CHAPTER V

SCOPE AND DESIGN OF THE STUDY

The designing of a research study requires most careful consideration. Any study should be so designed that suitable control of extraneous factors is accomplished on the one hand, and proper functioning of variables to be studied is achieved on the other. In certain cases, for example in experimental design, the control is achieved by manipulating the affecting factors with the help of experimental and controlled groups. But in many other cases where such a control is not possible, statistical methods are used to eliminate the effect of extraneous factors. The empirical studies reviewed in Chapter IV reveal that intelligence index, socio-economic status and the chronological
age of subjects are important factors that affect the growth and pattern of divergent thinking abilities/creativity in adolescent period. All the three factors have been found to covary with divergent thinking abilities. Therefore, in order to study the divergent thinking abilities as a separate dimension in measuring individual differences, these three factors must be controlled.

Some tests of divergent thinking abilities have been developed in foreign countries. These tests have been found to correlate with intelligence to varying degrees. For example, Wallach and Kogan battery of creative thinking has high inter-correlations among its test factors but negligible relationship with intelligence. But test batteries like those of Torrance, Guilford, Getzels and Jackson correlate with intelligence to the order of .3. In India, to the knowledge of this investigator no test of divergent thinking abilities has been developed and standardized so far. Therefore the immediate problem for this study was the development of a battery of tests of divergent thinking abilities. Other problems demanding simultaneous attention of the investigator related to exploring the (1) relationship
between intelligence and divergent thinking and (2) components of divergent thinking abilities at specific age-levels/stages. The data, thus gathered, was to be utilized in generating various hypotheses by this investigation. In order to achieve this end, therefore, the study was planned in two stages, i.e., the first stage and the second stage, each with its own set of objectives.

**AIMS OF THE STUDY AT STAGE I**

The study at first stage was undertaken with the following specific purposes:

(1) To develop a battery of tests of divergent thinking for adolescent boys and girls in different content areas with a view to bringing out clearly the difference between the two domains of intellect, viz., convergent thinking and divergent thinking,

(ii) To explore the patterns of growth of divergent thinking ability during adolescence so that a specific age or grade level could be taken up for the final study and tests suited to the pattern could be selected or devised.

(iii) To select the tests of divergent thinking and eliminate those that do not measure this ability
as a distinct and cohesive cognitive domain as defined for the purposes of this study.

FACTORS CONCERNING THE DESIGN OF THE PRESENT STUDY

In order to achieve these objectives the researcher had to develop tests of divergent thinking as it manifests in different content areas. Since a discussion of these tests and their rationale required larger space, the chapter VII is devoted to this purpose. However, the rationale for selecting the samples, and their nature and composition are discussed in the following pages.

To study the growth pattern of divergent thinking ability during the adolescent age, chronological age seems to be one of the most pertinent factors. With the change in chronological age, the level as well as the organisation of cognitive abilities are bound to change; hence a significant relationship between the two variables can be expected. Since it was planned to devise the tests of divergent thinking ability in such a manner 'that they would correlate with general
intelligence index negligibly, the age factor had to be controlled within the sample. The control is considered essential because the age would correlate with both the cognitive sub-dimensions, i.e., divergent and convergent thinking factors separately and consequently a correlation of significant order cannot be ruled out to exist between the two dimensions.

As regards the method to be adopted for studying the growth pattern of divergent thinking ability during the adolescent age, a choice had to be made out of two approaches, i.e., cross-sectional or longitudinal. The longitudinal study was not possible because of migrating (or changing) population of adolescent boys and girls in the schools, non-availability of records of divergent thinking index during childhood, and non-availability of suitable tests. Another major factor is its greater suitability to the study of individual cases rather than the study of groups. Whereas the cross-sectional method is suitable in formulating general principles in which we are interested at present. Further, it permits to draw more objective and unbiased results because of large size of samples.
Therefore cross sectional approach was adopted for this study. And the lowest, the highest and the middle cross-sections of school-going adolescent population, such as pupils of classes VI (median age 11.0), class VIII (median age 12.8), and classes X and XI (median age 14.5) were considered suitable for the purposes of studying the growth pattern. Still another reason for selecting the cross-sectional study is the consideration of the growth pattern of general intelligence, which is believed to function in the global form up to about 11\(^{+}\), becomes diversified at about 13\(^{+}\) and grows in the form of group factors at about 16\(^{+}\). Analogously, growth of divergent thinking ability, which is the concern of this study, is also assumed to follow a similar pattern.

To reduce the influence of age factor in studying relationship between general intelligence index and the divergent thinking ability to the minimum possible degree, samples were selected in a manner so that they had a narrow or/and equal age-range among themselves. The influence of age was controlled in the final study too by selecting subjects with narrow age variations.
Another important factor necessitating control in a study of this type is the socio-economic status of the families of the subjects. It was planned to focus the study at the first stage on adolescents of middle class background, the reason being that differing socio-economic strata provide differential opportunity and environmental stimulation to the subjects which might well impinge in many ways upon the various aspects of their behaviour under investigation. For the purposes of the present study, such effects were essentially extraneous and, hence, had to be controlled. We could not adopt the solution of conducting parallel studies of adolescents belonging to the middle class and lower socio-economic statuses by rotation, since the research problem of the study demanded a large sample of adolescents of both the sexes within a given social stratum. It simply was not possible within the limits of this project. The rationale for concentrating upon the adolescents of middle rather than lower socio-economic status was that this group constitutes the largest population in most of the relevant empirical studies and secondly it is the "middle" class which is emerging to constitute an ever-increasing segment of this
country's population; thus making it the most relevant socio-economic cultural group for which to establish generalizations.

Another pertinent factor found to be related to creativity or divergent thinking is the I.Q. level. In case of a normal distribution of general intelligence index, the relationship between creativity measures and index of general intelligence has been found to approximate to 0.3. The relationship shows covariance of intelligence with creativity. (At the high I.Q. level, however, creativity/divergent thinking ability has not been found to have one to one correspondence with general intelligence and hence the variation in I.Q. may or may not be accompanied with variation in creativity.) In order to study divergent thinking ability as a cognitive dimension different from general intelligence, therefore, subjects of high I.Q. were selected for the samples.

To some, sex difference may appear to be another pertinent factor in this study; but the investigator did not consider it related to the present study because it is assumed that its
relationship to divergent thinking ability may be the same as its relation to general intelligence, i.e., it may have no effect on intelligence as well as creativity. Therefore in selecting the subjects for this study at either of the two stages, sex difference was considered to be an ignorable factor.

Since the purpose of this investigation was to explore the configuration of divergent thinking ability in relation to certain personality dimensions, it was necessary to select a sample which is homogenous with respect to chronological age, high I.Q., and socio-economic status. Furthermore its size had to be so large as to yield stable results. It was not considered necessary to select the sample in a manner to make it representative of the adolescent pupils' population in general.

THE SAMPLE FOR THE STUDY AT FIRST STAGE

The number of adolescents selected for the first stage was 245. The sample was obtained by selecting 50, 95 and 100 boys and girls from VI, VIII and X grades respectively. The composition of this sample is given below:
## TABLE No. 5

(1) STRUCTURE OF THE SAMPLE WITH RESPECT TO SCHOOL AND GRADE

<table>
<thead>
<tr>
<th>School/Class</th>
<th>VI</th>
<th>VIII</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Banasthali Vidyapith</td>
<td>10</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>Multipurpose Higher Secondary School, Banasthali (Jaipur)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Adarsh Vidyamandir Higher Secondary School, Jaipur</td>
<td>8</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>4. S.M.D. Jain Higher Secondary School, Jaipur</td>
<td>7</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>5. Topdara Govt. Higher Secondary School, Ajmer</td>
<td>16</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>96</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
TABLE No. 6

(11) STRUCTURE OF THE SAMPLE WITH RESPECT TO CLASS AND RELATED FACTORS.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Class VI</th>
<th>VIII</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.E.S.</td>
<td>Median</td>
<td>12.0</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>7-16</td>
<td>8-18</td>
</tr>
<tr>
<td>I.Q.</td>
<td>Median</td>
<td>119</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>100-169</td>
<td>112-189</td>
</tr>
<tr>
<td>Chronological Age</td>
<td>Mean</td>
<td>10.8 yrs.</td>
<td>12.9 yrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 months</td>
<td>9 months</td>
</tr>
</tbody>
</table>

It can be observed that the adolescents in the present study came mostly from middle class families in respect of socio-economic status. This was determined on the basis of education of parents, their occupation and monthly income.
The data regarding intellectual development demonstrate that the subjects in VI grade were not intellectually high. So far as the investigator can understand the state of affairs which is rather unusual, may be the effect of education and language training on the performance on a verbal test of intelligence. (The performance is low because the level of educational attainments and the degree of command over language are certainly low in lower classes.)

The data regarding chronological age show that the samples were relatively homogenous in respect of variability in chronological age of the subjects. The average age differences between any two consecutive samples is approximately 2 yrs.

The above statistics show that chronological age factor and socio-economic status as factors influencing the relationship between general intelligence index and divergent thinking ability have been controlled by equalizing and minimizing the variability at the three levels. However, the average I.Q's were different in the samples; range of I.Q's almost remained the same.
TOOLS USED AT THE FIRST STAGE

The sample described above was used to collect data for the study at the first stage. All the tests and questionnaires used in this study were group tools. In order to avoid repetition, only a brief mention of the tools used at the first stage is being given here. They are discussed in detail in the seventh chapter.

TEST

1. Socio-economic status scale
2. Jalota Group test of Intelligence
3. Word fluency test
4. Word Association test
5. Number Association test
6. Sentence construction test
7. Number Rules test
8. Categorywise thing listing test
9. Similarities test
10. Controlled Association test
11. Make-up Mathematical Relations task
12. Circle Elaboration test
13. Parallel Lines test
14. Utility test
15. Remote consequences test
16. Fist titles test.
DATA COLLECTION AND CLASSIFICATION PROCEDURES

First, the two selection tools, the socio-economic status scale and Jalota's intelligence test, were administered to groups of 20 subjects at a time. These tests were scored and the subjects satisfying the two criteria i.e., belongingness to middle class social strata and high I.Q., were selected. The selected subjects were then grouped into small sub-groups to make the administration of tests of divergent thinking ability easy. The tests were scored with the help of scoring keys developed for the purpose.

The dimensions of divergent thinking ability measured in this study were (i) word fluency, (ii) ideational fluency, (iii) associational fluency, (iv) expressional fluency, (v) spontaneous flexibility, (vi) originality, and (vii) elaboration. The content which figured in the tests for measuring these intellectual abilities were semantic, symbolic and figural.

The scores were tabulated ability-wise on separate sheet of paper. The coefficient of
correlation 'r' was computed by electronic computer. The correlation matrix, so formed, was factor-analysed by Principal component factor-analysis method at each of the three stages. The factors were rotated by varimax method and thus normalized factor loadings were obtained. The factor loadings were used to analyse the various abilities measured by the tests.

The study was conducted according to Normative Survey Method since it mainly aimed at discovering the existing pattern of divergent thinking abilities at the three stages of adolescents' growth. The final study too followed the same method because it was designed to study the minimum number of divergent thinking factors and personality dimensions of the divergent thinking adolescents, and to explore the degree of functional relationship between the two domains i.e., divergent thinking and personality.

DETERMINING THE SAMPLE AND TOOLS FOR THE FINAL STUDY

As stated earlier, one major objective of the study at the first stage was to explore the level at which divergent thinking abilities become stabilized. The analysis revealed that the group factors mostly

1 See Infra Chapter VI.
based on context were clearly visible at the age 17.2 yrs. (median value) i.e., grade X. At the VII grade level (median age = 12.8), the divergent thinking abilities were found to be still in the process of differentiation. They were neither fully in global form nor in the differentiated form at the stage. Therefore, it was not considered suitable to include class VIII in this study. So far as the question of excluding class VI is concerned, the reason was that at this stage sufficient number of talented children was not available. And in the absence of a large sample it was difficult to draw reliable and stable generalizations. Therefore the X grade students were considered suitable for the final study.

The study at the first stage also helped the investigator in selecting tests for the final study. The analysis of the tests in terms of factors, amount of variance explained, and the size of loadings of test factors on extracted factors, revealed that some of the tests were not suitable for being included in the final study. Hence tests like Make-up Mathematical Test, Mathematical Reasoning test, Word Association test, Number Association test, Categorically Thing Listing test were discarded. The Circle Elaboration test
and the Parallel Lines Test were replaced by certain other figural tests. The new tests that were included in the battery of tests were - Word Grouping test, Multiple Grouping test, Figural Similarities Test, Circle Test and the Figure Drawing test. The scales which were added in the final study to measure personality dimensions were the Dogmatic scale, Conformity scale, Autonomy Scale and Ego Strength Scale.

AIMS OF THE FINAL STAGE:

The major objectives of the study at the final stage were:

(i) to study the factors of divergent thinking ability in the adolescent boys and girls of 17+,

(ii) to study the personality concomitants of divergent thinking factors,

(iii) to study the personality dimensions of adolescents possessing divergent thinking, and

(iv) to study the dependences of personality dimensions taken separately, on the divergent thinking factors.
To achieve these objectives, the data was not based on the students of middle class social strata as was done at the first stage. Instead, the adolescent boys and girls from above average and high socio-economic status groups were selected. The reason was non-availability of large number of talented subjects belonging to middle class socio-economic status. If the sample of the middle class socio-economic status had to be maintained, large number of schools were required to make up an adequate sample. That would have introduced another extraneous factor i.e., varying educative environment at school and at home. Therefore, in the final study the investigator had to concentrate primarily on public schools where talented adolescents were available in large numbers. But the number of subjects in Xth or equivalent class of all Public Schools in Rajasthan was so small that it could hardly be considered to comprise as adequate sample for a factor-analytic study. Therefore some other schools such as those officially deemed as public X schools and those declared by the Education Department as A-grade schools were also selected for the study. All these schools maintain good libraries, good buildings, well equipped laboratories, provide
for various types of co-curricular activities and maintain a good standard of education with the help of well qualified teachers as good as public schools. It may be assumed that the non-public schools provide fairly comparable background for the development of creative thinking in adolescent boys and girls.

SAMPLE FOR THE FINAL STUDY

The composition of the sample which consisted of 540 subjects studying in senior classes of Public and A-grade Schools of Rajasthan State is given below: (Table No. 7)
<table>
<thead>
<tr>
<th>Relevant information about the Group</th>
<th>S</th>
<th>O</th>
<th>C</th>
<th>H</th>
<th>O</th>
<th>L</th>
<th>S</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>[College Name]</td>
<td>B</td>
<td>S</td>
<td>P</td>
<td>S</td>
<td>H</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of selected subjects</th>
<th>59</th>
<th>88</th>
<th>53</th>
<th>56</th>
<th>66</th>
<th>57</th>
<th>72</th>
<th>89</th>
<th>540</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>S.E.S. Range</th>
<th>14-21</th>
<th>14-21</th>
<th>14-21</th>
<th>14-20</th>
<th>14-21</th>
<th>13-19</th>
<th>14-21</th>
<th>14-21</th>
<th>14-21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>19</td>
<td>18.5</td>
<td>17</td>
<td>16.5</td>
<td>16.5</td>
<td>15.5</td>
<td>20.5</td>
<td>18.0</td>
<td>17.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I.Q. Range</th>
<th>110-194</th>
<th>100-179</th>
<th>100-197</th>
<th>106-196</th>
<th>106-175</th>
<th>100-180</th>
<th>100-174</th>
<th>100-170</th>
<th>100-197</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>136</td>
<td>134</td>
<td>119</td>
<td>122</td>
<td>133</td>
<td>120</td>
<td>124</td>
<td>137</td>
<td>128.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chronological Age (Yrs.)</th>
<th>14.5-18.0</th>
<th>14.5-17.8</th>
<th>15.3-18.0</th>
<th>15.5-19.3</th>
<th>15.0-18.5</th>
<th>15.0-17.3</th>
<th>18.0</th>
<th>15.0-18.5</th>
<th>14.5-19.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>17.5</td>
<td>16.3</td>
<td>17.0</td>
<td>17.3</td>
<td>17.8</td>
<td>16.0</td>
<td>17.0</td>
<td>17.5</td>
<td>17.2</td>
</tr>
</tbody>
</table>
Like the first stage, the selection of students for the final study was made on the basis of measures of socio-economic status and intelligence. The socio-economic status scale consisted of items in three areas (i) education of parents, (ii) their occupation and (iii) their monthly income. The S.E.S. measure provided a 7-point scale to be marked by subjects on each of the three categories. The possible range of scores on this scale was (0-21). The S.E.S. scores of the selected students ranged from 14 to 21, with a median value of 17.5. Parents of most of the students were graduates and post-graduates. Some of their major occupations were class I, Government, Civil and Military services, teaching at Collegiate level, business, agriculture, industry and engineering. The subjects varied widely with respect to general intelligence index since the I.Q. range was 100-197, with a median of 128.5. Thus all the subjects were intellectually bright. The chronological age of the subjects ranged from 14.5 to 19.3 years around the median value 17.2. The subjects were boys as well as girls though the number of girls was small in comparison to boys. The sources of variation were considered ineffective because intelligence is not affected by sex difference.
Thus the selected group of adolescent students could be considered sufficiently informed about the present social and physical environment, well equipped with communication skills, approximately homogeneous with respect to learning experiences, and coming from relatively open social environment at home and at school. The subjects were assumed to be sufficiently equipped to carry on divergent thinking in varying stimulating situations.

TOOLS USED AT THE SECOND STAGE

The selected students, at every place, were divided in small groups so that each of the tests could be administered in proper testing situation. The time allotted to administer a test, rationale of a test, administration and scoring procedures have been discussed in the VII Chapter. However, a brief mention of tests and questionnaires retained from the battery of the tests administered at the first stage as well as those others which were added to them to make the final test battery is given below. The traits/traits a tool measures are not given here simply to avoid repetition.
TESTS

1. Word Fluency test
2. Controlled Association test
3. Number Rules test
4. Sentence construction test
5. Word Grouping test
6. Multiple Grouping Test
7. Similarities test
8. Figural Similarities test
9. Utility test
10. Remote consequences test
11. Plot titles test
12. Picture Drawing test
13. Circle test
14. A.D. Scale
15. C. Scale
16. E.S. Scale
17. D - Scale
18. Jalotas Group test of Intelligence
19. S.E.S. Scale

It may be noted that tests 18 and 19 above were used primarily to select students for administering the battery of divergent thinking tests.
PROCEDURES USED FOR CLASSIFICATION AND STATISTICAL ANALYSIS OF THE DATA

Each test was scored for specified factors/factor of divergent thinking ability. As revealed by the test, mentioned in the preceding paragraphs, 29 sets of scores were available for all the 540 students. The scores were arranged in a matrix or table, with the columns corresponding to the test - factors and the rows to the individuals. At the final stage of this study, the distributions of raw scores were represented by frequency polygons and they were evaluated with respect to measures of central tendency, variability, symmetry, kurtosis and modality. The degree of dependence of a personality dimension on divergent thinking abilities was determined by multiple correlation, for which the Beta Coefficients were calculated by Privotal Condensation Method.

Scores on each test - factor were correlated with scores on every other test-factor. This
yielded \( \frac{n(n-1)}{2} \) i.e., number of coefficient of correlation calculated by electronic computer was 406. These were arranged in a 29 x 29 correlation matrix.

The correlation matrix was factor-analysed by the method of principal components. The principal-component Factor loadings for the correlation matrix were arranged in tabular form. The test-factors expressed in rows and columns representing the extracted factors were reported in the factor matrix. The elements in the cells of the table were factor loadings. The sum of the squared factor loadings in each row of the table was equal to 1.00, within rounding errors. It may also be noted that the sum of cross-products between the elements or loadings in any two columns of the table was, within rounding errors, equal to zero. The sum of the squared loadings in each column has been named an eigen value or latent root. The eigen value represents the amount of the total variance that can be accounted for by a given factor. The total variance was equal to the number of test-factors i.e., 29, and it was observed that the sum of eigen values was, within rounding errors, equal to 29. Thus the 14 factors accounted for all the variance in the 29 test factors. The
The proportion of the total variance accounted for by a factor, was calculated by dividing the sum of squared factor loadings in a given column by the number of scales (29).

**NORMALIZED FACTOR LOADINGS**

In general, the number of principal component factors would be equal to the number of tests in scales; because the principal component factors were extracted in such a way that the first factor accounts for the largest proportion of the total variance, the second the next largest, and so on; the later factors often accounted for a very small proportion of the total variance.

When all the principal component factors were extracted, the sum of the squared loadings in each row was equal to 1.00. As the investigator was concerned only with the first $K'$ factors where $K' \leq K$, then, in general, the sum of squared loadings in each row would be less than 1.00 and would simply be the proportion of the total variance in the scale that could be accounted for by the first $K'$ factors. In other words, the sum of squared loadings in a given row would be the
proportion of variance that a scale had in common with \( K' \) factors and was called the communality of the scale i.e. \( h^2 \).

Kaiser's varimax orthogonal rotation was carried out with \( K' \) factors simply to obtain simple structure factor loadings matrix.

There are several methods of factor analysis but the Principal Component method was considered to be more appropriate for factoring the data of this study. The main advantage of this method is the uniqueness of the factors that are obtained to explain the correlation matrix. There are two other advantages which it shares with other methods of factoring a correlation matrix. Firstly, there is the economy of describing each individual terms of factors extracted which would be pure and less in number than the tests used to collect data. This is, indeed, the objective when the Principal component method is used without rotation of axes. Secondly, one is to get a relatively small number of factors which explain functional unities underlying the processes. This is obtained by rotating the principal components configuration.
to simple - structure factor patterns. There is a limitation too of this method in that it involves much labour in condensing the correlation matrix of as big a size as was obtained in this study. However, the advantages of this method outweigh its limitations and hence the extra-labour was considered worthwhile.

Therefore, the multiple correlation and the factor analysis are perceived to provide minimum number of such sets of divergent thinking factors and personality dimensions, which demonstrate functional relationship and determine potential creativity.