CHAPTER FOUR

METHODOLOGY

4.1.0. INTRODUCTION

The term 'methodology' refers to the processes and procedures one adopts while carrying out a study in order to achieve the particular objectives specified. It is concerned with how one goes about actually conducting the research. What particular procedure one might employ in a given investigation will, however, depend upon the nature and objectives of the study. This chapter explains how the present study was conducted; objectives, nature of the problem investigated, hypotheses, the design used, the sample, the tools and instruments used, and other procedural details are explained in this chapter.

4.2.0. PROBLEM UNDER INVESTIGATION

To develop a therapeutic intervention package and try out its impact on some disruptive behaviour disorders of children.

4.3.0. OBJECTIVES OF THE STUDY

The objectives of the present study were as under:

1. To develop a therapeutic package and study its effect on disruptive disorders.
2. To study the effect of yoga on aggression and hyperactivity.

3. To study whether reinforcement contingencies have an effect on disruptive disorders.
4. To study the effects of time-out on the two disruptive disorders.
5. To study the effects of all three therapeutic techniques combined on both the disruptive behaviour disorders.
6. To study the differential impact of the three intervention strategies on the two behaviour disorders, and to measure the effectiveness of each technique with respect to each behaviour disorder.

4.4.0. HYPOTHESIS TESTED IN THE STUDY

Considering the four intervention techniques and the two behaviour disorders, there were several hypotheses which were tested.

HYPOTHESIS 1 :

There will be no impact of yoga on aggression.

HYPOTHESIS 2 :

There will be no impact of reinforcement on aggression.

HYPOTHESIS 3 :

There will be no impact of time-out on aggression.

HYPOTHESIS 4 :

There will be no impact of the combined therapeutic package (consisting of all the three strategies, namely, yoga, reinforcement and time-out) on aggression.

HYPOTHESIS 5 :

There will be no reduction of aggression in children belonging to the control group.

HYPOTHESIS 6 :

There will be no difference between the experimental groups (the groups undergoing the intervention techniques) and the control group with reference to the reduction of aggression.

HYPOTHESIS 7 :

There will be no impact of yoga on hyperactivity.

HYPOTHESIS 8 :

There will be no impact of reinforcement on hyperactivity.

HYPOTHESIS 9 :

There will be no impact of time-out on hyperactivity.

HYPOTHESIS 10 :

There will be no impact of the combined therapeutic package (consisting of all the three strategies, namely, yoga,

reinforcement and time-out) on hyperactivity.

HYPOTHESIS 11 :

There will be no reduction of hyperactivity in children belonging to the control group.

HYPOTHESIS 12 :

There will be no difference between the experimental group (the groups undergoing the intervention techniques) and the control group with reference to the reduction of hyperactivity.

4.5.0. SAMPLE

The sample comprised of students between the ages of 9 and 12 years ($\bar{X}$ = 10.25, SD = 1.35) of both sexes, studying in classes 4 and 6. The sample totaled 120. It was matched in terms of sex and medium of instruction (that is, 60-60 boys/girls and 60-60 English/Gujarati medium). The socio-economic status could not be taken as a variable due to the lack of sample in the high socio- economic strata.

The following 6 tables show the distribution of the sample.

TABLE I: Number of teachers, standard-wise, who rated the children.

	SCHOOL I	SCHOOL II	SCHOOL III
STD. 4	3	1	1
STD. 6	1	1	1
TOTAL	4	2	2

TABLE II: Total number of students, standard-wise, who were rated by parents and teachers, for the purpose of choosing the sample.

	SCHOOL 1		SCHOOL 2		SCHOOL 3	
	GIRLS	BOYS	GIRLS	BOYS	GIRLS	BOYS
STD. 4	70	92	27	14	21	29
STD. 6	22	24	21	28	24	36
TOTAL	92	116	48	42	45	65
	208		90		110	
GRAND TOTAL	408					

The mean score of parent and teacher ratings on aggression and hyperactivity put together was found. This score was put in an orderly fashion from which the following students totalling 120 were chosen, 60 of which were from Standard 4 and 60 from Standard 6.

TABLE III: Sample size at the start of the present study.

	SCHOOL 1		SCHOOL 2		SCHOOL 3	
	GIRLS	BOYS	GIRLS	BOYS	GIRLS	BOYS
STD. 4	16	10	4	2	15	13
STD. 6	6	6	4	12	16	16
TOTAL	22	16	8	14	31	29
	38		22		60	
GRAND TOTAL	120					

These 120 students were further biforcated into two groups of 60 of the highest scorers of aggression and 60 of the highest scorers of hyperactivity.

The following two tables, therefore, show this distribution of students.

TABLE IV: Number of students, for aggression, school-wise.

AGGRESSION						
	SCHOOL I		SCHOOL II		SCHOOL III	
	GIRLS	BOYS	GIRLS	BOYS	GIRLS	BOYS
STD. 4	9	5	2	1	8	7
STD. 6	2	4	1	6	8	7
TOTAL	11	9	3	7	16	14
	20		10		30	
GRAND TOTAL			60			

TABLE V: Number of students, for hyperactivity, school-wise.

HYPERACTIVITY						
	SCHOOL I		SCHOOL II		SCHOOL III	
	GIRLS	BOYS	GIRLS	BOYS	GIRLS	BOYS
STD. 4	7	5	2	1	7	6
STD. 6	4	2	3	6	8	9
TOTA L	11	7	5	7	15	15
	18		12		30	
GRAND TOTAL			60			

The sample size originally totalled 120. However, the results of only 110 children were taken into account. The scores of 10 children were rejected due to several reasons. Two of the ten children had left the school during the academic year 1993-1994. Their data on the delayed intervention, therefore, could not be obtained. The other eight children did not hand in their data either because they had lost it or because parents had not completed it. These children were, therefore, lost due to lack of cooperation.

Due to the necessity of rejecting the data of these 10 children, the balance of gender, school, disorder and therapeutic intervention could not be maintained.

The next table shows the distribution of this reduced sample size.

TABLE VI: Reduced sample size at the end of the study.

	SCHOOL 1		SCHOOL 2		SCHOOL 3	
	GIRLS	BOYS	GIRLS	BOYS	GIRLS	BOYS
STD. 4	13	9	3	2	15	13
STD. 6	6	6	4	9	14	16
TOTALS	19	15	7	11	29	29
	34		18		58	
GRAND TOTAL			110			

The sample thus collected was administered the intervention strategies, the details of which are described in the following sections.

4.6.0. DATA COLLECTION

The sample of students for the present study was collected from three schools in the city of Vadodara, Gujarat. The three schools selected were:

1) Baroda High School, Jr-II, Alkapuri.

2) Vidyakunj High School, Vishwamitri.

3) Gujarat Electricity Board School, J.P.Road.

Baroda High School, Jr.II, Alkapuri. In June 1961, the Baroda Lions Club Education Trust was established, which subsequently started Baroda High School, Sr. in the same year. The premises were provided by His Highness The Maharaja Shri Fatesinhrao Gaekwad. Baroda High School, Jr. was opened in the ONGC premises to meet the needs of this public sector organization.

In the year 1974, the government of Gujarat allotted a plot of land in Alkapuri, and Baroda High School, Jr.II was started.

All the branches of this school are of English medium instruction, and all of them have the kindergarten (KG), primary, secondary, and higher secondary sections.

Vidyakunj High School, Vishwamitri. This school is managed by the Junior Chamber Education Trust, Vadodara, and is situated at two locations - Manjalpur and Vishwamitri.

At Vishwamitri the main building is located on the Vishwamitri-Padra road, near the road bridge to the Vishwamitri river. It is spread over some 3.5 acres of land.

The academic section of both schools provides education at the nursery, kindergarten (KG), primary, secondary and higher

secondary levels.

Gujarat Vidyutboard School, J.P.Road. This school was established by the Gujarat Electricity Board (from which it gets its name), in the year 1966, and is situated on the campus of the GEB staff quarters.

The school's medium of instruction is Gujarati and the school has the pre-primary, primary, secondary, and higher-secondary sections.

4.7.0. TOOLS DEVELOPED AND USED

The first step in the present study was to develop material which could be used for diagnosing the aggressive and hyperactive children who were to make-up the sample. The need for this was felt since the investigator could not find any other standardized test for the two behaviour disorders under investigation.

The materials thus developed were of two kinds:

1) a questionnaire, and

2) a baseline.

THE QUESTIONNAIRE was developed in two stages. The first stage involved collecting statements, putting them into questionnaire

form, and analyzing them for their face validity.

Statements that could be included in the questionnaire were taken from various sources like books, journals, etc.. They totalled 46 in number. After these had been combined and put together in questionnaire form, this pilot questionnaire was given to five professors for judging the items. They were asked to assess whether the statements actually measure what they purport to measure.

Two questionnaires were generated, one measuring aggression and one measuring hyperactivity. However, the items measuring these two disorders were put into the form of a single questionnaire to make their administration easier.

In the second stage of questionnaire development, this questionnaire was duplicated into two questionnaires, one relevant to teachers and one relevant to parents. On the basis of the pilot assessments, rejected statements were left out and a new questionnaire of only the valid statements was made. Most of the statements, however, overlapped. But two of the statements had to be deleted from the parents questionnaire as they were not applicable; for example, "Is the first to interrupt in class". Therefore, the total number of statements in the teacher's

questionnaire was 31, while the total in the parent's questionnaire remained 29. The statments of the questionnaire were to be marked on a 3 point scale of Very Often, Sometimes and Never, giving them a rating of 3, 2 and 1 points respectively. Therefore, the higher the score on the questionnaire ratings, the greater was the intensity of the disorder.

THE BASELINE was developed on the lines of the questionnaire.

A baseline is, generally, the normal frequency or occurrence of any response, statistic, or other measure per unit of time. Baselines are used as foundations against which to evaluate effects of specific manipulations.

In the present study the behaviours observed in the baseline were similar to the statements in the questionnaire. The difference in the two, however, lay in the method of scoring. On the baseline, the raters had to rate the child over a period of 15 consecutive days. A fixed time period was set side for each of these days whereby they would observe the child and note down the number of times he or she indulged in the misbehaviour.

The questionnaire and the baseline were, therefore, used to diagnose the disorder and gauge the effect of the intervention,

if any.

Copies of the questionnaires and baselines used are shown in Appendix 1.

4.8.0. DESIGN

The present research investigation was an intervention study. The study aimed at evaluating changes on a sample of subjects as a result of the intervention strategies employed. It was an experimental study in that comparisons were made between experimental subjects undergoing the intervention techniques and a control group, on a pre-post design, in an effort to identify the intervention strategy that would help the sample group the most.

The basic outline of the design maybe summarized as follows:

BEHAVIOUR DISORDERS	INTERVENTION STRATEGIES					
	YOGA	REINFORC-EMENT	TIME-OUT	ALL 3 COMBINED	CONTROL GROUP	TOTAL
AGGRESSION	12	12	12	12	12	60
HYPERACTIVITY	12	12	12	12	12	60
TOTAL	24	24	24	24	24	120

The above figure shows the 5 intervention groups and the two behaviour disorders. For each disorder included under each intervention group, there were 12 children.

The detailed design of the study has been shown in Appendix 2.

4.9.0. THE VARIABLES

All research work consists of events with lawful relationships amongst themselves. It is useful to classify events into three categories - Independent Variables, (IV), Dependent Variables (DV) and Control Variables. They are called variables because they vary in terms of such things as quality, quantity and type. Scientific research seeks orderly relationships between the values of these variables.

The variables in the present study were as follows :

Independent Variables - Yoga, Reinforcement and Time-out.

Dependent Variables - Aggression and Hyperactivity.

Control Variables - Sex of the Child, Standard they studied in and Medium of Instruction.

The **Independent Variable** is a condition that a researcher observes, manipulates, or controls, in order to determine its

effects on `behaviour'. In this study, there were three independent variables, namely the three intervention strategies: Yoga, Reinforcement and Time-Out.

Yoga There are now a wide range of nonpharmacological techniques used for the reduction of behaviour disorders, which involve relaxation. They are assumed to involve a common mechanism. The most popular methods include progressive relaxation, autogenic training, hypnosis, biofeedback, yoga, and meditation.

From the theoretical and philosophical points of view, yoga has a very long history, but scientific interest in it may be said to date only from the last 2 decades of the last century.

In the past, yoga has been used for spiritual development, mainly through practices of pranayama and meditation. The physical aspect of yoga - Asanas - was only a means to an end. However, since the last 2-3 decades, asanas are recognized as a major part of yoga, and are now practiced independently for the many benefits derived from them.

The asanas which were performed in the present study, are discussed in an Chapter II.

Reinforcement was a popular strategy of early social skill

workers. However, although studies demonstrate the controlling effects of social reinforcement and extinction procedures, the application to a wider spectrum of interpersonal behavior has not been demonstrated.

Behaviour change occurs when certain consequences are contingent upon performance. A consequence is contingent when it is delivered only after the target behavior is performed. A contingency refers to the relationship between a behaviour and the events that follow that behaviour. The notion of contingency is important because behaviour modification techniques often alter behaviour by altering the consequences that control or fail to control a particular behaviour.

Contingency of Reinforcement can be defined as "the relationship between an operant response and the consequences which precede and follow the operant response."

Time-out procedures are a type of negative reinforcement. As soon as the child behaves undesirably, he is sent away from the positive reinforcements surrounding him, by either being made to leave the room or being left alone in the room. This procedure, followed several times and consistently, leads to a reduction of the undesirable behaviour.

Time-out can be defined as "removal of an individual from a situation in which positive reinforcers are available to a situation which contains minimum opportunity for positive reinforcement". This is the definition that was applied in the present study.

The **Dependent Variable** varies systematically with or is dependent upon another variable, the independent variable. The dependent variable is what is observed and measured in an experiment. In Psychology, the dependent variable most often studied is behaviour.

In the present study, the dependent variables were the two disruptive behaviour disorders, namely Aggression and Hyperactivity.

Aggression. Among the varieties of definitions given to aggression, those which involve the attributes of anger, assumptions about the instigators, emotional aspects and intent to injure, are the most frequent. Kaufmann (1970) argues that any definition of aggression must also include the notion that there is a chance of harm being done to the victim. Hence after much sifting of literature, Russell Geen's definition of aggression has been accepted. He defines aggression as: " the delivery of a

noxious stimulus by one organism to another with intent to harm and with some expectation that the stimulus will reach its target and have the intended effect."

This was how aggression was defined in the present study as well.

Hyperactivity is a shorthand term for a cluster of complaints about children's behavior; restlessness, inattentiveness, excitability, overactivity, impulsivness, fidgetiness, distractedness, and disruptiveness are most prominent. These are frequent complaints by parents and teachers.

The definition of hyperactivity applied in the present study, is as follows: "perennially restless, impulsive and aimless behaviour involving motor activity which occurs at a very high rate."

The **Control Variable** is one which is neither manipulated nor observed by the experimenter. It is a potential independent variable that is held constant in an experiment. This is achieved by equating the two groups (experimental and control groups) on these variables.

In the present study, the control variables were the sex of

the children, the standard in which they studied and the medium of instruction. An equal number of students was taken from each gender, each standard and each medium of instruction.

4.10.0. PROCEDURAL DETAILS

The present investigation, as mentioned earlier, was an experimental study in that it studied the comparison between two groups - the experimental groups and the control group - with respect to the effects, if any, of the intervention strategies used.

The study was conducted in four phases.

(1) the pre-intervention phase

(2) the intervention phase

(3) the post-intervention phase

(4) the delayed-intervention phase.

The PRE-INTERVENTION PHASE, consisted of four stages. The first stage involved the administration of the questionnaire and baseline, the development of which has already been described in an earlier section of this chapter.

The schools which had earlier been selected for data

collection by means of a letter from the Head of the Department requesting permission to work there were contacted again. The questionnaires were then handed over to the teachers and parents of all the students of Standards 4 and 6. The students of Std. 5 were not included in the sample because primary sections of some schools terminate at the 5th standard and children leaving this standard would then be dispersed in different schools. It would then be difficult to manage the third and fourth phase of the study.Therefore, only students of standards 4 and 6 were taken.

The teachers were asked to rate each child on the questionnaire. Parents were asked to rate their respective child on a similar questionnaire. Once this was done, the questionnaires were scored. A note was made of each child's score on each of the two behaviour disorders as given by teachers and parents. An average of these scores was of each child on each behaviour disorder from teachers and parents was then obtained. This was essential as the children would be categorized into each group according to the average scores given to them by the two raters. The range of the averages having been obtained, they were divided into the three categories on the basis of the quartile deviation.

The children whose averages fell on or above Q1 were categorized into the sub-group of High Aggression/Hyperactivity.

The children whose averages fell on or below Q3 were categorized into the sub-group of Low Aggression/Hyperactivity.

The children whose averages fell between the limits of Q1 and Q3 were categorized into the sub-group of Medium Aggression/ Hyperactivity.

All the children to be included in the sample were thus assigned to one of the six groups, which were High Aggression, Medium Aggression, Low Aggression, High Hyperactivity, Medium Hyperactivity and Low Hyperactivity.

The second stage involved the administration and collection of the baseline data. This was done by listing the behaviors the child engaged in - which depended on each child's behaviour disorder. This list was given to the teachers and parents to mark over a period of 15 days. They were requested to observe and note down how many times the child behaved according to the list, during a certain fixed period each day.

Teachers were expected to observe the children during their class hours. Parents were expected to observe their child during

the morning hours, for one hour each day.

The children were then randomly assigned to 1 of 5 intervention groups, for example, every first child going to yoga, every second child going to reinforcement, and so on. This was the third stage. The intervention groups were:

1. Yoga
2. Reinforcement
3. Time-Out
4. A combination of all three
5. Control group

The fourth stage - and the final one- consisted of meeting with parents and teachers and explaining to them various strategies of therapy. It also involved teaching the children in the first and fourth intervention groups different yoga asanas included in the intervention procedure. Training the children for the asanas was done over a period of 15 consecutive days and involved the investigator's meeting daily with these children.

As soon as the above mentioned 4 stages were completed, the INTERVENTION PHASE was set into motion. The different types of intervention strategies were, as mentioned earlier, five: yoga,

reinforcement, time-out, a combination of the three and a no-intervention or a control group.

A note on these strategies follows.

As mentioned in Chapter II, yoga asanas form the third item of the yogic curriculum. Asana is considered as a physical aid to concentration. Hathayoga deals with innumerable postures of the body, aiming at perfecting the physical mechanism of the body, bringing about longevity and resistance to disease.

The yogic exercises which were used for intervention were the following:

Padmasana

Bhadrasana

Paschimotanasana

Ardha-Matsyendrasana

Yoga-Mudra

Shavasana

Pranayama

These exercises were performed twice a week in the presence of the investigator at school, and daily at home. They took for a total of approximately 25 minutes to perform. These asanas were

performed throughout the intervention period of 3 months.

The second intervention strategy was that of reinforcement. Contingency. This means that reinforcement is contingent upon not indulging in a disruptive behaviour. It was, therefore, explained to teachers and parents that for behaviour change to occur, the child has to be motivated, both intrinsically and extrinsically, to change his behaviour. This could be done only by reinforcing or rewarding the child every time he refrained from acting out a disruptive behaviour.

Reinforcement was undertaken in two stages.

In the pre-intervention phase the reinforcements to be given to the children had already been decided. These varied from child to child. They had to be such so as not to involve extra expenditure for the parents.

Various reinforcements included sweets, chocolates, ice-creams, pencils, erasers, an occasional gift or present, etc.. All this constituted material reinforcement, which lasted for the first one and a half months of the intervention period.

The second half of the three months of intervention constituted the second stage, where the nature of reinforcements

changed from material to verbal, and the schedule changed from continuous to intermittent.

The parents and teachers were asked to change their rewards from `things' to `words' , which would help make the child feel that he has done something good. Verbal reinforcement includes praises such as `very good', `good', `I'm very happy you behaved in such a way', `that was a very nice thing you did', `thank you for not hitting your brother/sister', etc..

Reinforcements by the investigator were given twice weekly, and by parents and teachers daily.

The third intervention strategy involved time-out. Time-out, though a type of punishment, does not incorporate corporal or physical punishment.

The two most common time-out methods are that of `Exclusion', and `Isolation'. In exclusion time-out, the child is excluded from a particular activity of positive reinforcement while being allowed to stay in the same room and observe it. He is,therefore, `excluded' from any play or activity.

The was the type of time-out used in the present study. Parents and teachers were asked to follow the instructed time-out

pattern wherein, whenever the child engaged in disruptive behaviour, he or she was to be sent to a corner of the room for a fixed amount of time, and then made to rejoin the group activity.

This intervention strategy, too, was carried out in two stages, involving the two halves of the intervention period.

During the first one and a half months, every time the child misbehaved, he or she was sent out of the group activity for a fixed period of time - that of two minutes. When the time had elapsed the child was allowed back into the group. During time-out , the child was made to stand at some distance from the group and the group members were told not to pay any attention to that child. If they did so, they would suffer the same punishment.Parents and teachers, too, were requested to follow the same procedure.

During the second stage, that is, the remaining one and a half months, the time structure of the execlusion time-out was changed; that is, the child was initially excluded for a period of two minutes, but with every misbehaviour that occurred while in time-out , the period of exclusion was increased by one minute each. This was incorporated by the parents and teachers as well.

The group activity mentioned above consisted of different things. In the classroom with the teacher it was whatever group work was being conducted at that time. At home with parents it was any play or leisure activity that the child was engaged in. With the investigator it was always an out-of-the-classroom activity which the children normally enjoyed, for example, playing different word games.

The fourth intervention strategy was a combination of yoga, reinforcement and time-out. The children included in this group were administered all three interventions simultaneously, as and when the behaviour occured. Parents and teachers, too, were asked to reinforce the absence of a disruptive behaviour and punish the occurence of a disruptive behaviour. The child was also made to perform yogic asanas. All these interventions were carried out in the same manner on this group of children as on the other three groups.

The fifth group comprised the no-intervention group; that is, the control group. This was the group of children to whom no intervention strategy was administered. They behaved as they usually did without any interference from either the parents, teachers, or the investigator.

All through the intervention phase a continuous report was asked for from the parents and teachers about the changes they noticed, if any, in the children. The investigator, too, was observing the same, independently.

As soon as the three months of the intervention phase were completed, the POST-INTERVENTION PHASE was put into motion. This phase conisted of readministration of the questionnaire and baseline to parents and teachers.

The scores of this phase were compared to the scores of the pre-intervention phase, and results thus obtained.

The final phase of this research study was that of DELAYED INTERVENTION. This was conducted a further three months after the completion of the post-intervention phase, after the children returned from their summer vacations in the new academic year. This phase lasted for 15 days, wherein the children were given the same intervention strategies as before. That is, yoga asanas were performed by the first group of children; reinforcement was given to the second group; time-out was administered on the third group of children; a combination of all these three strategies was given to the fourth group; and the fifth group of children was the control group, as before.

At the end of the 15 days, the parents and teachers were given the questionnaires and baselines and asked to note the child's score on each.

The final analysis of results, therefore, comprised the scores of all three administrations of the questionnaire and baseline. These results are discussed in detail in Chapter V.

4.11.0. STATISTICAL TOOLS USED

The statistical tools used by the investigator for the analysis of results in the present study were four: the Student's t-Distribution(t-test), Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA) and Correlation Analysis.

STUDENT'S t-DISTRIBUTION (t-test)

Gosset, in a paper published in 1905, derived a theoretical distribution which has come to be known as "Student's t-distribution", after the pseudonym he used. Gosset's discovery is often considered as the beginning of the modern era in mathematical statistics with its emphasis on the use of exact sampling distributions and on making the best possible use of observed data for inferring parameters.

Student's t is defined as

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Tables of t-distribution show the degrees of freedom (v or nu) associated with the sample and selected probability levels. The former will be (n - 1) and the latter is often taken as 5% as the lowest level at which we can regard a difference as significant. If the value of the calculated t is greater than the value shown in the table, it indicates that the difference between the means being considered is significant.

ANALYSIS OF VARIANCE (abbreviated as ANOVA).

This is an extremely useful technique concerning researches in the fields of economics, biology, education, psychology, sociology, etc.. This technique is used when multiple cases are involved.

The ANOVA technique is important in the context of all those situations where we want to compare more than two populations. In such circumstances one generally does not want to consider all possible combinations of two populations at a time, for that

would require a great deal of tests before we would be able to arrive at a decision. Therefore, one quite often utilizes the ANOVA technique and through it investigates the differences among the means of all the populations simultaneously.

Prof. R. A. Fisher was the first person to use the term "variance" and, in fact, it was he who developed a very elaborate theory concerning ANOVA explaining its usefulness in the practical field. Later on Prof. Snedecor and many others contributed to the development of this technique.

The basic principle of ANOVA is to test for differences among the means of the populations by examining the amount of variation within each of these samples, relative to the amount of variation between the sample. That is, we have to make two estimates of population variance, namely, one based on between-sample-variance and the other based on within-sample-variance. Then the said two estimates of population variance are compared with the F-test

$$F = \frac{\text{Estimate of population variance based on between-sample-variance}}{\text{Estimate of population variance based on within-sample-variance.}}$$

This value of F is to be compared to the F-limit for given degrees of freedom. If the F-value we work out is equal to or exceeds the F-limit value, we may say that there are significant differences between the sample means.

ANALYSIS OF COVARIANCE(abbreviated as ANCOVA).

The object of experimental design, in general, is to ensure that the results observed may be attributed to the treatment variable and to no other casual circumstance. For instance, the researcher studying one independent variable, X, may wish to control the influence of some uncontrolled variable, Z, which is known to be correlated with the dependent variable, Y. He should then use the technique of ANCOVA for a valid evalivation of the outcome of the experiment. "In psychology and education, primary interest in ANCOVA rests in its use as a procedure for the statistical control of an uncontrolled variable" (Ferguson, 1959, p.347).

While applying the ANCOVA technique, the influence of uncontrolled variables is usually removed by simple linear regression, and the residual sum of squares is used to provide variance estimates which, in turn, are used to make tests of significance. The questions which ANCOVA attempts to answer are

quite similar to those with which ANOVA is concerned. The main distinction between ANOVA and ANCOVA is the fact that in ANOVA we have only one basic variable to analyze while in ANCOVA there are atleast two such variables, and in some cases, many more than two. Thus, ANOVA may be regarded as univariate analysis while ANCOVA may be regarded as multivariate analysis.

The techniques of variance and covariance are applicable not only to experimentally controlled data, but they may also be applied under certain conditions to data over which the experimenter does not have complete control. One example of this is the twin study in which the experimental factors are predetermined and the task of the experimenter is observation rather than manipulation of experimental factors.

Several related or cognate methods utilized frequently must be clearly differentiated from ANOVA and ANCOVA. If scores on two forms of a test are available for each individual in two contraasted groups, two possible questions may be put to the data. The first concerns itself wwith the reliability of the test as a whole and its differential reliability in the two contrasted groups. The second question concerns itself with discovering whether the gain fron the first to the second test is different

in the two contrasted groups. The first of these problems is a simple ANOVA problem, while the second calls for an ANCOVA. The same data can be treated in different ways depending upon the purpose of the experiment.

CORRELATION ANALYSIS

The techniques that have been developed to provide measures of the degree of association between variables are known as Correlation Methods. Consequently, when an analysis is performed to determine the amount of correlation, it is referred to as a Correlation Analysis. The resulting measure of correlation is usually called a Correlation Coefficient.

The correlation coefficient (written as `r'), is a measure of the degree of closeness of the linear relationship betwen two variables.

Two properties of `r' should be noted:

i) `r' is a pure number without units or dimensions and can be computed from coded values of X1 and X2. No decoding is necessary.

ii) `r' always lies between +1 and -1. Positive values of `r' indicate a tendency of X1 and X2 to increase together. Where `r'

is negative, large values of X1 are associated with small values of X2.

Perfect correlation (r=1) rarely occurs in data, though correlations as high as 0.99 are not unheard of. Each field of investigation has its own range of coefficients.

`r' can be computed by means of the following formula:

$$r = \frac{NEXY - EXEY}{\sqrt{[(NEX^2) - (EX)^2]\ [(NEY^2) - (EY)^2]}}$$