dhillon (1955), evolved their scales to measure the Socio-economic status of the people. These researchers have tried to make their scales - more comprehensive.

The present scale (Socio-economic Status Scales for Urban and Rural) are new aids for investigators to serve as more comprehensive, reliable and valid tool for recording the informations about the socio-economic status of urban as well as rural peoples.

The present scale is designed to measure socio-economic status of urban families. It collects informations about the following components variables:-

1. Parental and Sibling’s occupation
2. Parental and Sibling’s general education.
3. Parental and Sibling’s technical education.
4. Economic Indicators : Monthly income of the family, Bank and Post Office deposits/Debt on the family, Capacity to collect money in emergency, House ownership, Type of house, school
freelship, types of school reading family members, types of servants, number of shoes and clothes, and material in possession.

5. Cultural indicators: Types of newspapers/magazines and their frequency, invitation from Mohallas/City or Societies, membership of the clubs and societies.

6. Psychological Indicator: Types of colony, type of general thinking of others about your family, belief in caste, mobility and the liking towards the new practices.

This scale contains 20 items or statements. Each item is provided with 2 to 12 alternatives.

The reliability of the scale was calculated by test-retest method. The coefficient of correlation was found equal to .87. The validity of the scale was also calculated by comparing the scale with Dr. Kuppuswamy's and Pandey's Socio-economic status Questionnaire. The coefficient of correlations were found equal to .57 and .89 respectively.

STOP WATCH:

For the present study, the investigator used Racer's make stop watch to keep the time record accurately.
PROCEDURE:

The present investigation was conducted in single session, the investigator first of all collected the relevant material from the departmental laboratory and got the answer sheets of SPM and GMAT and SES scale and got them photocopied. Then, a list of selected families was made and the investigator contacted the participants personally and got the date and time fixed for testing. On the meeting/testing time and date, investigator went to the house of the participant and subjects were tested in separate room of their house.

First of all, the relevant information and biodata were recorded and SES Scale was administered. Then the Standard Progressive matrices was administered, the subjects were given liberal time to complete this. This was followed by General mental ability test. This is a speed test and only 20 minutes were given to complete this test. A 10 minutes rest pause was given after SES and SPM tests. These tests were administered according to the standard procedure laid down in their manuals. Instructions were given as specified in manuals.
The same procedure was adopted for the second group i.e. the mixed/random group. The investigator visited personally to the houses of the participants and got the test administered as described above.

SCORING:

Scoring for all the tests was done on the basis of the procedure specified in the manual. For SPM one score was given for one correct answer. Thus maximum score for any subject on this test, might be 60 and the minimum is 0. Total score of any subject on this test was his total right answers.

For General mental ability test also, one score was given to one correct answer, hence, for General mental ability test the score of a particular subject might vary from zero to 100.

For SES scale scoring key summarises the information recorded on the scale. The weightage of each item has been written on the key. The key is transparent and can be used in most convenient manner. Keep the key on the scale and total the marks mentioned above each box on key for each right answer. The grand total should be taken into consideration for determining the status of the testee.
ANALYSIS:

The obtained data were analyzed by employing usual and behavioural genetics analyses. The mean and SD for SPM & GMAT scores were calculated for both the criterion groups.

Intra class correlations (Guilford, 1981) for different groups were obtained. For the random/mixed groups the random pairing of Ss were generated and the average correlation was obtained. The intra-class correlation is defined as:

\[ r_i = \frac{\text{MS}_T - \text{MSE}}{\text{MS}_T + (K-1) \text{MSE}} \]

Where \( \text{MS}_T \) = mean square of variance between rows, where each row stands for a person.

\( \text{MSE} \) = Mean square for residuals or error

\( K \) = number of columns.

Finally, indices of inheritance were obtained using Harris (1965) formula:

\[ h^2 = \frac{2 \text{Cov}(P.S)}{\sigma_g^2 + \sigma_e^2} \]

\[ h^2 = \frac{2 \text{Cov}(P.O.)}{\sigma_g^2 + \sigma_e^2} \]
Where:

\[ 2 \text{Cov} = \text{double the covariance of full siblings or parent-offsprings as the case may be} \]

\[ \sigma^2 + r \sigma^2 = \text{The Total variance.} \]

Significance of difference between mean and SD of scores obtained by the two criterion group as different measures and between the intra-class correlations were tested employing the 't' test (Garrett, 1981).

Test of goodness of fit \( \chi^2 \) was used to study whether the observed intra-class correlation fits better to that expected on the basis of genetic theory.