

DECISION-MAKING IN TASK-ORIENTED  
AND INTERACTION-ORIENTED GROUPS

Submitted in fulfilment of the  
Requirements for the Degree of  
M.A. in Psychology

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	<u>Page No.</u>
<u>CONTENTS</u>	
ACKNOWLEDGEMENTS	(ii)
NOTATION	(vi)
SUMMARY	(vii)
CHAPTER I : INTRODUCTION	1
1.1 Trait versus Behavioural Approach to Leadership	5
1.2 TO and RO Viewed as "Either/Or" Orientations	6
1.3 Leadership Research Where TO and IO are Conceptualised as Two Independent Dimentions	16
1.4 Power	28
1.5 Groups	31
1.6 Hypotheses of the Present Study	40
CHAPTER II : INSTRUMENTS	45
2.1 The Ray Questionnaire	46
2.2 NASA Moon Survival Problem	50
2.3 Interaction Process Analysis	53

	<u>Page No.</u>
CHAPTER III : METHOD	58
3.1 Administration of the Ray Questionnaire	59
3.2 Subjects	61
3.3 Organisation of the Sub-Groups	61
3.4 The Decision-Making Exercise	62
3.5 Observation of the On-Going Group Process	64
CHAPTER IV : RESULTS AND ANALYSIS	66
4.1 Results of the Ray Questionnaire	67
4.2 Division into Groups	72
4.3 Overview of Treatment of Data From the Decision-Making Exercise	74
4.4 Data From the NASA Moon Survival Problem	79
4.5 Data From the Bales IPA	81
4.6 Analysis of Ray, Bales and NASA Data	86
CHAPTER V : DISCUSSION AND CONCLUSIONS	90
5.1 Hypothesis A	91
5.2 Hypothesis B	93
5.3 Hypothesis C	96
5.4 The Ray Questionnaire	98
5.5 The NASA Game	104
5.6 IPA Analysis and the Sub-Groups	105
5.7 Directions for Future Research	112

	<u>Page No.</u>
APPENDICES	115
Appendix A	116
Appendix B	127
Appendix C	132
REFERENCES	135

NOTATION

TO : Abbreviation for Task-Orientation  
"Reflects the extent to which a person is concerned about completing a job, solving problems, working persistently and doing the best job possible" (Ray, 1973).

IO : Abbreviation for Interaction-Orientation  
"Reflects the extent of concern with maintaining happy, harmonious personal relationships - interest in group activities is high" (Ray, 1973).

Group : The Ray Questionnaire assigns a measure to the TO and IO of each subject. On the basis of their scores on the questionnaire, the subjects were divided into four homogeneous groups.

- (i) H-H (High TO, high IO)
- (ii) H-L (High TO, low IO)
- (iii) L-H (Low TO, high IO)
- (iv) L-L (Low TO, low IO)

Sub-Group : The term sub-group refers to a small discussion group of four or five participants, all members of one of the four groups described above.

## SUMMARY

Within an organisation, leadership involves accomplishing goals by working with and through people. This comprises the concepts of concern for the task and concern for relationships, and leadership research has been concerned with predicting the way in which these concepts interact, whether they are independent dimensions or not and how a balance may be achieved between the two.

The present research follows directly on from the Ohio State Leadership studies (Fleishman and Peters, 1962) which viewed the concepts of task-orientation (Initiating Structure) and relationship-orientation (Consideration) as two separate dimensions and not as situated along a single continuum. Research following on from this (e.g. Blake and Mouton, 1964; and Hersey and Blanchard, 1969) all take this concept of these two dimensions as their starting point.

Bales (1950) developed his system of Interaction Process Analysis (IPA) for observing and recording the on-going process in small groups. He similarly conceptualises a group as having two sets of problems - those relating to the task and those relating to the socio-emotional needs of group members.

Bass (1967) has developed the Orientation Inventory (Ori) which is an ipsatively scored instrument yielding measures of an individual's task-, interaction- and self-orientations. The reliability and validity of this inventory has been criticised by Ray and the



ipsative scoring has come under particular attack. As a result, Ray developed a questionnaire consisting of a 27-item Likert scale measuring task-orientation (TO) and a 32-item Likert scale measuring interaction-orientation (IO). These were combined into one 62-item scale for the purposes of the present research.

In the present study, groups were constituted on the basis of the task-orientation and the interaction-orientation scores obtained from the Ray questionnaire (Ray, 1973). Performance of these groups was predicted in terms of both the decision outcome on the NASA game (Hall, 1971) and the amount of synergy generated. The group processes measured by Bales IPA (Bales, 1950) which were used in reaching the solution to the NASA game were also predicted on the basis of the Ray scores. Lastly, performance on the NASA game was predicted from the Bales scores.

The Ray questionnaire was administered to students enrolled in the first course in Psychology at the University of Cape Town. Their TO and IO scores were ranked and the rankings divided into high, medium and low. Medium was defined as the middle 25% of scores on both scales. This meant that there were nine possible groupings of pairs of TO and IO scores. The pairs involving the middle scores were eliminated, leaving the following four groups :

- (1) H-H : High TO and high IO scores
- (2) H-L : High TO but low IO scores
- (3) L-H : Low TO but high IO scores
- (4) L-L : Low TO and low IO scores.

In terms of these four groups three hypotheses were put forward.

- A It was predicted that the H-H groups would perform best on the NASA game and achieve the greatest degree of synergy, the H-L group would perform next best but would achieve less synergy than the L-H group which would rank third in terms of decision adequacy. The L-L group would be the least efficient in terms of both criteria.
- B Using the Ray scores as predictors of Bales scores it was predicted that the H-H group would show the highest total rates of interaction and would achieve a balance between the task and socio-emotional areas of functioning. The H-L group would show the next highest rates of interaction but the emphasis would be on the task areas. With regard to the L-H group, the emphasis would be on the socio-emotional areas and the total rates of interaction would be lower than for the H-L group. The L-L group would show the lowest rates of interaction in all categories.
- C With regard to using Bales scores as predictors of NASA scores, it was predicted that groups emphasising task and socio-emotional areas of functioning would perform best, followed by groups emphasising task areas of functioning. Groups whose main concern was with the socio-emotional areas of functioning would perform third best, and groups which emphasised neither concern would perform least best.

Sub-groups consisting of four or five members drawn from one of the above groups were constituted and given the NASA Moon Survival Problem which requires participants to rank 15 items in order of their importance for survival. The students were asked to complete this first individually and then together as a sub-group with the aim of reaching consensus. Group decision instructions were read out to each sub-group in an effort to legitimise certain process behaviours within each sub-group, enabling the members to strive toward reaching consensus. No time limit was set and the groups were observed using the Bales IPA.

The data were then analysed - a Chi-square test of homogeneity was performed on the NASA difference scores (sub-group error score minus individual error score) for the four groups and on the data from the 12 Bales categories for the four groups. Spearman Rank Correlation Coefficients were computed between all possible pairs of variables of the Ray scores, the Bales scores and the NASA difference scores.

The results only partially supported Hypothesis A. The Chi-square test showed no significant differences between the groups. The hypothesis was supported with regard to the amount of synergy generated by the H-H and L-L groups, but the order was reversed from that which was predicted for the H-L and L-H groups.

Hypothesis B was not supported. The Chi-square test showed no significant differences even at the very high 0.995 level of significance. The Ray scores were

thus shown not to predict the Bales scores. The results of the Spearman Rank Correlation Coefficients computed between all possible pairs of Ray TO and IO scores and Bales scores in the task-areas and in the socio-emotional areas of functioning were all positive and significant. This suggests that the Ray questionnaire does not divide people into the categories that Bales (1956) describes as task specialist, socio-emotional specialist, great man, etc., and that Bass (1967) describes as task-oriented and interaction-oriented. In terms of the present sample, these results suggest that the Ray questionnaire had no predictive value.

Since it has been conclusively shown that the grouping of subjects according to their Ray TO and IO scores was not predictive of Bales scores and was only partially predictive of performance scores, the last hypothesis becomes redundant. Thus the NASA game was given to heterogeneous groups and any correlation between the Ray scores and NASA scores would simply be a reflection of the association between these two measures.

Drawbacks of the research design were indicated and directions for future research suggested.

CHAPTER I : INTRODUCTION

1.1 Trait Versus Behavioural Approach to Leadership	5
1.2 TO and RO Viewed as "Either/Or" Orientations	6
1.3 Leadership Research Where TO and IO are Conceptualised as Two Independent Dimensions	16
1.4 Power	28
1.5 Groups	31
1.6 Hypotheses of the Present Study	40

## CHAPTER I : INTRODUCTION

Leadership can be viewed as a "relational concept implying two terms : the influencing agent and the person influenced" (Katz and Kahn, 1966). It is a concept applied not only to industrial organisations, but also to political parties, religious groups, sports teams, gangs, etc.

Any study of leadership thus involves the leader and his followers and it is necessary to focus on the concept and nature of the group and group processes. This becomes all the more apparent when leadership is studied within an organisation - organisation goals are accomplished through people; people work in groups and leadership is necessary in any group in order to achieve these group goals. Within the organisation, leadership is viewed as the process whereby the activities of the individual or group are influenced toward achieving group goals.

There are two aspects to this - goal accomplishment which can be seen as involvement with the task in hand and working with and through people which may be seen as involving the concept of relationships. The concepts of emphasis on the task and emphasis on relationships may be in conflict with one another; a group may accomplish goals, but the group needs of the members of that group may not be satisfied.

Much of the research into leadership has been concerned with the twin concepts of task-orientation (TO) and relationship-orientation (RO). The way in which these

concepts interact, whether they are independent dimensions or not and how a balance between the two may be achieved are among the issues that have been investigated.

Instruments which measure TO and RO have been developed. People have been found to 'possess' different amounts of the two orientations - some are more task-oriented, others more relationship-oriented. As situations change, different skills are needed and so attempts have been made to ascertain the orientations that are most effective in different situations.

The importance of situational variables came to be realised as a factor relevant to an individual's orientation. As situations change, so must tasks, group needs and therefore leadership roles change. Any study of leadership must take these situational variables into account (Reddin, 1967; Fiedler, 1967).

Effectiveness in group functioning can be examined in terms of the group's success in decision-making, the way group members resolve conflict or the way in which they take advantage of the different skills of each other, drawing them in to make a valuable contribution and hence a yet more effective group.

The key concepts in leadership then are : the leader, his followers, the situation and the effectiveness of the leadership attempt.

The present study aimed at investigating whether knowledge of the combination of TO and RO which people grouped in

small sub-groups of the same orientation combination possessed, could help us predict how they would perform in a decision-making situation (the outcome); and the way in which they would interact in such a situation (the processes employed). A further goal of the study was to investigate whether the pattern of interaction could predict the decision outcome.

Thus task- and relationship-orientations were ascertained by means of a questionnaire and subjects divided into four groups of homogeneous orientation from which sub-groups were arranged. Performance was evaluated in terms of nearness to a given solution and the interaction processes were observed and measured.

A survey of research in this field now follows. Theories related to the concepts of TO and RO are expounded. Then the issue of power is briefly dealt with and lastly the concept of groups and effective group functioning is examined.

In examining the different approaches to leadership that have been adopted, it is important not to get too bogged down in classifying and labelling these approaches rather than seeing the problems in a wider context. McGregor in his book "The Professional Manager", which was published in 1967, three years after his death, sums up this viewpoint. "It seems to me far less important to categorise and label managerial cosmologies than it is to understand their development, their impact on managerial strategies; and the implications of them for behavioural science knowledge."



### 1.1 TRAIT VERSUS BEHAVIOURAL APPROACH TO LEADERSHIP

The early studies on leadership were concerned with identifying certain traits which successful leaders were assumed to possess. These traits were considered to be inborn. Investigators therefore identified groups of good and poor leaders and measured them on certain personality traits in an attempt to determine the critical leadership traits which the good leaders were supposed to possess.

As might be expected, very few significant or consistent findings emerged from these studies which have also been criticised on methodological grounds. Identification of good and poor leaders can only be done with reference to a system of values and the question arises as to what system to adopt. Then there is the problem of defining traits and agreeing on definitions of them. These traits are, however, not only a function of the individual but also of the situation in which he finds himself. Lastly, the necessary cross-validation on a different sample of leaders was often not carried out.

Such studies do not provide any insight into the dynamics of a leadership situation. They also lead one to question the usefulness of leadership training; for training could only serve to perhaps bring out still further certain traits which were inherent in only the good leader (Blum and Naylor, 1968). Today leadership is seen in terms of a Situational or Behavioural Approach where the focus is on the behaviour of the leader and those he leads in different situations. This has proved a much more fruitful approach, not only in terms of research findings,

but also in terms of the positive implications of training leaders to be more effective.

## 1.2 TO AND RO VIEWED AS "EITHER/OR" ORIENTATIONS

### The Scientific Management Movement

This was founded by F.W. Taylor (1856 - 1917) during the early 1900's. The basis for it was technological and the emphasis was on a task-orientation. Taylor recognised the interdependence of management and the workers but considered that workers were expected to adjust to management and not vice versa. Thus, Taylor strove for excellence in performance and his experiments did lead to a more efficient utilisation of equipment, labour and materials.

Leadership was seen in terms of concern for the task and the function of the leader was "to set up and enforce performance criteria to meet organisational goals. His main focus was on the needs of the organisation and not on the needs of the individual" (Hersey and Blanchard, 1972). Thus the concept of a relationship - orientation was virtually non-existent.

### Mary Parker Follett (1863 - 1933)

Mary Parker Follett's views on management can be seen as spanning the gap "between the mechanistic approach of Taylor and our contemporary approach emphasizing human behaviour" (George, 1972).

She saw coordination as the central core of management

and her four fundamental principles of organisation encompass this. With regard to leadership, Mary Parker Follett felt that "the primary task of management is to arrange the situation so that people cooperate readily of their own accord", and she saw the problems "as essentially those of reconciling individuals and social groups" (Pugh, Hickson and Hinings, 1971). She advocated a group process approach.

She was one of the first to be concerned with the issue of power and one of the questions she raised was whether power meant "power over" people or "power with" people in an organisational setting. This can be seen as task versus relationship approach with regard to the concept of power.

#### The Human Relations Movement

During the 1920's and early 1930's the human relations movement evolved largely from the work of Elton Mayo (1880 - 1949) and his associates.

Mayo conducted a five-year investigation at the Hawthorne works of the Western Electrical Company in Chicago. These studies, now known as the Hawthorne Investigations have become a classic in the field of human relations.

It is well known how a team of engineers investigating the effects of illumination, isolated two groups of workers; varied the lighting conditions in one group, held the other constant and contrary to their expectations, found that production continued to rise

in both groups, even when the illumination in the experimental group was decreased to a bare minimum.

As a result of these then puzzling findings, Mayo conducted his "Hawthorne Investigations" and the important role that the informal organisation played within the larger organisation was realised. The ways in which the informal organisation could help or hinder management also became known. For the first time the human factor in work situations was considered.

Now at last, the needs of the people became an important issue and the concept of a relationship - orientation came into its own. Mayo (1949) sums up his investigations as follows. "Originally designed to study the comfort of workers in their work as a mass of individuals, it has come to clear specification of the relation of working groups to management as one of the fundamental problems of large-scale industry." It showed the importance too of "developing teamwork, that is to say, of developing and sustaining cooperation".

The three pioneers Taylor, Mayo and Follett emphasised aspects of leadership that have characterised research on leadership to this day - viz. concern for the task, concern for relationships and emphasis on group process.

These issues will be seen to emerge time and again in the review of the more contemporary research on leadership which now follows.

Douglas McGregor (1906 - 1964)

McGregor who formulated the concepts of Theory X (the traditional approach to management) and Theory Y (an alternative approach which leads to a more accurate understanding of human nature and what motivates man) sought to clarify in his 1967 book certain misconceptions that arose from his earlier publications.

He sees Theory X and Theory Y as two different "managerial cosmologies". They are not managerial strategies but rather "underlying beliefs about the nature of man that influence managers to adopt one strategy rather than another" (McGregor, 1967). These cosmologies cannot be conceptualised as lying along a continuous scale as they are qualitatively different.

Assumptions about the nature of man which underline Theory X and Theory Y

<u>Theory X</u>	<u>Theory Y</u>
1. Work is inherently distasteful to most people.	Work is as natural as play, if the conditions are favorable.
2. Most people are not ambitious, have little desire for responsibility and prefer to be directed.	Self-control is often indispensable in achieving organisational goals.
3. Most people have little capacity for creativity in solving organisational problems.	The capacity for creativity in solving organisational problems is widely distributed in the population.

<u>Theory X</u>	<u>Theory Y</u>
4. Motivation occurs only at the physiological and safety levels.	Motivation occurs at the social, esteem and self-actualisation levels, as well as physiological and security levels.
5. Most people must be closely controlled & often coerced to achieve organisational objectives.	People can be self-directed and creative at work if properly motivated.

(Hersey and Blanchard, 1972)

McGregor (1960) differentiates between his two theories as follows. "Theory X offers management an easy rationalisation for ineffective organisational performance. It is due to the nature of the human resources with which we must work. Theory Y, on the other hand, places the problems squarely in the lap of management." Theory Y is a dynamic theory which indicates the possibilities for human growth and development.

Theory X can be seen as emphasising a task-orientation and Theory Y a relationship - orientation but these concepts are not identified as two separate dimensions as in the Ohio State or Michigan research which are reviewed in sections 1.2 and 1.3 respectively.

#### Tannenbaum and Schmidt

Tannenbaum and Schmidt have shown how a manager may choose from different patterns of leadership according to the situation. These patterns are situated on a continuum and are based on the assumptions a leader

makes about his source of power and authority and human nature.

The continuum extends from an authoritarian approach (similar to Theory X) where the manager exercises a high degree of control to a democratic approach (similar to Theory Y) where the manager relinquishes this high degree of control.

Neither of these extremes is seen as absolute and it can be seen how "each type of action is related to the degree of authority used by the boss and to the amount of freedom available to subordinates in reaching decisions" (Tannenbaum and Schmidt, 1958).

In deciding what course of action to follow, the leader has to be aware and have insight into the forces in the manager, the subordinates and the situation.

Although this view of leadership behaviour has in its favour the recognition of the importance of different leadership situations, it is of limited utility in that it conceptualises task and relationship-orientations as being either-or concepts. This means that in striving toward effectiveness, a leader can only be highly task-oriented or highly relationship-oriented and training can similarly only be evolved in terms of this either-or situation. It is thus a very limiting approach.

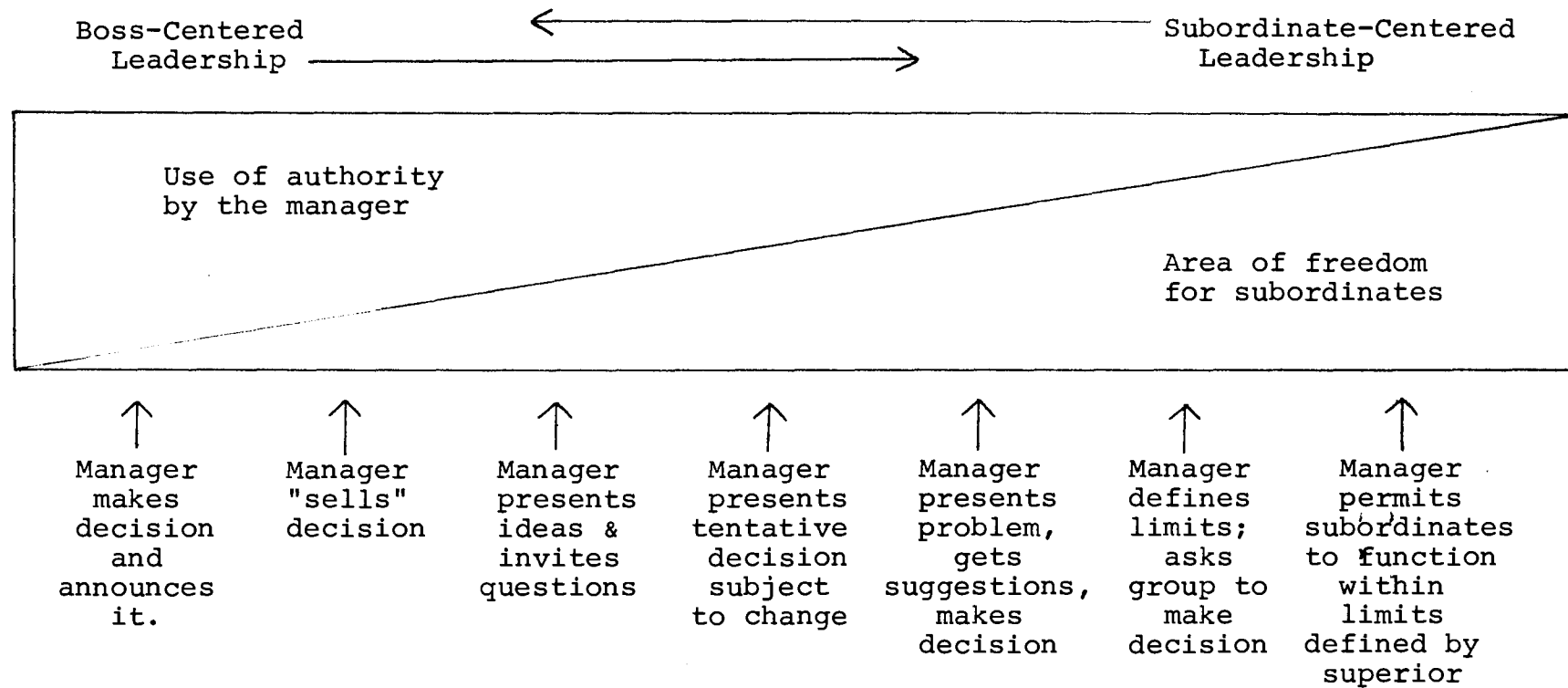


Figure I : Continuum of Leadership Behaviour  
(Tannenbaum and Schmidt, 1958)



### The Michigan Leadership Studies

The early work in leadership at the Survey Research Centre, University of Michigan, was carried out by Kahn, Maccoby and Morse (1950) (Blum and Naylor, 1968). These researchers aimed at locating clusters of characteristics associated with high- and low- producing supervisors of clerical workers.

Twelve pairs of sections of clerical workers and their supervisors at the Prudential Insurance Company were studied. One of each pair had previously been determined to be a high-productivity section and the other a low-productivity section. This information was obtained from work records of the actual time spent in completing a given amount of work. Each pair was matched with regard to the number of people, type of work carried on in the section and so forth.

As a result of extensive interview work, it was found that the orientation of supervisors in the high-producing sections was "employee-centered", whilst that of the low-producing sections was "production-centered". These concepts are similar to those of relationship- and task-orientation.

The Michigan researchers viewed the two concepts employee-centered and production-centered as lying along a continuum. Today, however, they have modified their view and these two concepts are viewed as independent dimensions. (This is in line with the Ohio State Leadership research - see section 1.3). The concepts identified in the initial study have remained the same;

it is only the nature of the relationship between them that has changed.

Vroom and Mann (1960) have found that the worker's preference for type of supervision was influenced by the nature of the job. In a study of a large trucking organisation, it was found that where the work was interdependent (e.g. package handling) employee-centered supervision was preferred, but where the work was independent (e.g. truck driving) production-centered supervision was preferred. This shows the importance of looking at the situation when studying task- and relationship-orientations.

Vroom (1960) showed that personality differences affect the worker's "preference for and response to the type of supervisor" (Schein, 1965). Dependent, authoritarian types preferred production-centered supervision, whilst independent types of men worked most productively under employee-centered supervisors who allowed participation in decisions.

#### Rensis Likert

Likert has used the Michigan studies as a starting place for his research. He has found that the most productive leader behaviour is employee-centered or democratic. These leaders concentrate on building effective work groups with high performance goals and supervise in a general as opposed to a close manner.

He views an organisation in terms of overlapping groups with each person linked to the rest of the

organisation by people (whom he calls linking pins) who belong to more than one group. As a result an effective supervisor must be skilled in both the leadership functions of his own group and in the membership functions of his superior's group. The organisation will function best when the people function not as individuals but as part of effective and overlapping work groups. All relationships are viewed as supportive.

There are no specific roles of supervision that will be applicable to all situations. "Supervision is, therefore, always a relative process" (Likert, 1961) and thus the leader must adapt his behaviour according to the expectations, values and interpersonal skills of those with whom he interacts. This, Likert calls the "interaction-influence system".

Likert has postulated four systems of management :

- System 1 : Exploitative-Authoritative
- System 2 : Benevolent-Authoritative
- System 3 : Consultative
- System 4 : Participative

System 1 emphasises a task-orientation and is very similar to Theory X assumptions. System 4 is relationship-oriented and is very akin to Theory Y assumptions. Systems 2 and 3 describe the intermediate stages.

### 1.3 LEADERSHIP RESEARCH WHERE TO AND IO ARE CONCEPTUALISED AS TWO INDEPENDENT DIMENSIONS

#### The Ohio State Leadership Studies

A research programme initiated by the Bureau of Business Research at Ohio State University in 1945 questioned whether leader behaviour could be conceptualised as lying along a single continuum as the Michigan researchers had done.

Two basic dimensions of leadership behaviour in a formal organisation were isolated that referred to a task-orientation and a relationship-orientation. These were termed "Initiating Structure" (S) and "Consideration" (C) and were conceptualised as independent orthogonal dimensions.

"Consideration" : Reflects the extent to which an individual is likely to have job relationships characterised by mutual trust, respect for subordinates' ideas and consideration of their feelings. A high score is indicative of a climate of good rapport and two-way communication. A low score indicates the supervisor is likely to be more impersonal in his relations with group members.

Initiating Structure : Reflects the extent to which an individual is likely to define and structure his role and those of his subordinates toward goal attainment. A high score on this dimension characterises individuals who play a more active role in directing group activities through planning,

communicating information, scheduling, trying out new ideas, etc." (Fleishman and Peters, 1962).

This conception of the two dimensions as being separate and distinct meant that now researchers began to conceive of leaders as having any possible combination of C and S. Task- and relationship-orientations were no longer seen as either-or approaches. This exerted a great change on training programmes for leaders.

For the first time the two dimensions were plotted on two axes rather than on a single continuum. This resulted in the development of what is now known as the Ohio State Quadrants which showed four possible combinations in terms of the dimensions C and S.

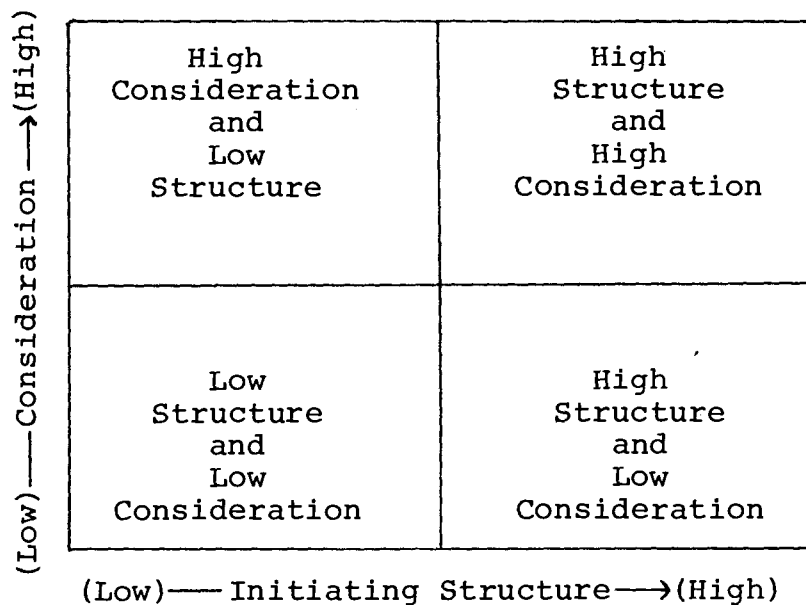


Figure II : The Ohio State Leadership Quadrants  
(Hersey and Blanchard, 1972)

These dimensions were isolated from data gathered by the Leader Behaviour Description Questionnaire (LBDQ). This is a 40-item Likert scaled self-administering inventory which measures subordinates' descriptions of their perceptions of their supervisor's behaviour and which was originally developed by Hemphill and Coons. Halpin and Winer (1952) factor analysed responses to the LBDQ and found that "the factors identified as Initiating Structure and Consideration accounted for approximately 34% and 50% respectively, of the common variance" (Lake, Miles and Earle, 1973).

The Leadership Opinion Questionnaire (LOQ) which is also a Likert-type attitude scale, drawn up on self-report lines assessing how the supervisor thinks he should behave in a leadership situation, yields the same two dimensions.

Fleishman (1953) instituted a supervisory training programme at the International Harvester Company and found that the changes in terms of an increase in C and a decrease in S attitudes due to the training were mainly short term. When the foremen were evaluated back at the plant, the effects of training had almost disappeared.

As a result of this study the importance of the leadership climate of the departments from which the men came was realised. Training was only effective in those departments in which the leadership climate at the start of the training was in congruence with the training goals. In those departments where this wasn't the case, the benefits of the training were lost almost immediately.

Once again the importance of the situation in relation to C and S is seen but here it is more in terms of the context from which the men were selected for training.

Fleishman and Harris (1962) studied the form of the "relationship between leader behaviour and indices of group behaviour" measured by labour grievances and employee turnover. Both of these indices were considered as "partial criteria of group effectiveness". The relationship was found to be curvilinear. They also examined the interaction effects of different combinations of C and S and found that "taken in combination, consideration is the dominant factor".

#### The Managerial Grid

Robert R. Blake and Jane S. Mouton have used the concepts of task- and relationship-orientation as conceptualised in the Ohio State studies - i.e. as two orthogonal dimensions - and have located five different types of leadership behaviour within the four Ohio State Quadrants and have given them "popular" terminology. This formulation is known as The Managerial Grid.

They term the two dimensions "Concern for Production" which is depicted on the horizontal axis and "Concern for People" which is depicted on the vertical axis. "Concern for" refers to an individual's general approach to management and just how he concerns himself with production and people. This can be seen to be an attitudinal model.

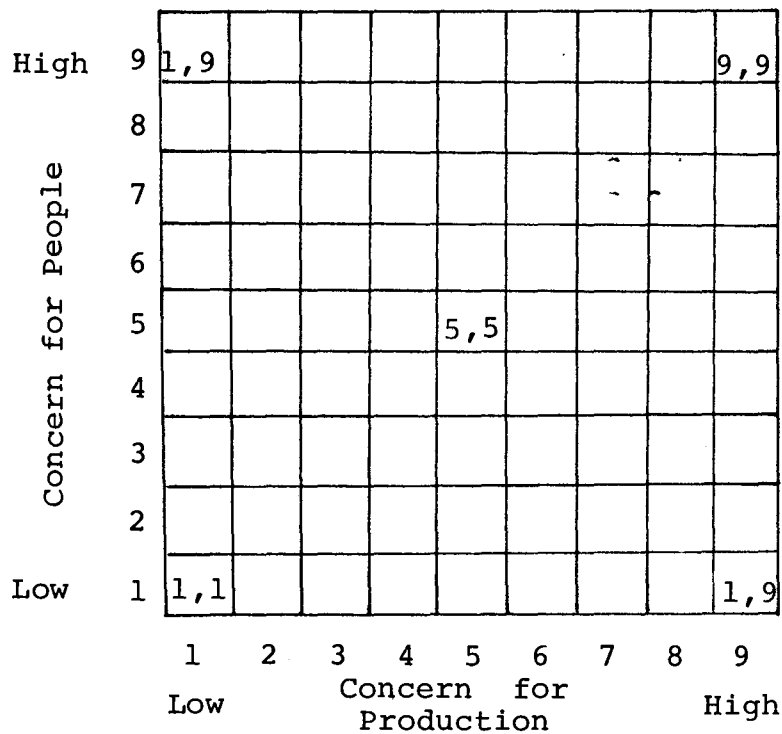


Figure III : The Managerial Grid  
(Blake and Mouton, 1964)

An individual can be rated anywhere from 1 to 9 in terms of his Concern for Production and similarly anywhere from 1 to 9 in terms of his Concern for People. The five main leadership styles illustrated above have been described by Blake and Mouton (1968) as follows :

1,1 "Exertion of minimum effort to get required work done is appropriate to sustain organisation membership.

1,9 Thoughtful attention to needs of people for satisfying relationships leads to a comfortable



friendly organisation atmosphere and work tempo.

- 9,1 Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum degree.
- 5,5 Adequate organisation performance is possible through balancing the necessity to get out work with maintaining morale of people at a satisfactory level.
- 9,9 Work accomplishment is from committed people; interdependence through a "common stake" in organisation purpose leads to relationships of trust and respect."

The above five leadership styles are not the only ones - there are many different possible combinations and "concern for production and concern for people are expressed in vastly different ways, depending on the specific manner in which these two concerns are joined" (Blake and Mouton, 1964).

Management styles are not viewed as fixed or unchanging and can be modified through training. The theory implies that 9,9 is the most desirable form of management behaviour for a leader and training programmes have been developed with this in mind.

### Reddin

Reddin has formulated the 3D theory of management

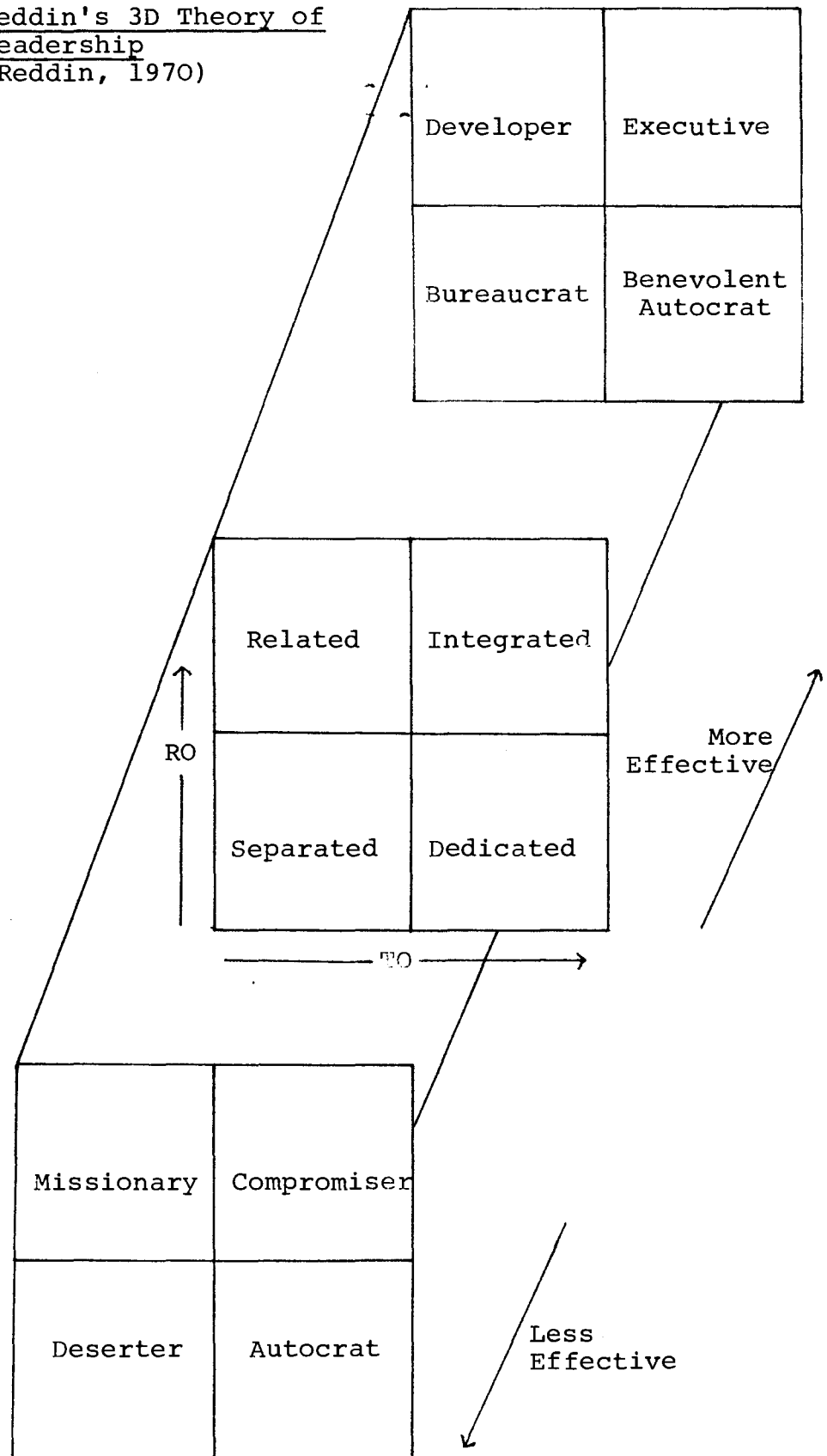
behaviour which uses the two dimensions of the Ohio State model as a starting point but adds an effectiveness dimension. He defines effectiveness as "the extent to which a manager's style; his combination of task and relationship orientation fits the style demands of the situation he is in" (Reddin, 1967). In his 1970 book, he amplifies on this, defining effectiveness as "the extent to which a manager achieves the output requirements of his position".

Reddin defines four basic styles which have been identified by the Ohio State Leadership Quadrants. These are : Integrated, Dedicated, Related and Separated styles. Each of these can be effective in certain situations. Their effectiveness is directly linked up with the situation in which they are used. Reddin conceptualises each of these basic styles as having two behavioural counterparts - one where the leadership behaviour is more effective and the other where it is less effective. The effectiveness dimension creates then eight styles. Reddin states that four of these are more effective - Executive, Benevolent Autocrat, Developer and Bureaucrat - and four which are less effective - Compromiser, Autocrat, Missionary and Deserter.

Reddin considers that it is necessary to have style flexibility and to understand different situations and adapt to them as the situation demands.

Reddin's model of the leadership process is a far more complete model than those previously presented.

Figure IV : Reddin's 3D Theory of Leadership  
(Reddin, 1970)



## Fiedler

Fiedler has developed a contingency model of leadership. The leader's success depends not only on his leadership style but also on the degree to which the situation is favourable or unfavourable to the leader. Favourableness of a situation is defined as "the degree to which the situation enables the leader to exert his influence over his group" (Fiedler, 1967).

There is an interaction between leadership style and the favourableness of the situation for the leader. The leader's style is defined in terms of his score on the Least Preferred Co-Worker Scale (LPC). A low LPC score means the leader is more task-oriented whilst a high score implies the leader is relationship-oriented. The "task-oriented person tends to give his least preferred co-worker a more negative evaluation than the relationship-oriented person" (Graen, Alvares and Orris, 1970).

The favourableness of the situation depends on leader-member relations - "the degree to which the leader is personally accepted and liked" (Fiedler, 1965); task structure - the degree to which the task is defined and power of position - the power and authority that his position provides.

The group-task situation has been defined in terms of a 3-D system conceptualised as a cube. Fiedler identifies eight possible combinations that arise from

these three situational variables.

The most favourable situation is where the leader-member relations are good, position power is high and task structure is high. The most unfavourable situation is where he is disliked, has little position power and the task is relatively unstructured. Controlling, directive (task-oriented) leaders perform best according to Fiedler when the situation is either very favourable or relatively unfavourable; whilst non-directive, permissive (relationship-oriented) leaders tend to perform best in situations of intermediate difficulty.

Hersey and Blanchard (1972) have pointed out that Fiedler appears to be "reverting to a single continuum of leader behaviour, suggesting that there are only two basic leader styles, task-oriented and relationships-oriented". They consider that leadership behaviour is better plotted on two separate axes where any combination of these two dimensions can occur.

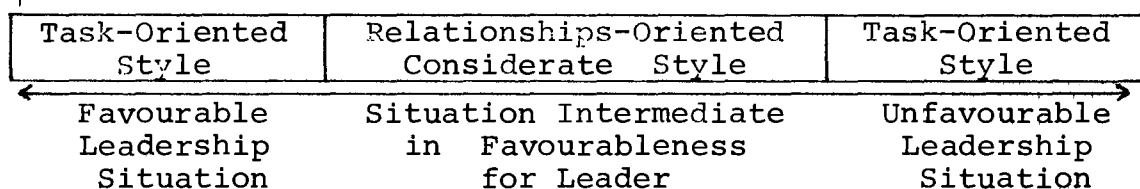


Figure v : Leadership Styles Appropriate for Various Group Situations  
(Hersey and Blanchard, 1972)

Graen, Alvares and Orris (1970) have also criticised the model. They have concerned themselves with methodological and statistical problems and consider that the model involves partitioning and assigning weights to variables in such a way as to support the model which then becomes less sensitive to other relevant variables and disconfirming results.

Jacoby (1968) working on creativity found that high LPC leaders (i.e. relationship-oriented) obtained very high scores on creativity measures. This was in line with theories relating the type of environment and type of supervisor necessary for creative output.

#### The Life Cycle Theory of Leadership

Korman (1966) has shown that the dimensions Consideration and Initiating Structure did not have any significant predictive value in terms of later effectiveness and/or satisfaction criteria. He, like Likert, Reddin and Fiedler, considers that too little attention has been paid to situational differences which require different leadership styles. Furthermore, Korman suggests that the relationship between C and S and other variables is probably curvilinear rather than linear.

The Life Cycle Theory developed by Hersey and Blanchard is based on this curvilinear relationship between task and relationships and the concept of maturity. It is an outgrowth of the Tri-Dimensional Leader Effectiveness Model which links the effectiveness of a managerial style to the appropriateness of that style to the situation in which it is used (Hersey & Blanchard, 1972).

According to this theory, as the level of psychological maturity of one's followers increases, the leader's behaviour requires less structure (task). Initially increasing socio-emotional support (relationships) is required but eventually there is also a decrease in the amount of socio-emotional support that is required. The emphasis is on the followers who ultimately effect the personal power of the leader.

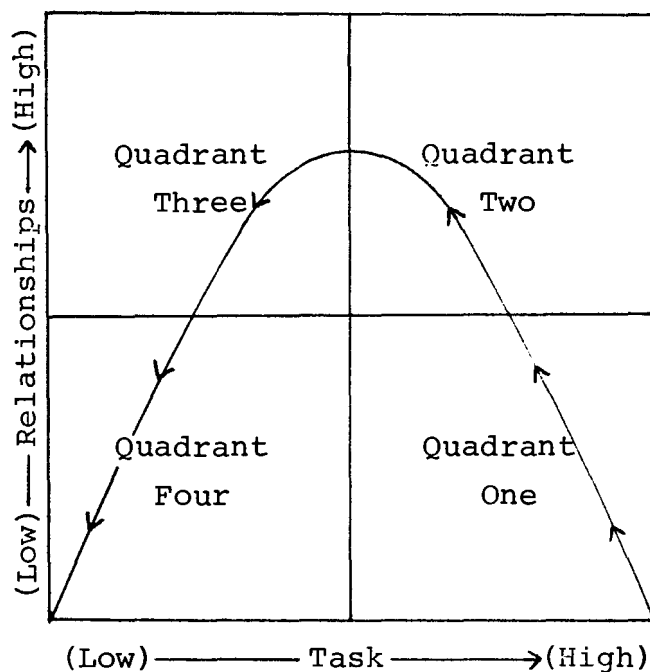


Figure VI : The Life Cycle Theory of Leadership  
(Hersey and Blanchard, 1969)

The Life Cycle Theory suggests that with maturity leader behaviour should move from Quadrant 1, a situation of high task but low relationships behaviour; through to Quadrant 2, where both task

and relationships behaviours are high; to Quadrant 3 where task behaviour is now low, but relationships behaviour is still high and finally to Quadrant 4 where both task and relationships behaviours are low.

Maturity can be influenced by the level of education or experience and is used to refer to the relative independence, the ability to take responsibility and the amount of achievement motivation of an individual or group.

This theory is an advance on previous theories of leadership as it is a dynamic theory implying change as effected by means of personal growth. It has implications for individual and organisational change in that greater maturity in leadership behaviour can be achieved by behaviour modification by "reinforcing positively successive approximations of a desired behaviour" (Hersey and Blanchard, 1974).

The theory has been shown to be consistent with Argyris' Immaturity-Maturity continuum, which postulates seven changes that take place in an individual as he develops toward maturity. Similarly, McGregor's Theory X and Theory Y and Likert's four systems of management can be conceptualised within this framework.

#### 1.4 POWER

Since leadership involves the influencing of people, any discussion on leadership must include an elaboration on the concept of power. Leadership must, however, be distinguished from power in that "it



entails influence, i.e. change of preferences, while power implies only that subject's preferences are held in abeyance" (Etzioni, 1965).

Power is an important consideration in any leadership situation but especially in an organisation. This is because within an organisation power is more deliberately distributed and thus is highly institutionalised.

Gibb (1969) distinguishes between the concepts headship and leadership. The former arises when power in a group is imposed from a body outside that group and the latter arises when from within a group there is acknowledgement of a leader's authority by his followers.

Etzioni (1965) uses the following model to illustrate the concepts of leadership and power.

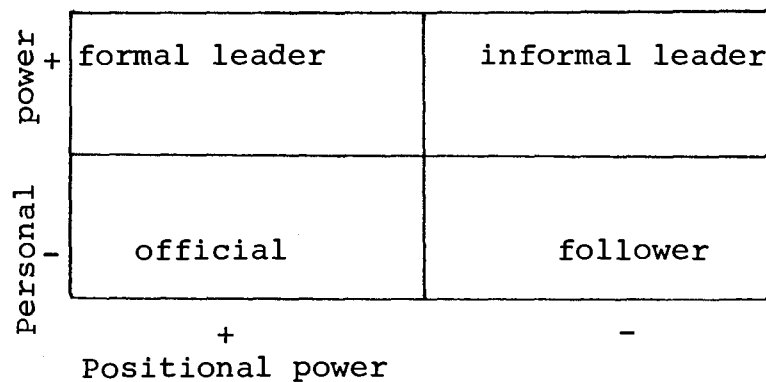


Figure VII: Leadership and Power

The formal leader has a great deal of personal power

and a great deal of positional power; whilst the informal leader has perhaps even more personal power but virtually no positional power. The organisation frequently has to allocate positional power in order to make its leaders effective and to back them with organisational power as there might otherwise be discrepancies between leadership and power positions.

French and Raven (1959) in an early study on power have identified five major types of power.

- (1) Reward power - where the basis rests on the ability of the leader to reward.
- (2) Coercive power - where the basis rests on the expectation of punishment (by those being led) if they don't conform to the attempt made to influence them.
- (3) Legitimate power - which stems from the internalised values of the followers which dictate that the leader has a legitimate right to influence them and which they have an obligation to accept.
- (4) Referent power - where the followers feel and desire to identify with the leader.
- (5) Expert power - where the followers see the leader in terms of his knowledge or abilities in a special area.

### 1.5 GROUPS

Hare (1962) examines social behaviour in terms of the goal to which it is directed. He has linked the concepts of task and socio-emotional areas of functioning to the individual and the group.

	Task	Socio- Emotional
Group		
Individual		

Figure VIII: Individual and Group Functioning  
(Hare, 1962)

The review of leadership so far has been concerned with theories of leadership behaviour. The leader cannot be considered apart from those he leads and so it is necessary not only to look at task and socio-emotional orientations of individuals but within groups as well. Leadership is a group function and it is important to focus on research relating to effective group functioning.

#### Group versus Individual Decision-Making

There has been a conflict as to whether the group as a problem-solving unit is more efficient than the individual. Frequently this is simply solved by the nature of the problems or goals in a particular situation but this is not always the case.

Collins and Guetzkow (1964) consider that the group is the more efficient problem-solving unit if the demands set by the task point to a gain from a division of labour or duplication of effort. Furthermore, in situations involving the generating of creative ideas or remembering information, the probability of a group coming up with a solution is greater than that when an individual works on his own. Accuracy would also be increased where the task is one involving random errors since the group will combine several individual solutions and so circumvent this problem. In a group, inferior individual contributions will be eliminated.

On the negative side however, a productivity increase resulting from working as a group may only be temporary as the presence of other individuals can prove a distraction. The defensiveness of some individuals within a group may increase as a result of working as part of a unit. This may or may not be temporary. Groups usually consume more man hours when working on a problem as compared to the working hours of several individuals working separately or to a group with fewer members.

Maier (1967) approaches this problem in terms of what he calls the assets and liabilities of group functioning. The leader's function is to concentrate on the group's processes so that the assets outweigh the liabilities. Maier considers that "the deficiencies that appear in group solutions reside in the processes by which group solutions develop" since the members individually possess the necessary ingredients for

the solution. He highlights the importance of the concepts of organisation and integration in training a group to function efficiently.

It is necessary to understand the "hows" and "whys" of group functioning before instituting a training programme aimed at increasing group efficiency.

Hall (1971) has done work on just this type of training. He shows how this has led to more adequate decision-making performance. He also considers that when group processes are most effective, the group's effort almost always constitutes an improvement over its average individual resource. Frequently, the group's effort is found to be better than even its best individual contribution.

This has become known as the concept of synergy - viz. that the group result is better than that of any individual member. The concept of synergy has been linked to the effective integration of task and socio-emotional issues by Collins and Guetzkow (1964). This means that an effective group, which generates synergy, is a group where these twin issues have been confronted and adequately dealt with. Lafferty et al (1972) have also adopted this approach. "The Task (Q) x the acceptance of each member in inter-personal participation (A) = Synergistic Decisions".

#### Measurement of Orientations of Group Members - Bass

Bass has stated that the members of a group differ as to what attracts them to remain in that group. He

considers that for some, satisfaction is attained "if and when the group attains task success; other members will be satisfied mainly if the group affords opportunity to interact harmoniously with others; still others will primarily be attracted to the group if they expect to gain esteem, status and other direct rewards for themselves, regardless of the amount of interaction and task success of the group" (Bass, 1960).

As a result, Bass has developed the Orientation Inventory (Ori), which measures three types of orientation - self, interaction and task. "The Ori consists of 27 statements or questions regarding attitudes and opinions to which the examinee responds by choosing both the most and the least preferred of three alternatives" (Bass, 1967).

This then represents an attempt to construct a questionnaire measuring the orientations defined by previous researchers.

The validity of Ori has been criticised by Ray (1973) who considers the ipsative scoring of the inventory to be its major drawback. A person can only score high on one of the three scales and hence the orientations cannot be correlated with one another to ascertain how "opposite" both self- and interaction-orientations are to task-orientation.

Ray has also challenged the reliability of Ori and as a result of what he considers to be shortcomings on the inventory, has developed two new scales.

These are designed to measure task-orientation and interaction-orientation respectively and have a higher reliability than Ori.

The Ray questionnaire was used in the present research as a measure of task-orientation and interaction-orientation.

#### Interaction Processes in Groups - Bales

Working at Harvard, Bales has developed an observational method for the study of ongoing interaction processes present in small groups. He has specifically focussed on the task and socio-emotional problems arising in the group.

Much of his work rests on the assumption that groups are assumed to be similar in that they are composed of a "plurality of persons who have certain common task problems arising out of their relation to an outer situation, and certain problems of social and emotional relationships arising out of their contact with each other" (Bales, 1950).

He has concerned himself with the interaction or process content of group functioning as opposed to the topical content and has developed a system of inclusive and continuous analysis that has enabled him to study a group's "approach to problem-solving, their roles and status structure, and changes in these over time" (Bales, 1968).

Bales' method of observation is known as Interaction

Process Analysis (IPA). His system of analysis involves 12 mutually exclusive and jointly exhaustive categories which he uses in categorising the interaction of group members with one another.

<u>Socio-Emotional</u> <u>Area</u> Positive	1. Seems Friendly 2. Dramatises 3. Agrees
<u>Task Area</u> Attempted Answers	4. Gives Suggestions 5. Gives Opinion 6. Gives Information
<u>Task Area</u> Questions	7. Asks for Information 8. Asks for Opinion 9. Asks for Suggestions
<u>Socio-Emotional</u> <u>Area</u> Negative	10. Disagrees 11. Shows Tension 12. Seems Unfriendly

Figure IX : The 12 Categories of Bales' IPA  
(Bales, 1970)

From the above it can be seen how Bales divides interaction into socio-emotional and task areas. He has taken these concepts a step further and formulated the idea of the task specialist and the socio-emotional specialist who take on the "task roles" and the "social roles" respectively in any problem-solving group (Bales, 1958). "One of the most interesting problems in small-group research is the relationship between the network of affective relations, such as liking and disliking, among members, and the network of relations that grows out of the performance of functions required by the more technical tasks of the group (Bales, 1956). Bales has devoted



a large part of his work to the examination of the differences and interrelationships in the roles of the task and the socio-emotional specialists.

Bales and Slater (1955) refer to the two types of specialists as the idea man and the best liked man. Relating this to the 12 IPA categories cited above, they have shown how the idea man "shows a concentration of activity in the task area" (categories 4 - 9) whereas the "liked man shows a concentration in the socio-emotional types of activity, both positive and negative" (categories 1 - 3 and 10 - 12).

From research on the three factors - activity, task ability and likeability - which were found to be in general uncorrelated, Bales and Slater showed that the idea man was high on activity and task ability ratings but low on likeability. The best liked man, the socio-emotional specialist, was found to be high on likeability ratings, but rated low on the other two factors.

Bales has also identified three other types of behaviour patterns. There is the "great man" who is high on all three of the above mentioned factors; the deviant who rates high on activity but low on the other two factors and the residual member who rates from medium to low on all three factors. This individual frequently serves as a kind of scapegoat in a group.

These concepts may be compared to Blake and Mouton's formulation of 9,1 (task specialist); 1,9 (socio-

emotional specialist) and 9,9 (great man) types of individuals. Bales has in fact studied the same concepts as Blake and Mouton, Reddin and others but has focussed on the ongoing processes in the group rather than on the attitudes and resultant behaviours of group members.

Bales has also studied the ways group processes change as groups develop over time. He has shown how groups undergo different problem-solving phases and also how the process of role differentiation takes place with two different individuals usually emerging as the leaders - one as the idea man, the other as the best liked man (Slater, 1955).

#### Improvement of Group Functioning

A great deal of work is currently being carried out on the improvement of group effectiveness in decision-making by laboratory training. This type of intervention is made possible because of the dynamic properties of group systems.

However, in order to do this it is necessary to understand group processes (as previously described). "Without a clear recognition of the importance of teams, what blocks and facilitates their development, and under what conditions they are appropriate, management may not be fully utilizing their potential human resources" (McGregor, 1967).

Linking this to the research done on task-orientation and relationship-orientation, the value of understanding

when and under what conditions the task oriented or relationship -oriented person performs best can be seen if a programme of intervention vis-a-vis the group processes is to be undertaken. It is only by having knowledge of all that that interventionists can have a clear idea of when and how they ought to intervene in their attempt to optimise the decision-making resources of the group.

Hall and Watson (1970) and Hall (1971) have undertaken research in this area using the NASA Moon Survival Problem as the decision-making exercise. This game simulates a multi-stage decision-making situation and requires the participants to rank 15 items in order of their importance for survival first individually and then as a group.

Groups were instructed by means of a list of decision rules that led to effectiveness in reaching a consensus that encapsulated the lessons learnt by trainees in previous laboratory learning programmes held during a two-week period. This intervention was aimed at the normative system within a group and strove to legitimise behaviours such as striving for consensus within a group - hence the term "normative intervention". These groups performed more adequately not only in terms of more constructive ways of resolving conflicts but also in terms of a better utilisation of resources (as shown by their reaching a more nearly correct solution).

With regard to the concept of synergy - the performance of the instructed groups surpassed that of their best

members in 75% of the situations whilst this was found to be the case with only 25% of the uninstructed groups.

Group performance is largely a function of the conditions under which a particular group is working. These conditions are primarily controlled by "the inclinations and procedural orientations of the collective membership" (Hall and Watson, 1970).

#### 1.6 HYPOTHESES OF THE PRESENT STUDY

There has been a great deal of conceptual confusion as to exactly what the terms task-orientation and relationship-orientation mean and how such orientations affect behaviour. Following on from the theory presented regarding leadership and group functioning, the present study was concerned with predicting the performance of groups of students, with different task- and relationship-orientations, involved in a decision-making situation and the processes used to arrive at these decisions. An attempt was also made to predict performance from an analysis of the group processes.

This study leans heavily on the work of the Ohio State Leadership studies (see section 1.3) from where the concepts of the two separate dimensions of task- and relationship-orientation originate; on the work of Bales (see section 1.5) and his study of group processes and on research on group functioning (see section 1.5).

The decision-making task used was the NASA Moon

Survival Problem (Hall, 1971) and the group processes were observed by using the Bales IPA system of categorising observable behaviour (Bales, 1950). The Ray questionnaire (Ray, 1973) was used to obtain measures of task-orientation (TO) and interaction-orientation (IO) and from this data the following four groupings of students were obtained :

- |   |     |
|---|-----|
| (1) Those scoring high on both the TO and IO dimensions | H-H |
| (2) Those scoring high on TO but low on IO              | H-L |
| (3) Those scoring low on TO but high on IO              | L-H |
| (4) Those scoring low on both dimensions                | L-L |

All students in each of the sub-groups involved in the decision-making exercise were drawn from the same larger group.

A The first hypothesis concerns the attempt made to use the Ray scores as predictors of the NASA scores. In terms of the criterion of effectiveness of group functioning - measured both by the nearness of the group's solution to the given one and by the amount of synergy generated - it was predicted that :

- (1) The H-H group would be the most efficient; in terms of both of the above-mentioned criteria. This is because they were regarded as being not only highly goal oriented, but also very concerned about the socio-emotional aspects of their group

functioning and tolerant of conflicting ideas. This would in turn lead to better group functioning as group resources would be more fully utilised.

- (2) The H-L group would reach the next best solution. This is because the TO dimension is the important one in a short, discrete decision-making exercise such as this and in such a situation a fairly adequate solution could be reached even if the socio-emotional needs of the group were largely neglected. However, since participation, cooperation and the ability to listen to others' opinions are important considerations in achieving synergy, this group would generate less synergy than the L-H group.
- (3) The L-H group would reach the third best solution. There would not be any concerted striving toward goal achievement but because the emphasis is on satisfaction of group needs and because there is greater tolerance of conflicting ideas, more synergy would be generated than in the H-L group.
- (4) The L-L group would prove the least efficient group in terms of both criteria. Neither TO nor IO is emphasised and thus there would not be much goal orientation nor much concern for group needs. As a result the solution would be poor and very

little, if any, synergy generated.

B The second hypothesis involved using the Ray scores as a predictor of the Bales scores. This would show whether the TO and IO scores measured by the Ray questionnaire could be considered equivalent to Bales' socio-emotional and task areas of functioning. Specifically, it was predicted that :

- (1) The H-H group would show higher total rates of interaction as compared to the other three groups. This interaction would strike a balance between the task areas of functioning (Bales categories 4 - 9) and the socio-emotional areas of functioning (Bales categories 1 - 3 and 10 - 12). This is consistent with Bales' propositions concerning the "great man".
- (2) The H-L group would show high total rates of interaction because this was a task involving the making of decisions and a highly task-oriented group would be more involved in this than a highly interaction-oriented group. The major concern would be with the task and so activity in the task area (categories 4 - 9) would outweigh that in the socio-emotional area (categories 1 - 3 and 10 - 12). This is consistent with Bales' concept of the "task specialist".

- (3) The L-H group would show lower total rates of interaction and would be concerned with the socio-emotional areas of functioning (categories 1 - 3 and 10 - 12). This is consistent with Bales' concept of the "socio-emotional specialist".
- (4) The L-L group would show the lowest total rates of interaction with low rates of interaction on the task areas (categories 4 - 9) and the socio-emotional areas (1 - 3 and 10 - 12) of functioning. This ties up with Bales' description of the "residual member".

C Finally, the Bales scores were used to predict the NASA scores. This, in other words, investigated if the process (which emphasised some combination of the task and socio-emotional areas of functioning) could be used to predict the performance. It was predicted that :

- (1) The group which emphasised both task and socio-emotional areas of functioning and achieved a balance between them would achieve the best decision.
- (2) The next best decision would be achieved by the group which emphasised task concerns and was highly goal oriented.
- (3) The third best decision would be that of the group whose main concern was for the socio-emotional needs of its members.
- (4) The group which emphasised neither orientation to any marked degree would score lowest in terms of performance criteria.



Page No.

CHAPTER II : INSTRUMENTS

2.1 The Ray Questionnaire	46
2.2 NASA Moon Survival Problem	50
2.3 Interaction Process Analysis	53

## CHAPTER II : INSTRUMENTS

In this section the three instruments used in this research are described.

They are :

- (1) The Ray Questionnaire;
- (2) The NASA Game;
- (3) Bales Interaction Process Analysis.

### 2.1 THE RAY QUESTIONNAIRE

The Ray Questionnaire was developed by Ray (1973) as a result of criticisms levelled against the Orientation Inventory (Ori) of Bass (1967).

To recapitulate, (see section 1.5), Bass concerned himself with the measurement of the three orientations - self, task and interaction. "The Ori consists of 27 statements or questions regarding attitudes and opinions to which the examinee responds by choosing both the most and the least preferred of these alternatives" (Bass, 1967). This means that an individual can only score high on one of the three orientations and medium or low on the other two.

The overt behaviours of people with any of these three orientations have been found to be consistent with the meanings of self-, interaction- and task-orientations. Self-descriptions by subjects on a battery of personality inventories and attitude questionnaires

were found to be consistent with the above as well (Bass and Dunteman, 1963).

A self-orientation describes those who are "attracted to groups in the expectation of direct reward to themselves regardless of the task or interaction effectiveness of the group. The group is merely the theatre in which certain generalised needs can be seen" (Bass et al, 1963).

The same researchers describe an interaction-orientation as referring to those who gain the greatest reward from the "satisfactions of the interactions with others. They are likely to be less concerned about getting the job done and about striving for succeeding in solving the group's external problems". Maintaining "harmonious, conflict-free relationships" is the most satisfying. This then is a relationship - orientation.

The task-oriented member is the one who is "most attracted to a group by the expectations of task success and its rewards" (Bass et al, 1963). He is reinforced by task effectiveness. Getting the job done and solving the group's external problems are of the greatest importance.

The ipsative scoring of this inventory is a drawback as an individual cannot be high on, for example, two out of the three orientations. Self- and interaction-orientations are considered as opposites to task-orientation, but as these orientations cannot be correlated with one another in any meaningful way because of this ipsative scoring, there is no way of

ascertaining just how opposite these orientations are. Ray has challenged the validity of the Ori on this basis and considers that the ipsative scoring does not allow one to get a complete view of the individual.

The reliabilities of Ori have also come under criticism. Bass (1967) gives the test-retest reliabilities for his three scales as follows : self-orientation 0.73; interaction-orientation 0.76; and task-orientation 0.75. Stritch (1964) reports reliabilities of 0.63; 0.35; and 0.40 respectively for the above-mentioned orientations (Bass, 1967). Ray has stated that these reliabilities are far below the level considered by Shaw and Wright (1967) as minimal in a research instrument. They consider 0.75 to be the minimum level.

As a result of his criticisms of the Ori, Ray developed his TO and IO scales, which are an extension of the work of Bass. He attempted to de-ipsatise Ori and devise a more valid measuring instrument which had higher reliabilities. He has not concerned himself with self-orientation as he considers this the "most clearly socio-pathological and least likely to be of importance" (Ray, 1973).

Thus he has developed two Likert-type attitude scales. The one measuring TO consists of 27 items and the other, containing 35 items, measures IO. These two scales have been combined in a random manner for the purposes of the present study and there is thus one 62-item scale.

The definitions Ray puts forward for TO and IO are largely adapted from the work of Bass. "Task-orientation: Reflects the extent to which a person is concerned about completing a job, solving problems, working persistently and doing the best job possible. Interaction-orientation: Reflects the extent of concern with maintaining happy, harmonious personal relationships - interest in group activities is high" (Ray, 1973).

Ray's research has shown his TO scale to have a reliability of 0.80 and his IO scale to have a reliability of 0.84. These figures are considerably higher than those obtained by Bass.

With regard to the validity - the t-score for the difference between the means of the criterion-group was 1.97 for TO and 2.68 for IO. The number in the sample was 126 and the significant differences in the expected direction were established at the 0.05 level.

Furthermore, since TO and IO were found to be positively correlated on some of the samples, Ray considers that the ipsative scoring of Ori is inappropriate as an individual may be high on both TO and IO. These dimensions are not opposed.

Ray (1973) obtained the following means for his TO and IO scales :

	<u>IO</u>	<u>TO</u>	<u>Sample Size</u>
(1) Friends of students	111.30	84.32	N = 74
(2) School students	127.52	93.32	N = 53
(3) Technical college students	111.51	92.89	N = 65
(4) Evening college students	117.98	89.62	N = 61

When the students in his samples were rated by their peers, those scoring high on the IO scale were found to be more tolerant of conflicting ideas and more interaction-oriented. Those scoring high on the TO scale were more task-oriented, and more authoritarian and less tolerant of conflicting ideas.

A copy of the Ray questionnaire, together with the key stating which questions measure TO and which measure IO, is to be found in Appendix A.

## 2.2 NASA MOON SURVIVAL PROBLEM

This is a decision-making exercise developed by Jay Hall. It concerns the fate of the crew of a space flight who were due to rendezvous with their mother ship on the lighted surface of the moon but have crash-landed. Survival depends on their reaching the mother ship which is 200 miles away. However, all their equipment, apart from some 15 items which are listed, was damaged during the crash landing and is unable to be used (Hall, 1971).

The exercise requires participants to rank the 15 undamaged items of equipment in order of their importance for survival during their 200 mile journey to the mother ship. This ranking is done first on an

individual basis and then by the group all working together to reach a final solution. The object is for the group to reach consensus.

An answer to the task has been obtained from the Crew Equipment Research Department of the NASA Manned Spacecraft Centre at Houston, Texas. This enables the performance of individuals and groups to be evaluated in terms of an objectively correct criterion.

Decision adequacy can be assessed by summing the deviations of the individual or group scores from the expert rank order obtained from NASA. The "total decision product for both individuals and groups is composed of 15 interdependent judgements" (Hall and Watson, 1970). Thus, the magnitude of the error score can range from 0 - 112 points and is inversely related to the quality of the decision. The average individual error score has been established as being 39.30. This score was obtained from a series of normative studies conducted by the above authors.

The following norms have also been established with regard to individual scores :

0-25	excellent	56- 70	poor
26-32	good	71-112	very poor, suggests
33-44	average		possible faking of
45-55	fair		the use of earth-bound logic.

The NASA problem has been found to "generate extremely high levels of ego-involvement on the part of subjects, and decision adequacies have been found to be sensitive to a number of substantive and procedural contributions. Thus, the decision task employed affords a reasonable analogue of commonly encountered multi-stage decision-making situations" (Hall and Watson, 1970). As a result, it has been used in many training programmes aimed at modifying and hence improving group decision-making processes.

As a result of research done on using the NASA problem in laboratory learning situations, it has been found that groups can be taught the lessons of a training period (which usually lasted for two weeks), in a far shorter time period. This was done by using a system termed "normative intervention" (Hall and Watson, 1970). Normative intervention is a process which aims at legitimising certain process behaviours within a group, enabling members to direct their energies at reaching consensus. It has been found to lead to increased group effectiveness, not only in methods of problem-solving and decision-making, but also in handling conflict constructively.

Normative intervention is carried out by a list of Group Decision Instructions being read out to a group, enabling members to understand the attitudes and approaches which lead to effective group functioning. These groups have been found to function far more effectively than groups who were placed 'blind' in a decision-making situation.



Hall (1971) considers one measure of the extent to which a group is utilising its resources, is the degree of synergy achieved by that group, (i.e. the degree to which the group result is an improvement over that of any of its individual members). Where normative intervention took place, 75% of the groups achieved synergy, but only 25% of the uninstructed groups achieved this. Synergistic decisions are more difficult to reach but are more effective. This is because in order to achieve synergy, differences of opinion must be accepted as something positive within the group's framework and must be explored in order to gather additional information, clarify issues or point to better alternatives. Thus participation is necessary, as well as cooperation, involvement and the ability to listen to other's viewpoints. The importance of the interpersonal process is emphasised.

A copy of the Moon Survival Problem, the Group Decision Instructions and the solution to the problem are to be found in Appendix B.

### 2.3 INTERACTION PROCESS ANALYSIS

Bales (1950) developed the system known as Interaction Process Analysis (IPA) for the observing and recording of ongoing behaviour in small groups. Since the theoretical background to his work and the way in which the IPA can be used to focus on task and socio-emotional behaviours has already been described in the Introduction (see section 1.5), it will only be briefly outlined now, but the method of scoring and

analysing behaviour will be described in more detail.

Every group is faced with two sets of problems - those relating to the task in hand and those arising from the social and emotional relationships of group members. All interactions within a group are categorised in terms of 12 mutually exclusive and jointly exhaustive categories of behaviours. Six of these categories deal with behaviours related to the task areas of group functioning (categories 4 - 9) and the remaining six encompass behaviours in the socio-emotional areas (categories 1 - 3 and 10 - 12). To reiterate, the 12 categories are :

1. Shows solidarity
2. Shows tension release
3. Agrees
4. Gives suggestions
5. Gives opinion
6. Gives orientation
7. Asks for orientation
8. Asks for opinion
9. Asks for suggestions
10. Disagrees
11. Shows tension
12. Shows antagonism.

#### What is Scored

The observer, in scoring, has to abstract from the content and instead focus on the form of the behaviour. The essential operation is one of inference as to the "meaningful or functional content of behaviour" (Bales, 1950). Knowing the meanings of the categories, the

observer can break down behaviour into meaningful segments and score it under the appropriate category.

"The unit to be scored is the smallest discriminable segment of verbal or non-verbal behaviour" (Bales, 1950) to which the observer can assign a classification, under conditions of continuous serial scoring. Thus both verbal and non-verbal responses such as gestures, facial expressions, body movements etc., are scored. Since the scoring is continuous, observers frequently work a certain distance 'behind' the ongoing interactions, recording almost in a rhythmic and sequential pattern.

#### How Interactions are Scored

The method of recording interactions is as follows. Each group is observed and their behaviour recorded during a 15-minute time sample. An interaction recorder is frequently used for this purpose. This consists of a moving wide paper tape on which the interaction is recorded. An alternative to this is to use a scoring sheet, as was the case in the present study (see Appendix C.1).

This scoring sheet lists the 12 categories down the left-hand side of the page. Across the page, columns numbered from 1 to 5 are drawn. Each group member is assigned an identification number and hence a column in which all the interactions initiated by that member are recorded. The form of the recording is such that the number of the person being addressed is entered under the column of the member initiating it, but in the row of the particular Bales category which

pertains to that interaction. Thus, if member number 2 makes a statement agreeing with what member number 4 said, a 4 is entered under column 2 in row 3.

The observer has to watch the group as much as possible, not only in order to be able to score non-verbal behaviour, but in order to ascertain who is addressing whom. He scores continuously, recording 10 - 12 scores per minute. One observer must score all the interactions within a particular group during a specified time sample. There is no question of there being any division of labour.

#### Training of Observers

Bales considers that observers require a long period of practice and thereafter frequent retraining sessions in order to be able to score consistently. The initial training should be directed to the understanding of the specific content of categories and the definition of the particular unit to be scored. Then practice is undertaken with written protocols and recordings and finally practice sessions are carried out on groups. Observers are also taught to overcome any personal biases which they may have.

Before an observer is considered to have been trained, Bales considers that an appraisal of the observer's reliability is essential, to compare how his method of scoring compares with that which has been developed by Bales.

### Analysis of Data

There are many different ways of analysing the data but the most frequently used method, which is also used in the present study, is to analyse the data in terms of the percentage rates of activity in each category. From this, an Interaction Profile for the group or for any individual within that group can be drawn up. This is a diagrammatic presentation of the data.

Variations in profiles can be due to personality variations, differences in the social organisation of groups, cultural differences or variations in the type of problem and situation. These factors must be borne in mind when interpreting the profiles of any given group.

### Definition of the Categories

The categories are briefly described on the score sheet to be found in Appendix C.1. They are in accordance with those originally formulated by Bales. A more detailed description of the meaning of the categories may be found in the appendix of his 1950 book, "Interaction Process Analysis".

A slight revision of the meaning of these categories is put forward by Bales in his 1970 book, "Personality and Interpersonal Behaviour". This modified system has not been used in the present study as it has been developed in order to refer to a three-dimensional model which was not of prime concern to the present study.

CHAPTER III : METHOD

3.1 Administration of the Ray Questionnaire	59
3.2 Subjects	61
3.3 Organisation of the Sub-Groups	61
3.4 The Decision-Making Exercise	62
3.5 Observation of the On-Going Group Processes	64

### CHAPTER III : METHOD

The Ray questionnaire was administered to first year Psychology students and the sampling procedure described. On the basis of their task- and interaction-orientation scores, the students were divided into four groups.

Sub-groups, constituted from the same groups and containing four or five students, participated in the decision-making exercise, the NASA Moon Survival Problem. Members were required to complete the task individually and then working together to reach consensus.

Whilst this was being completed the interactions of each sub-group were observed using the Bales Interaction Process Analysis.

#### 3.1 ADMINISTRATION OF THE RAY QUESTIONNAIRE

The Ray Questionnaire (Ray, 1973) which yields measures of Task-Orientation (TO) and Interaction-Orientation (IO), was administered to Psychology I and IA students at the beginning of one of their afternoon practical sessions.

This questionnaire is described in greater detail in section 2.1 and a copy of it may be found in Appendix A.1. For each student two scores were obtained - one measuring TO, the other IO. These scores were ranked, first according to the TO scores and then in terms of the IO scores. Each set of rankings was divided into three categories - high, medium and low. Medium was defined

as those scores which constituted the middle 25% of all scores in the ranking (to the nearest category). This procedure was adopted so as to make the concepts of high and low meaningful, since with the middle 25% of all scores eliminated, the lowest of the scores designated as high did not overlap with the highest of those scores designated as low.

From this data the students were divided into 9 groups, determined by all possible pairs of combinations of high, medium or low scores on both the IO and TO dimensions (see section 4.2). Four of these groups were of concern to the present study. These were :

- (1) Students scoring high on both the TO  
and IO dimensions (H-H)
- (2) Students scoring high on TO but low  
on IO (H-L)
- (3) Students scoring low on TO but high  
on IO (L-H)
- (4) Students scoring low on both  
dimensions (L-L)

This procedure, then, resulted in there being four homogeneous groups each composed of students with different combinations of TO and IO (see section 4.2).

These groupings can be seen to be very similar to



the 9,9; 9,1; 1,9; and 1,1 designations of Blake and Mouton (1964) and to the great man, task specialist, socio-emotional specialist and under-active deviant described by Bales and Slater (1955).

### 3.2 SUBJECTS

As already mentioned above, the subjects were drawn from amongst those students (both male and female), completing their first course in Psychology. From the data and background information obtained from the Ray questionnaire, students over the age of 25 or who were not English-speaking were eliminated from the sample in order to meet the criteria laid down for the sample.

As a result, the final sample consisted of White, English-speaking students, aged 25 or under, who were enrolled for the first course in Psychology at the University of Cape Town.

### 3.3 ORGANISATION OF THE SUB-GROUPS

The students in each of the four groups were then telephoned and asked whether they would be willing to participate in a small discussion group that would take the form of a decision-making exercise. They would only be required to attend one such session. Participation was therefore on a voluntary basis but very few of the students approached declined to take part.

Each discussion group was composed of five students drawn from one of the four homogeneous groups.

(These discussion groups will hereafter be referred to as the sub-groups.) If however, only four students turned up to any one sub-group, the experiment carried on as planned, but if fewer than four were present, the sub-group would have to be rearranged for another time. Toward examination time, some difficulty was experienced in getting together the right number of students at the right time and it was decided to organise sub-groups consisting of six members. If all six were present, then one out of the six was asked to watch the sub-group and feed back his comments afterwards as to how he thought the sub-group had gone about the decision-making task.

In organising the discussion groups, an attempt was made to not put together in any one sub-group, students from the same practical sessions. This was done in order to try not to have students who had previously worked together, in the same sub-groups.

### 3.4 THE DECISION-MAKING EXERCISE

When the members of a sub-group had all assembled, the participants were introduced to one another and some time was spent just chatting and affording them an opportunity of getting to know each other.

The decision-making exercise which was used was the NASA Moon Survival Problem which requires participants to rank 15 items in order of their importance for survival. This is done first on an individual basis and then by the sub-group as a whole where the aim was to reach consensus with regard to deciding how to rank

the 15 factors. This is described in greater detail in section 2.2

A copy of this exercise, entitled "Lost on the Moon", was then given to each sub-group member. The instructions and background information regarding the task were then read out by the experimenter. Each member had a copy of this information. They were asked first to complete the task individually. No time limit was laid down.

After this had been carried out, they were asked to do the task as a group and by sharing one another's ideas to reach consensus as to the best ranking of the 15 factors. Once again, there was no time limit. Before starting on this, a list of Group Decision Instructions ('normative' process instructions) were handed round to each participant and these were read out by the experimenter and elaborated upon. These instructions were adapted from those used by Hall (1971) when using the NASA game and from those used by Lafferty et al (1972) using the Desert Survival Problem (a group problem exercise which is very similar to the NASA game and which has also been extensively used as a training tool for increasing individual and group effectiveness).

Instructions such as these (which sum up the lessons learnt in laboratory learning programmes over a period of approximately two weeks) when read out to a group have been found to lead to better and more effective methods of reaching consensus and of handling and resolving conflict. This is because they

legitimise certain group processes leading to reaching consensus. It was hoped that by reading out instructions, all groups would start out with constant conditions both as regards the task to be done and the way in which it was suggested they approach it, and in this way differences in group functioning that were not attributable to the above could be evaluated.

Only when all the sub-groups had completed the decision-making exercise were solutions to the problem made available. Each student was sent a copy of the solution on which his individual rankings and those of his sub-group as a whole were entered.

A copy of the Moon Survival Problem, together with the Group Decision Instructions and Solution, may be found in Appendix B.

### 3.5 OBSERVATION OF THE ON-GOING GROUP PROCESSES

This was carried out by means of Bales' system of Interaction Process Analysis (1950). A description of this method of recording group processes can be found in section 2.3.

In an attempt to avoid observer bias in using the Interaction Process Analysis (IPA), the four homogeneous groups were labelled only by the letters A, B, C and D. This was done so that the observer (who was also the experimenter) would not know whether the sub-group under observation belonged to the H-H or the H-L group, etc. Furthermore, all the sub-

groups were evaluated using the IPA before any of the results were analysed, so that there was no way of ascertaining what the emerging results looked like.

The observer was trained in the use of the IPA by a management consultancy firm in the United Kingdom during 1973, where the reliability of scoring was assessed and found to be in accordance with the stipulations laid down by Bales.

A few of the sessions were tape-recorded in an attempt to get an independent rater to score the interactions and thus establish the reliability of scoring in the present study. Unfortunately, there was a great deal of background noise and the tape-recordings were not considered clear enough by the rater to allow a complete set of data to be obtained.

Page No.

CHAPTER IV : RESULTS AND ANALYSIS

4.1 Results of the Ray Questionnaire	67
4.2 Division into Groups	72
4.3 Overview of Treatment of Data From the Decision-Making Exercise	74
4.4 Data From the NASA Moon Survival Problem	79
4.5 Data From the Bales IPA	81
4.6 Analysis of Ray, Bales and NASA Data	86

#### CHAPTER IV : RESULTS AND ANALYSIS

In this section the TO and IO scores of the Ray questionnaire are computed, ranked and the students are then divided into four groups on the basis of their TO and IO ranking. The correlation between the TO and IO scores is then computed.

The scores from the decision-making exercise, the NASA Moon Survival Problem are analysed to see if there is any difference between the four groups and the degree of synergy achieved in each group is examined. Percentage profiles for each group are drawn up and differences between the groups investigated.

Lastly, the data are searched for possible correlations between every pair of variables.

##### 4.1 RESULTS OF THE RAY QUESTIONNAIRE

The total number of questionnaires filled in was 272. Of these, 27 were incompletely or wrongly filled and hence were discarded, leaving a total of 245 questionnaires.

The Ray questionnaire is in fact composed of two separate scales - 27 of the items yield the TO score and the remaining 35 items yield the IO score. A complete list of the 245 students' scores may be found overleaf, where the student number and corresponding TO and IO scores are listed - Table I. The computer program used for marking these questionnaires

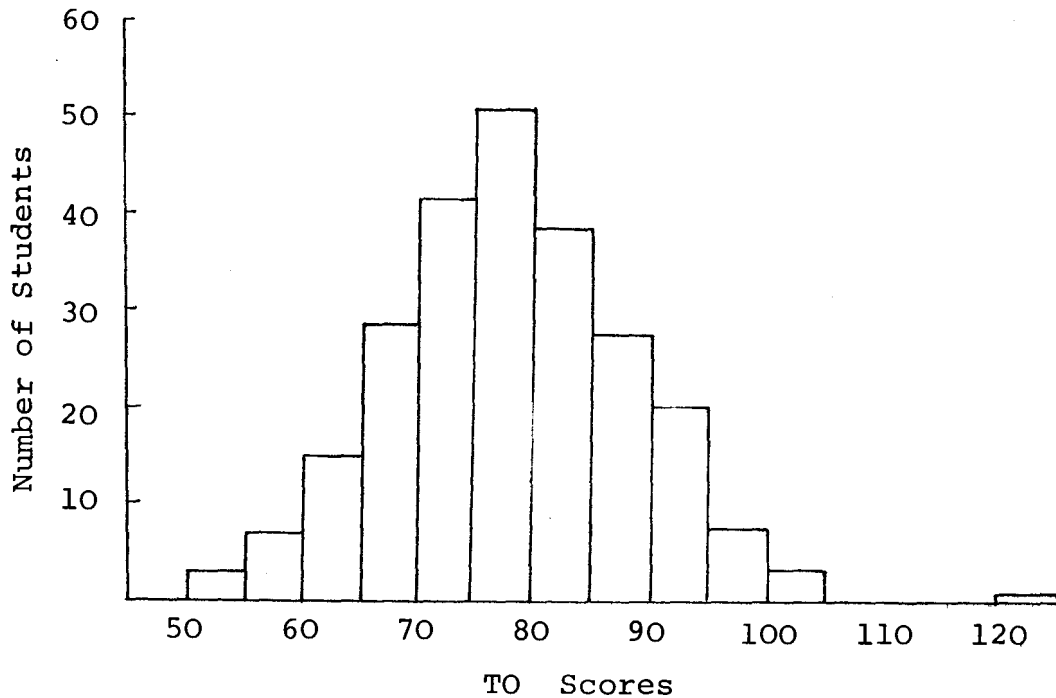
TABLE I : RESULTS OF COMPLETED RAY QUESTIONNAIRE

STUD NO	TASK SCORE	INTER- ACTION SCORE	STUD NO	TASK SCORE	INTER- ACTION SCORE	STUD NO	TASK SCORE	INTER- ACTION SCORE	STUD NO	TASK SCORE	INTER- ACTION SCORE	STUD NO	TASK SCORE	INTER- ACTION SCORE
1	79	100	51	65	103	101	68	110	154	91	97	206	78	100
2	85	73	52	70	99	102	92	106	155	75	84	207	79	100
3	59	86	53	90	104	103	83	99	156	80	79	208	67	90
4	82	98	54	66	97	104	76	92	157	95	78	209	65	82
5	70	88	55	83	95	105	85	92	158	72	84	210	79	84
6	75	103	56	103	124	107	82	94	159	77	103	213	59	76
7	121	127	57	70	93	108	92	91	160	94	107	214	96	86
8	78	84	58	78	91	109	84	83	161	85	110	215	65	86
9	94	107	59	84	112	110	71	93	162	75	95	216	98	113
10	64	99	60	91	88	111	63	73	163	83	107	217	84	102
11	66	75	61	78	92	112	85	94	164	56	98	218	74	81
12	59	79	62	69	102	113	79	102	165	97	92	219	79	94
13	69	84	63	98	104	114	77	84	166	85	96	220	77	73
14	71	85	64	63	71	115	69	93	167	83	88	221	80	101
15	85	118	65	91	96	116	73	102	168	85	91	222	74	91
16	79	85	67	83	105	117	85	97	169	95	81	223	86	87
17	63	93	68	68	95	118	97	103	170	84	93	224	71	99
18	86	103	69	72	95	119	84	107	171	92	73	225	78	89
19	84	108	70	82	86	120	81	96	172	75	82	226	89	92
20	66	87	71	74	92	121	62	103	173	61	95	228	65	82
21	68	98	72	51	83	122	81	100	174	79	69	229	56	74
22	81	90	73	66	102	123	97	103	176	68	67	230	71	106
23	74	118	74	89	105	124	79	74	177	77	63	231	64	69
24	88	94	75	83	78	125	65	59	178	88	87	232	70	78
25	84	107	76	70	94	127	63	85	179	66	83	233	59	63
26	86	101	77	81	72	128	74	85	180	65	86	234	81	101
27	76	110	78	74	91	129	63	69	181	78	102	235	80	94
28	63	88	79	76	75	130	88	92	182	82	102	236	69	90
29	77	55	80	93	85	131	82	101	183	74	83	237	73	96
30	74	98	81	73	94	132	89	96	184	92	97	238	83	90
31	83	97	82	74	88	133	64	83	186	75	94	239	73	95
32	86	98	83	76	96	134	80	96	186	78	92	240	73	93
33	64	81	84	65	111	135	79	82	187	72	95	241	66	80
34	78	114	85	84	112	136	100	108	189	75	85	242	75	101
35	79	75	86	80	89	137	84	67	190	64	71	243	91	88
36	93	75	87	73	99	138	92	104	191	74	113	245	61	73
37	52	97	88	71	79	139	71	90	192	73	79	246	80	84
38	71	84	89	94	90	140	76	113	193	72	84	247	70	92
39	63	99	90	77	96	141	96	92	194	90	97	249	82	86
40	90	97	91	90	94	142	93	107	195	79	112	250	78	72
41	68	79	92	90	106	143	67	87	196	69	98	251	75	81
42	82	98	93	85	93	144	70	94	197	81	82	252	89	78
43	89	85	94	85	79	145	95	77	198	65	69	253	73	103
45	76	115	95	77	77	146	77	88	200	70	87	254	84	93
46	85	99	96	68	94	147	86	75	201	89	99	255	70	109
47	102	96	97	90	102	148	74	90	202	76	84	252	89	78
48	69	73	98	76	64	149	73	84	203	75	96	252	73	103
49	78	66	99	92	87	152	75	102	204	72	104	254	84	93
50	74	95	100	57	85	153	95	107	205	71	89	255	70	109



is to be found in Appendix A.4.

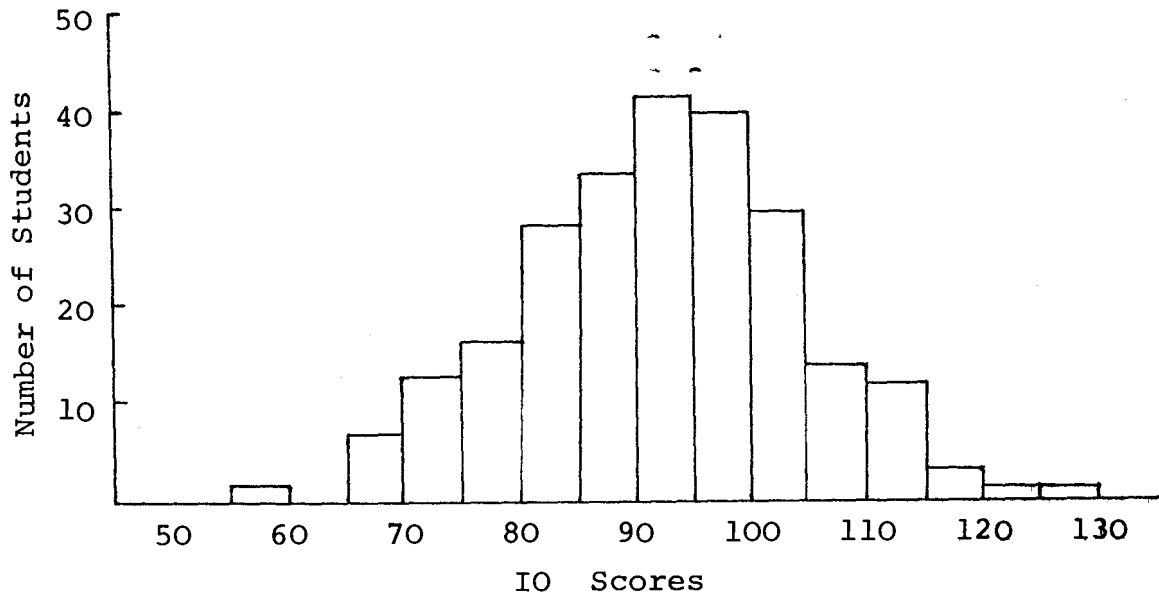
The scores of all 245 students were then ranked - first according to the TO scores and corresponding IO scores, and then in terms of the IO and corresponding TO scores. From this a histogram for each scale was drawn up. Means and standard deviations were computed.



$\bar{x} = 77.47$

SD = 10.42

FIGURE Xa : Histogram of TO Scores



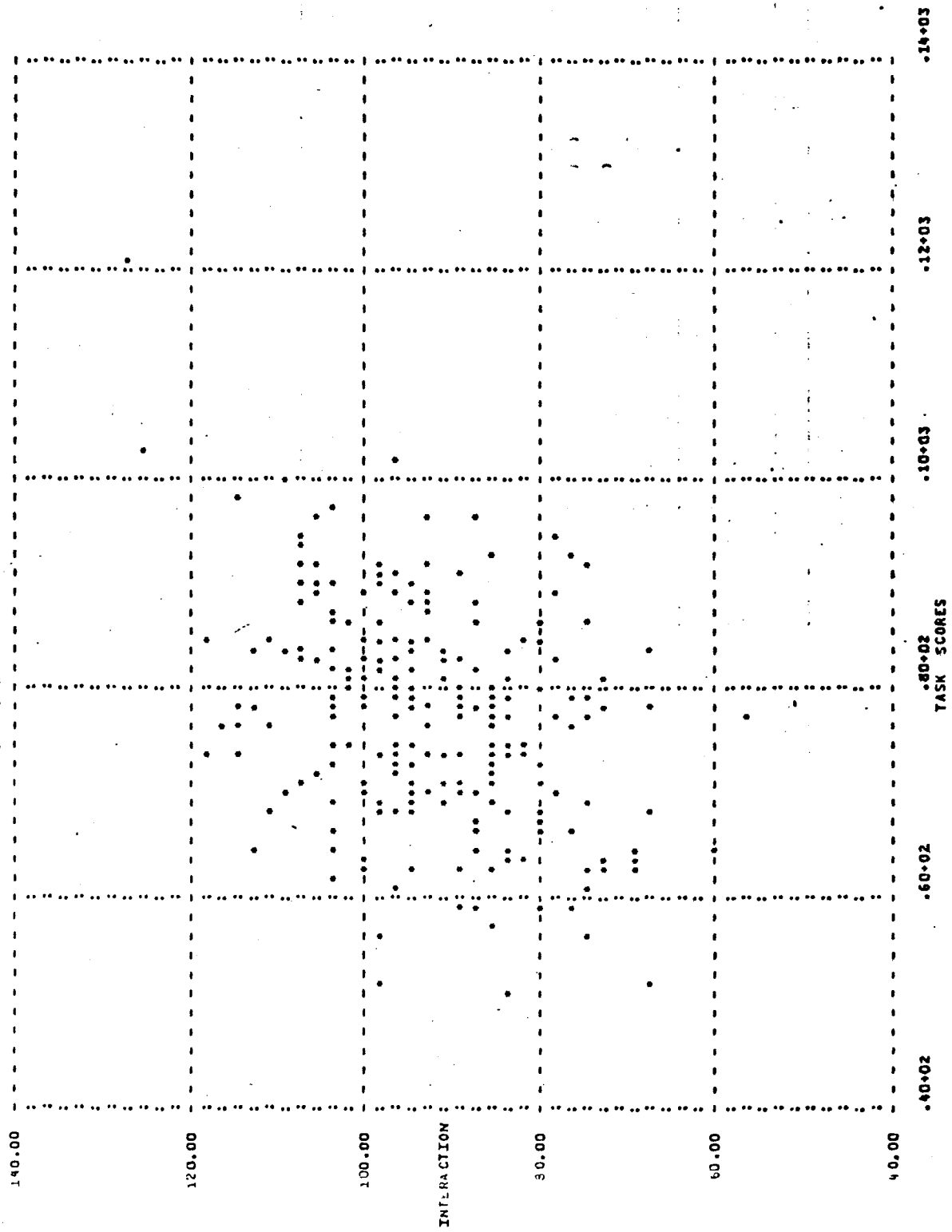
$\bar{x} = 91.66$        $SD = 11.98$

FIGURE Xb : Histogram of IO Scores

From these results it can be seen that there was a fairly normal distribution of scores on both the T0 and IO scales. Since exclusively non-parametric statistical tests were used throughout, any test for normality of the data would obviously be superfluous.

The scatter diagram (Figure XI) from the output of the computer program shows the distribution of T0 and IO scores. (On the horizontal axis,  $.40 + 02$  means  $.40 \times 10^{+02}$  or 40, and so forth.)

FIGURE XI : SCATTER DIAGRAM OF RAY TO AND IO SCORES



The claim of Ray (see section 2.1) that TO and IO are in some cases positively correlated was now examined. The Spearman Rank Correlation Coefficient,  $r_s$  between TO and IO scores was computed (Siegel, 1956). The correction for tied-scores was made. As a check, the same coefficient was computed for odd and even numbered students.

The results obtained are presented in Table II.

<u>Students</u>	<u><math>r_s</math></u>	<u>d.f.</u>	<u>t-Score</u>	<u>Significant at Level</u>
All Students	0.29	243	4.65	0.0005
Even-Numbered	0.32	120	3.73	0.0005
Odd-Numbered	0.33	121	3.83	0.0005

Table II : Spearman Rank Correlation Coefficients for  
TO and IO Data

As can be seen from the last column of Table II, the correlation between TO and IO scores is very highly significant at the 0.0005 level.

#### 4.2 DIVISION INTO GROUPS

For the second part of the research it was necessary to divide the sample into the following four groups :

- (1) Students scoring high on both TO and IO scales (H-H)
- (2) Students scoring high on TO but low on IO (H-L)
- (3) Students scoring low on TO but high on IO (L-H)
- (4) Students scoring low on both scales (L-L)

To do this, each set of rankings was subdivided into three categories - high, medium and low. Medium was defined as those scores which constituted the middle 25% of all scores in the ranking (to the nearest category). This made the concept of high and low meaningful as the lowest of the high scores were not adjacent to the highest of the low scores.

This resulted in the sample being divided into nine categories. These are listed below. In each case the first label refers to the TO score. The number of students in each category is given in brackets after each designated grouping.

High-High	(50)	Medium-Medium	(19)	Low-Low	(47)
High-Medium	(21)	Medium-High	(20)	Low-High	(22)
High-Low	(20)	Medium-Low	(21)	Low-Medium	(25)

Four of these groups were of importance to the second part of the research. These were :

High-High	(50 Students)
High-Low	(20 Students)
Low-High	(22 Students)
Low-Low	(47 Students)

See Appendix A.3 for a listing of the students in each of the four groups.

#### 4.3 OVERVIEW OF TREATMENT OF DATA FROM THE DECISION-MAKING EXERCISE

First of all the results of the NASA Moon Survival Problem and the Bales IPA will be individually presented. Thereafter, these results will be examined together with the TO and IO scores.

A summary of the data for each of the four groups is to be found on the following four pages (Tables IIIa-d). For each group the student number of every participant is given, together with the corresponding Ray TO and IO scores; Bales interaction scores for each of the 12 categories; Bales scores for the task (TO) and socio-emotional (IO) areas of functioning, and for the total number of interactions initiated per person; and the difference score obtained between individual and group scores on the NASA problem.

It will be seen from Tables IIIa-d that in the final analysis the number of students in each group and the number of students were as follows :

(1)	H-H	21 Students	5 Sub-Groups
(2)	H-L	18 Students	4 Sub-Groups
(3)	L-H	16 Students	4 Sub-Groups
(4)	L-L	23 Students	5 Sub-Groups

The diminution in numbers was primarily due to four causes: some of the students declined to take part in

STUD NO ----	RAY ----		BALES -----												NASA ----	
	TO	IO	INDIVIDUAL I.P.A. CATEGORIES												TOTAL SCORE	CHANGE
			1	2	3	4	5	6	7	8	9	10	11	12		
216	93	113	5	7	5	8	18	23	3	12	3	7	0	0	67	24
234	81	101	3	4	7	3	7	6	3	0	0	3	2	0	19	19
154	91	97	2	8	8	4	9	14	6	12	2	2	0	0	47	27
182	82	102	2	8	8	8	9	15	4	6	3	4	0	0	45	22
138	92	104	0	1	6	4	17	10	1	6	0	0	1	0	38	8
122	81	100	2	5	5	3	13	16	7	6	0	3	2	0	45	17
7	121	127	1	8	14	1	31	31	3	8	0	2	3	0	74	28
160	94	107	3	7	5	10	51	62	1	13	1	4	3	0	136	22
85	84	112	3	10	11	5	15	20	6	7	3	7	2	0	56	33
63	96	104	2	4	13	4	16	20	5	7	2	5	1	1	54	26
42	82	98	4	8	2	8	12	15	4	8	1	7	0	0	48	21
56	103	124	0	9	9	3	20	30	2	2	2	10	6	5	53	39
9	94	107	3	6	11	7	11	13	3	4	1	5	5	0	39	30
102	92	106	2	5	5	3	13	18	4	4	0	1	0	0	42	13
67	83	105	2	3	2	5	7	12	1	3	0	1	2	0	28	17
217	94	102	1	4	5	4	8	14	4	3	0	5	0	0	33	15
97	90	102	0	5	5	0	11	13	1	4	0	3	0	0	29	12
136	100	108	5	5	11	6	15	18	2	8	2	7	1	0	51	29
123	87	103	1	3	5	4	14	15	2	7	2	4	0	0	44	13
201	89	99	2	5	7	3	12	15	4	6	0	6	3	0	40	23
25	84	107	1	3	4	7	26	27	2	2	0	6	0	0	64	14

TABLE IIIa : DETAILED ANALYSIS OF SCORES OF H-H GROUP

STUD NO ----	RAY ---		BALES -----												NASA -----	
	TO	IO	INDIVIDUAL						I.P.A. CATEGORIES						TOTAL SCORE	CHANGE
			1	2	3	4	5	6	7	8	9	10	11	12		
171	92	73	0	3	5	3	13	25	4	4	3	3	5	0	52	16
252	89	78	3	2	2	2	15	17	2	2	0	3	0	0	38	10
249	82	86	3	1	2	2	11	13	1	2	0	1	0	0	29	7
169	85	81	0	1	2	3	11	7	1	0	2	0	1	0	24	4
137	84	67	1	2	3	2	14	16	4	5	1	3	0	0	42	9
94	85	79	0	3	4	2	8	17	5	7	3	3	0	0	42	10
2	86	73	0	2	3	2	8	14	2	3	1	2	0	0	30	7
178	88	87	0	3	4	0	10	21	5	3	1	2	0	0	40	9
80	93	85	0	1	3	1	12	26	4	5	0	4	0	0	48	8
157	95	78	1	2	2	3	18	23	3	5	1	3	0	0	53	8
75	83	78	1	3	2	2	12	11	3	3	0	3	0	0	31	9
36	93	75	2	2	2	2	17	16	2	2	1	2	0	0	40	8
147	86	79	1	3	2	2	11	17	2	4	1	0	0	0	37	6
145	95	77	1	4	6	4	25	35	7	8	0	3	0	0	79	14
214	96	86	1	1	5	9	16	24	3	5	0	7	3	6	57	23
70	82	86	1	5	4	2	11	14	4	3	3	5	0	0	37	15
77	81	72	0	4	3	1	9	13	1	4	3	6	0	0	31	13
109	84	83	0	3	5	1	7	11	2	3	0	4	0	0	24	12

TABLE IIIb : DETAILED ANALYSIS OF SCORES OF H-L GROUP



STUD NO ----	RAY ---		BALES -----												NASA -----			
	TO	IO	INDIVIDUAL					I.P.A. CATEGORIES							TOTAL SCORE	CHANGE		
			1	2	3	4	5	6	7	8	9	10	11	12				
191	74	113	4	15	10	4	18	31	4	5	0	5	0	0	62	34	96	-8
62	69	102	4	10	11	2	12	16	11	6	3	4	0	0	50	29	79	-24
39	63	99	1	11	11	3	20	15	7	6	0	3	2	0	51	28	79	-8
51	65	103	1	6	8	3	17	39	10	2	5	6	1	0	76	22	98	7
21	68	98	3	4	9	7	11	14	2	3	1	0	0	0	38	16	54	0
37	52	97	2	1	7	2	9	7	2	3	1	3	3	0	24	16	40	4
84	65	111	2	1	1	2	16	20	3	1	0	1	0	0	42	5	47	10
224	71	99	1	6	9	3	11	16	3	10	1	9	0	0	44	25	69	16
23	74	118	5	7	10	7	24	29	9	6	0	5	0	0	75	27	102	8
164	56	98	0	4	8	2	11	15	6	4	2	4	2	0	40	18	58	-4
101	68	110	2	10	10	5	27	28	8	6	0	2	0	0	74	24	98	4
30	74	98	1	7	6	4	12	16	3	6	0	3	0	0	41	17	58	16
121	62	103	2	6	13	8	12	25	4	7	5	6	0	0	61	27	88	6
196	69	98	0	3	3	3	12	9	5	4	3	1	2	0	36	9	45	-2
73	66	102	3	5	10	3	17	26	6	5	3	4	0	0	60	22	82	2
230	71	106	4	7	12	2	13	12	2	5	2	1	0	0	36	24	60	14

TABLE IIIc : DETAILED ANALYSIS OF SCORES OF L-H GROUP

STUD NO ----	RAY ----		BALES -----												NASA -----	
			INDIVIDUAL I.P.A. CATEGORIES												TOTAL	
	TO	IO	1	2	3	4	5	6	7	8	9	10	11	12	TO	IO
208	67	80	2	3	2	2	15	18	4	3	0	3	0	0	42	10
143	67	87	1	2	3	2	21	20	3	2	2	4	1	0	50	11
99	52	67	0	2	0	0	0	0	0	0	0	0	0	0	0	2
13	69	84	1	4	2	0	14	21	3	3	2	0	1	0	43	14
241	66	80	1	4	2	2	12	20	2	2	0	1	1	0	38	9
41	68	79	0	5	6	3	6	8	4	4	0	2	3	0	25	16
231	64	69	0	4	3	1	4	1	0	2	1	0	0	0	9	7
215	65	86	2	2	9	1	18	25	4	2	0	0	0	0	50	13
149	73	84	0	5	3	4	16	27	4	6	0	2	3	0	57	13
190	64	71	0	1	2	1	4	3	4	1	0	0	0	0	13	3
192	73	79	0	3	2	4	19	20	2	4	0	5	0	0	48	10
11	66	75	0	3	1	3	19	18	0	1	0	2	0	0	41	6
232	70	78	0	3	0	3	13	13	3	1	0	2	0	0	33	5
111	63	73	0	3	5	2	7	10	2	2	1	3	0	0	24	11
64	63	71	0	3	2	4	10	22	2	2	1	2	0	0	41	7
100	57	85	1	7	2	2	24	30	9	5	0	2	1	0	70	13
4	71	85	2	2	3	2	24	27	11	11	1	7	3	0	76	17
229	56	74	1	1	1	2	10	8	2	1	1	1	2	0	24	6
213	59	76	0	3	2	2	7	5	1	3	2	1	0	0	20	6
228	65	82	2	3	3	2	13	16	6	2	0	1	0	0	39	9
20	66	87	0	6	5	2	20	26	5	2	2	4	1	0	57	16
125	65	59	0	2	2	0	14	20	3	1	1	2	2	3	39	11
158	72	84	2	5	4	3	21	29	4	4	3	0	1	0	64	12
179	68	83	1	6	3	3	27	31	2	8	2	3	1	0	73	14

TABLE IIId : DETAILED ANALYSIS OF SCORES OF L-L GROUP .

the research; others were unable to be contacted; a few were willing to come, but their timetables were such that they were not free at the same times as the majority of other students were; and several others agreed to come but did not in fact do so. This was particularly noticeable in the L-H and L-L groups where several sub-groups had to be reorganised because of insufficient numbers turning up.

#### 4.4 DATA FROM THE NASA MOON SURVIVAL PROBLEM

In each case an individual and a sub-group error score were obtained. The score given here is the difference between the individual error score and that of the sub-group to which he belonged. The lower the error score, the nearer that score is to the correct score. Thus, if the difference between the individual and sub-group error scores is positive, the sub-group has reached a better solution than the individual. Similarly, if this number is negative, the individual's solution was the better solution and the sub-group has not functioned effectively in making use of all available resources.

This change between the individual and the sub-group error scores can thus be seen to constitute a measure of the amount of synergy operating within the sub-group and the degree of sub-group effectiveness. A complete list of all the individual and sub-group scores on the NASA Moon Survival Problem may be found in Appendix B.4.

The reason for this procedure being adopted was to enable a true picture of sub-group versus individual

functioning to be formed and to allow comparisons between the four groups to be made. By looking at the difference scores, it is possible to compare individuals in terms of their contribution to effective sub-group functioning and the problem of how to evaluate the individual with exceptional ability or knowledge in this field is avoided. The important issue then, is not the individual who knows the answers and individually scores very well, but of the individual who knows how to work together with others in the most effective manner.

A Chi-square test of homogeneity was carried out on the (individual error minus sub-group error) scores to see if there was any difference between the four groups with regard to the change in NASA scores. As with the Ray questionnaire, the middle 25% of scores was eliminated in order to make the concepts of the top and bottom difference scores meaningful. The results are presented in Table IV. There is no significant difference between the groups.

Difference Scores			
Group	Top	Bottom	
	H-H	11	5
	H-L	4	9
	L-H	8	5
	L-L	7	11

Chi-square = 5.75      d.f. = 3

Not significant at 0.01 level

Table IV : Chi-square Test of Homogeneity on (individual error minus sub-group error) scores

The concept of synergy was also examined. Groups which showed increments in the quality of their decisions beyond that of the performance of their most skilled member or beyond the sum of the individual efforts were said to have achieved synergy. The results for each of the four groups will be found in Table V.

Group	Percentage of sub-groups who achieved synergy
H-H	100%
H-L	75%
L-H	25%
L-L	0%

Table V : Synergy Within the Four Groups

#### 4.5 DATA FROM THE BALES IPA

The data were first analysed in terms of the individual scores on the IPA score sheets. The number of interactions in each of the 12 categories plus the total number of interactions for each individual was obtained. A further analysis was done, in terms of the total number of interactions per person in the socio-emotional (categories 1 - 3 and 10 - 12) and task (categories 4 - 9) areas of functioning. These data have been presented in Tables IIIa-d where the individual scores have been arranged according to the group to which they belong.

The data were also analysed as a function of the four groups. Here the total and average number of inter-

actions in each of the 12 categories were calculated for all four groups. The number of interactions per category were also expressed as percentages to enable comparisons to be made between the groups. These data are presented in Table VI. As a result of using percentages, the proportion of interactions in the different categories can be compared across the four groups, with any differences simply due to one group having higher overall rates of interaction being eliminated.

In the present study, the total number of interactions for the L-H sub-group was 1499 which was considerably higher than that obtained by the H-L sub-group where the total number of interactions was only 922. The necessity for the above procedure can be clearly seen.

From the percentage of interactions in each category, profiles showing the interaction rates per category for each sub-group were drawn (see Table VII). It can be seen that the profiles for the H-H and L-H groups and for the H-L and L-L groups appear to be very similar.

To test whether there was any difference between these percentage profiles a Chi-square test of homogeneity was performed. The results appear in Table VIII. There is no significant difference whatsoever between these profiles (level of significance 0.995).

Category	H-H			H-L			L-H			L-L		
	Total	Av.	%	Total	Av.	%	Total	Av.	%	Total	Av.	%
1	35	2.19	3.04	15	0.83	1.63	44	2.10	2.94	16	0.67	1.31
2	103	6.44	8.93	45	2.50	4.88	118	5.62	7.87	82	3.42	6.73
3	138	8.63	11.97	59	3.28	6.40	148	7.05	9.87	67	2.79	5.50
4	60	3.75	5.20	43	2.39	4.66	100	4.76	6.67	50	2.08	4.11
5	242	15.13	20.99	228	12.67	24.73	335	15.95	22.35	338	14.08	27.75
6	318	19.88	27.58	320	17.78	34.71	407	19.38	27.15	418	17.42	34.34
7	85	5.31	7.37	55	3.06	5.97	68	3.24	4.54	80	3.33	6.57
8	79	4.94	6.85	68	3.78	7.38	128	6.10	8.54	72	3.00	5.91
9	26	1.63	2.25	20	1.11	2.17	22	1.05	1.47	19	0.79	1.56
10	57	3.56	4.94	54	3.00	5.86	92	4.38	6.14	53	2.21	4.35
11	10	0.63	0.87	9	0.50	0.98	31	1.48	2.07	20	0.83	1.64
12	0	0.0	0.0	6	0.33	0.65	6	0.29	0.40	3	0.13	0.25
Total	1 153	72.06	-	922	51.22	-	1 499	71.38	-	1 218	50.75	-

Table VI : Bales Scores for All 12 Categories in Each Group

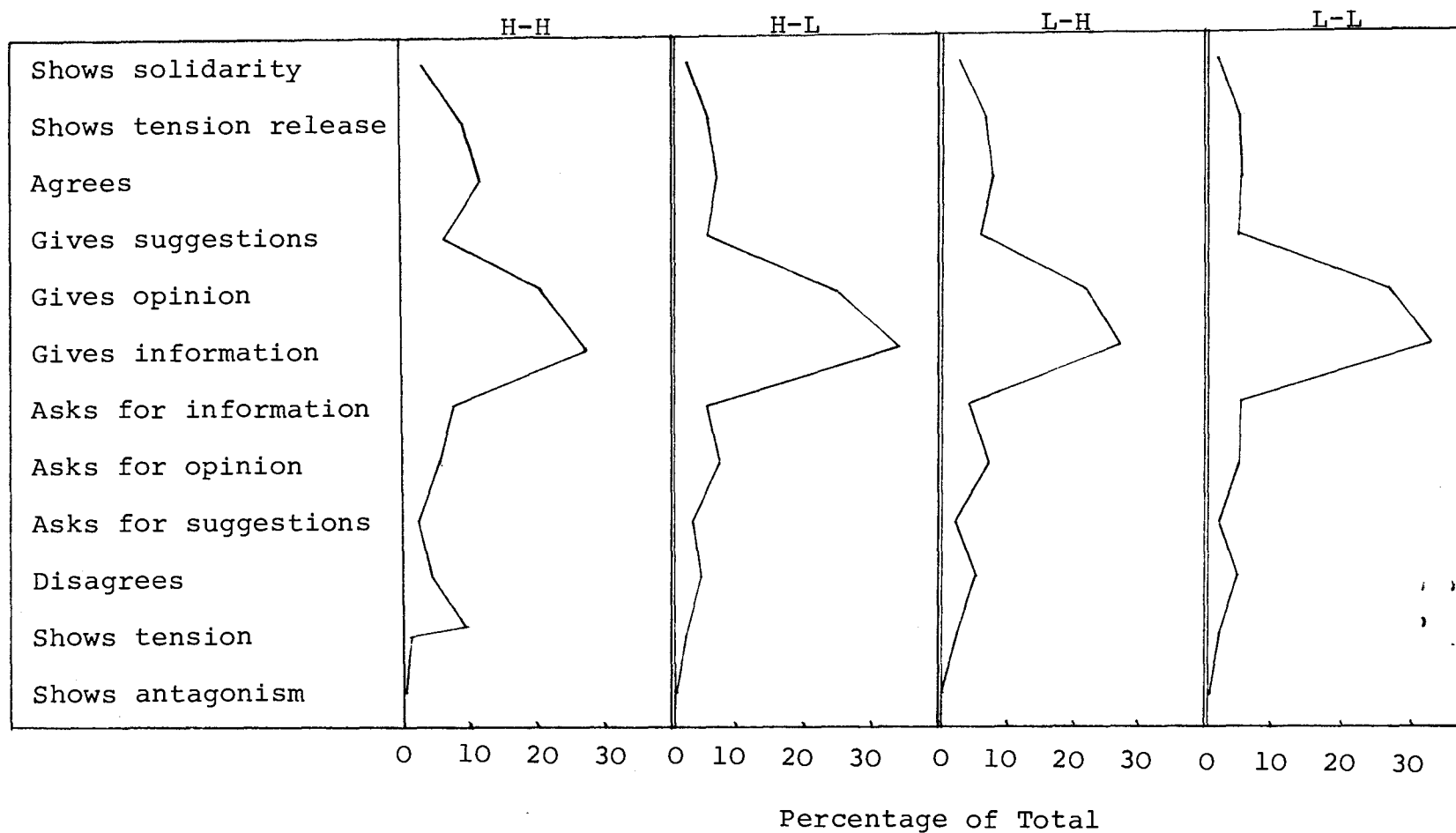


Table VII : Percentage Profiles of the IPA for Each of the Four Groups



Bales IPA Categories - Percentage of Acts Falling into Each Category

	1	2	3	4	5	6	7	8	9	10	11	12
H-H	2.94	7.87	9.87	6.67	22.35	27.15	4.54	8.54	1.47	6.14	2.07	0.40
H-L	1.63	4.88	6.40	4.66	24.73	34.71	5.97	7.38	2.17	5.86	0.98	0.65
L-H	3.04	8.93	11.97	5.20	20.99	27.58	7.37	6.85	2.25	4.94	0.87	0.00
L-L	1.31	6.73	5.50	4.11	27.75	34.34	6.57	5.91	1.56	4.35	1.64	0.25

Chi-square = 13.02      d.f. = 33      No significant difference at 0.995 level

Table VIII : Chi-Square Test of Homogeneity of Bales Profiles

1  
8  
5  
1

#### 4.6 ANALYSIS OF RAY, BALES AND NASA DATA

The Spearman Rank Correlation Coefficients were computed between all possible pairs of variables entered in Table III. The results appear in Table IX and the matrix of corresponding t-scores in Table X. The row and column numbers of Tables IX and X have the following meaning :

- 1 - 12 Bales categories 1 - 12
- 13 Bales socio-emotional score (sum of categories 1 - 3 and 10 - 12)
- 14 Bales task score (sum of categories 4 - 9)
- 15 Total number of interactions on Bales IPA (and hence categories 13 + 14)
- 16 Ray IO
- 17 Ray TO
- 18 NASA difference score (group error score minus individual error score).

The computer program used for obtaining the correlation and t-score matrices may be found in Appendix C.2.

Apparently significant differences between categories 13, 14 and 15 on the one hand, and categories 1 - 12 on the other hand must be ignored because 1 - 12 are the constituent parts of 13, 14 and 15. For the same reason, the very large correlation between category 15, and categories 13 and 14 must be ignored.

Of the large number of pairs of variables significantly correlated, specific reference will be made in the next chapter to the eight listed in Table XI.

TABLE IX : SPEARMAN RANK CORRELATION COEFFICIENTS COMPUTED BETWEEN ALL POSSIBLE PAIRS OF VARIABLES

SPEARMAN RANK CORRELATION MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.000	.368	.390	.412	.270	.198	.236	.353	.047	.230	-.033	-.107	.530	.338	.450	.564	.162	.057
2	.368	1.000	.619	.405	.238	.315	.377	.539	.217	.380	.095	-.063	.770	.474	.642	.566	.076	-.128
3	.390	.619	1.000	.371	.160	.200	.387	.529	.230	.388	.195	.106	.853	.391	.593	.673	.213	-.146
4	.412	.405	.371	1.000	.268	.240	.115	.464	.074	.344	.129	.072	.483	.440	.498	.503	.300	.074
5	.270	.238	.160	.268	1.000	.796	.263	.308	-.055	.251	.191	.152	.318	.829	.741	.341	.175	-.076
6	.198	.315	.200	.240	.796	1.000	.393	.348	.067	.355	.125	.183	.369	.910	.812	.290	.182	-.085
7	.236	.377	.387	.115	.263	.393	1.000	.376	.111	.262	.098	-.012	.435	.515	.537	.236	-.077	-.325
8	.353	.539	.529	.464	.308	.348	.376	1.000	.209	.433	.095	-.051	.608	.587	.657	.435	.407	.008
9	.047	.217	.230	.074	-.055	.067	.111	.209	1.000	.278	.082	.056	.245	.174	.224	.058	-.001	-.092
10	.230	.380	.388	.344	.251	.355	.262	.433	.278	1.000	.138	.211	.662	.478	.573	.386	.298	-.018
11	-.033	.095	.195	.129	.191	.125	.098	.095	.082	.138	1.000	.314	.335	.170	.249	.193	.067	-.050
12	-.107	-.063	.106	.072	.152	.183	-.012	-.051	.056	.211	.314	1.000	.208	.138	.184	.051	.210	.151
13	.530	.770	.853	.483	.318	.369	.435	.608	.245	.662	.335	.208	1.000	.571	.782	.706	.228	-.117
14	.338	.474	.391	.440	.829	.910	.515	.587	.174	.478	.170	.138	.571	1.000	.947	.449	.226	-.107
15	.450	.642	.593	.498	.741	.812	.537	.657	.224	.573	.249	.184	.782	.947	1.000	.587	.257	-.105
16	.564	.566	.673	.503	.341	.290	.236	.435	.058	.386	.193	.051	.706	.449	.587	1.000	.302	.037
17	.162	.076	.213	.300	.175	.182	-.077	.407	-.001	.298	.067	.210	.228	.226	.257	.302	1.000	.290
18	.057	-.128	-.146	.074	-.076	-.085	-.325	.008	-.092	-.018	-.050	.151	-.117	-.107	-.105	.037	.290	1.000

Key : 1 - 12 Bales categories 1 - 12  
 13 Bales socio-emotional score (sum of categories 1-3 and 10-12)  
 14 Bales task score (sum of categories 4-9)  
 15 Total number of interactions on Bales IPA (and hence categories 13 and 14)  
 16 Ray IO  
 17 Ray TO  
 18 NASA differences score (group error score minus individual error score)

TABLE X : T-SCORES OF THE SPEARMAN RANK CORRELATION COEFFICIENTS OF TABLE IX

MATRIX OF T-SCORES  
DEGREES OF FREEDOM= 77

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	.00	3.48	3.72	3.97	2.46	1.77	2.13	3.31	.42	2.08	-.29	-.94	5.48	3.15	4.42	6.00	1.44	.50
2	3.48	.00	6.92	3.88	2.15	2.91	3.58	5.62	1.95	3.61	.83	-.55	10.58	4.72	7.35	6.03	.67	-1.13
3	3.72	6.92	.00	3.51	1.42	1.89	3.69	5.47	2.07	3.70	1.74	.93	14.33	3.73	6.46	7.99	1.91	-1.29
4	3.97	3.88	3.51	.00	2.44	2.17	1.01	4.59	.65	3.22	1.14	.63	4.84	4.30	1.03	5.11	2.76	.65
5	2.46	2.15	1.42	2.44	.00	11.52	2.39	2.64	-.48	2.28	1.71	1.35	2.94	13.02	3.68	3.19	1.56	-.67
6	1.77	2.91	1.80	2.17	11.52	.00	3.75	3.26	.59	3.33	1.11	1.63	3.49	19.25	12.22	2.65	1.63	-.75
7	2.13	3.58	3.69	1.01	2.39	3.75	.00	3.56	.93	2.39	.86	-.11	4.23	5.27	5.59	2.13	-.68	-3.02
8	3.31	5.62	5.47	4.59	2.64	3.26	3.56	.00	1.87	4.21	.84	-.45	6.71	6.35	7.65	4.23	3.90	.07
9	.42	1.95	2.07	.65	-.48	.59	.93	1.87	.00	2.54	.73	.50	2.22	1.55	2.02	.51	-.01	-.81
10	2.08	3.61	3.70	3.22	2.28	3.33	2.39	4.21	2.54	.00	1.22	1.90	7.74	4.78	6.14	3.67	2.74	-.15
11	-.29	.83	1.74	1.14	1.71	1.11	.86	.84	.73	1.22	.00	2.90	3.12	1.51	2.26	1.73	.59	-.44
12	-.94	-.55	.93	.63	1.35	1.63	-.11	-.45	.50	1.90	2.90	.00	1.86	1.22	1.64	.44	1.88	1.34
13	5.48	10.58	14.33	4.84	2.94	3.49	4.23	6.71	2.22	7.74	3.12	1.86	.00	6.10	11.00	8.76	2.06	-1.03
14	3.15	4.72	3.73	4.30	13.02	19.25	5.27	6.35	1.55	4.78	1.51	1.22	6.10	.00	25.95	4.41	2.04	-.94
15	4.42	7.35	6.46	5.03	3.68	12.22	5.59	7.65	2.02	6.14	2.26	1.64	11.00	25.95	.00	6.36	2.33	-.93
16	6.00	6.03	7.99	5.11	3.19	2.65	2.13	4.23	.51	3.67	1.73	.44	8.76	4.41	6.36	.00	2.78	.32
17	1.44	.67	1.91	2.76	1.56	1.63	-.68	3.90	-.01	2.74	.59	1.89	2.06	2.04	2.33	2.78	.00	2.66
18	.50	-1.13	-1.29	.65	-.67	-.75	-3.02	.07	-.81	-.15	-.44	1.34	-1.03	-.94	-.93	.32	2.66	.00

Key : 1 - 12 Bales categories 1 - 12  
 13 Bales socio-emotional score (sum of categories 1-3 and 10-12)  
 14 Bales task score (sum of categories 4-9)  
 15 Total number of interactions on Bales IPA (and hence categories 13 and 14)  
 16 Ray IO  
 17 Ray TO  
 18 NASA differences score (group error score minus individual error score)

For significant correlation at the following levels, the absolute value of the t-score must exceed the critical values given.

Level of Significance	Critical Value
.05	1.67
.01	2.38
.005	2.65
.0005	3.44

Variable	Variable	$r_s$	t-score	Level of Significance
Ray TO	NASA	0.29	2.66	0.005
Ray IO	NASA	0.04	0.32	not significant
Ray TO	Bales TO	0.23	2.04	0.05
Ray TO	Bales IO	0.23	2.06	0.05
Ray IO	Bales TO	0.45	4.41	0.0005
Ray IO	Bales IO	0.71	8.76	0.0005
Bales TO	NASA	-0.12	-0.94	not significant
Bales IO	NASA	-0.12	-1.03	not significant

Table XI : Level of Significance of Spearman Rank  
Correlations - Summarised from Tables IX and X

In the following chapter, the relationship of these results to the hypotheses is discussed.

Page No.

CHAPTER V : DISCUSSION AND CONCLUSIONS

5.1 Hypothesis A	91
5.2 Hypothesis B	93
5.3 Hypothesis C	96
5.4 The Ray Questionnaire	98
5.5 The NASA Game	104
5.6 IPA Analysis and the Sub-Groups	105
5.7 Directions for Future Research	112

## CHAPTER V : DISCUSSION AND CONCLUSIONS

In this, the final chapter, the implications of the results presented in the previous chapter are examined.

Deficiencies in the research design of the present study are discussed and possible future research directions suggested.

### 5.1 HYPOTHESIS A

Hypothesis A is now examined (see section 1.6). This involved the use of Ray scores as predictors of group effectiveness. Group effectiveness was measured by the nearness of the group solution to the given one and by the amount of synergy generated.

Out of the four groups constructed on the basis of the Ray questionnaire, it was predicted that the H-H group would prove the most efficient in terms of both the criteria; the H-L group would perform next best in terms of decision-adequacy but would achieve less synergy than the L-H group, which would rate third in terms of adequacy of solution. The L-L group would be the least efficient in terms of the criteria of both performance and synergy.

The Chi-square test of homogeneity on the error scores (individual error score minus group error score) achieved by the groups, showed no significant difference at the 0.01 level (see Table IV) and hence there is no statistical difference between the performance of

the four groups, on the NASA game. These results then lead us to reject that part of Hypothesis A relating to the performance of the four groups:

It should be noted that, as with the Ray scores, the middle 25% of the NASA error scores was eliminated, to make the concepts of good and poor decision-making adequacy more meaningful.

The differences between the individual and group error scores were used to eliminate effects due to a member of exceptional ability or who had great knowledge in the field. In this way, the efficiency of the performance of the group as a whole could be assessed, taking into account the different initial levels of performance of group members.

That the results of the Chi-square test were not significant can thus not be attributed to any of the above-mentioned factors.

The second criterion, viz., that of synergy, showed that the H-H group achieved synergy in 100% of the groups, the L-H group in 75% of the groups, the H-L group in 25% of the groups and the L-L group in 0% of the groups. These results are as predicted with regard to the H-H and L-L groups, but the order is reversed for the L-H and H-L groups.

Hypothesis A is thus partially supported with regard to the amount of synergy generated by the four groups. However, the results of the H-H and L-L groups which are as predicted merit special attention as the amount of synergy achieved in each group is so markedly in the expected direction. There appears to be a



relationship between the IO and TO scores as measured by the Ray questionnaire and the amount of synergy generated in the H-H and L-L groups.

The Spearman Rank Correlation between the Ray TO and NASA difference scores was significant at the 0.005 level; but the Spearman Rank Correlation between the Ray IO and NASA difference scores was not significant (see Table XI).

This again only partially supports Hypothesis A.

Since this is a situation where task accomplishment is the goal, the significant correlation between Ray TO and NASA difference scores can be accounted for, as scant attention to the socio-emotional needs of a group in a short, discrete, decision-making situation such as this would have no serious repercussions on group functioning.

But, one would expect significant differences in terms of both the TO and IO scores. This raises the issue as to what the Ray questionnaire is measuring. This issue will be dealt with in greater detail in section 5.4.

## 5.2 HYPOTHESIS B

Here Ray scores were used as predictors of Bales scores (see section 1.6). The following was predicted for each of the four groups.

- (1) The H-H group would show the highest total rates of interaction which would strike a balance between categories 4 - 9 of Bales (task categories) and categories 1 - 3 and 10 - 12 (socio-emotional categories).
- (2) The H-L group would show the second highest rates of interaction, but the major concern would be with the task categories.
- (3) The L-H group would show lower total rates of interaction than either the H-H or H-L groups, but would be more concerned with socio-emotional areas of functioning.
- (4) The L-L group would be lowest in terms of total rates of interaction and in terms of interaction on both the task and socio-emotional categories.

The scores for all 12 categories in each group (see Table VI) and the percentage profiles (see Table VII) showed the interaction patterns of the H-H and L-H groups to be very similar. The interaction patterns of the L-L and H-L groups were likewise found to be very similar.

Furthermore, when a Chi-square test of homogeneity of each group over all 12 categories was performed, no significant differences were found even at the very high 0.995 level. The Ray scores thus do not predict the Bales scores when the results are considered group by group.

Bales (1950) has noted that certain consistent patterns have been found when the IPA has been used to study groups involved in "purposeful and goal-directed" action. Attempted Answers (categories 4, 5 and 6) usually "account for a little over 50% of the total activity", while Attempted Questions (categories 7, 8 and 9), Positive Reactions (categories 1, 2 and 3) and Negative Reactions (categories 10, 11 and 12) usually account for the other half.

The present results are in accordance with results found by Bales for undifferentiated groups involved in decision-making activities.

Bass (1967) reports that "Fairly consistent results have been obtained when groups of homogeneous orientation have been assembled and contrasted with each other or with heterogeneous groups. Such groups have been studied by Bales' process analysis (Penrod, 1962) and by observer and member ratings." Penrod also found that "Accordant with their needs for belonging, groups homogeneous in interaction-orientation tended to be low in negative socioemotional activity" and "Conversely, groups homogeneous in task-orientation were seen to generate the most negative socioemotional activity" (Bass, 1967).

Thus when results of research on IPA analyses are examined for groups homogeneous in orientation (as measured by Bass' Ori) the results are at variance with those of the present study. The Bales IPA has

been used for over 20 years and consistent results have been obtained using it. That the results of the interaction analyses in this study were in accordance with those of a decision-making situation in general, but not in accordance with those found in differentiated groups, would seem to point to characteristics of the Ray Questionnaire that differ from Bass' Ori.

Thus the Ray scores do not predict the Bales scores.

This is even more conclusively shown when the Ray and Bales scores are all considered together and not in terms of the four groups. The Spearman Rank Correlation between all possible combinations of pairs of Ray TO and IO scores and the Bales scores in the Task Areas and Socio-emotional Areas of functioning were significant (see Table XI). This means that the Ray Questionnaire does not divide people into the categories that Bales describes as task-specialist, socio-emotional specialist, great man, etc. and that Bass describes as task- and interaction-oriented. That all the correlations were positive and significant suggests that the grouping in terms of the Ray Questionnaire had no predictive value.

### 5.3 HYPOTHESIS C

The last hypothesis was concerned with using the Bales scores to predict NASA scores (see section 1.6). It was predicted that :

- (1) Groups who emphasised task and socio-emotional areas of functioning and kept a balance between them would achieve the best decision.
- (2) Groups who emphasised task concerns and were predominantly goal oriented would reach the next best decision.
- (3) Groups who emphasised socio-emotional concerns would reach the third best solution.
- (4) Groups who emphasised neither orientation would reach the worst solution.

With regard to Hypothesis C, since it has been conclusively shown that the grouping of the subjects according to their Ray T0 and IO scores are not predictive of Bales scores and are only partially predictive of performance scores (as measured by NASA difference scores and the amount of synergy generated), this last hypothesis becomes redundant.

This means that the NASA game was in effect submitted to heterogeneous groups who were observed using the Bales IPA. Thus any correlation between these two scores would simply be a reflection of the associations between these two measures.

With one exception there was no correlation between any of the 12 Bales categories and the change in NASA score (see Table XI). The correlation between Bales category 7 (Asks for orientation) and NASA was negative

and significant at the 0.005 level - i.e. amongst those individuals where there was much asking for orientation, there was little change in NASA score (and vice-versa).

Looking at the overall results, it can be concluded that in this study the Ray scores were predictive of performance on the NASA game only with regard to the TO scores but not with regard to the IO scores. The TO and IO scores were predictors of the amount of synergy generated in the H-H and L-L groups only. Thus the Ray questionnaire can be regarded as yielding TO and IO scores that were only partially predictive of performance as measured in the present study.

The TO and IO scores were shown not to predict Bales scores and hence the Bales scores were similarly found not to predict performance scores on the NASA game.

The Ray questionnaire did not appear to yield the four homogeneous groupings it was anticipated it would and in terms of the present sample, the concepts of TO and IO were not unequivocal predictors of performance.

#### 5.4 THE RAY QUESTIONNAIRE

##### Ray's Findings as Compared with Those of the Present Study

Ray (1973) in measuring the task- and interaction-orientations of individuals divides his sample into those with high and those with low TO and IO scores without defining what he means by high and low. He

does not state explicitly whether high refers to the top 50% of scores and low to the bottom 50%, but this seems implicit from his work.

This means there is a negligible difference between someone whose score is at the bottom of the high group and someone whose score is at the top of the low group.

The present study employed what may be regarded as a more appropriate and valid procedure in that the middle 25% of scores was eliminated and there was a clearly definable difference between those who scored either high or low on either dimension.

The scores obtained for the means of both the interaction- and task-oriented scales by Ray are considerably higher than those obtained in the present study. Ray's results for the means of TO and IO scales were as follows :

<u>Sample</u>	<u>IO Means</u>	<u>TO Means</u>	<u>Sample Size</u>
(1) Friends of students	111.30	84.32	N = 74
(2) School students	127.52	93.32	N = 53
(3) Technical college students	111.51	92.89	N = 65
(4) Evening college students	117.98	89.62	N = 61

In the present study the means were :

<u>Sample</u>	<u>IO Means</u>	<u>TO Means</u>	<u>Sample Size</u>
1st Year Psychology students	91.66	77.47	N = 245

No means are as yet available for Ray's questionnaire

(Ray, 1974) and therefore no statement as to the significance of the considerably lower means obtained in the present study can be made. ~ However the Standard Deviations for both scales in the present study are within the range of those reported by Ray (1973) and thus the spread of the scores about their respective means is of the same order of magnitude in both studies.

#### Correlation Between IO and TO

The Spearman Rank Correlation between TO and IO was significant at the 0.0005 level (see Table II). Although Ray states that in some cases TO and IO are positively correlated, it is clear that in the present study the positive correlation is very strong indeed.

It also points to Ray's critique of Bass' Orientation Inventory which is ipsatively scored, as not being an appropriate procedure for measuring task-, interaction- and self-orientations, as an individual can only be high on one of the three orientations. The present results support Ray in that one can be high on both TO and IO. Clearly then, TO and IO are not opposed. This then constitutes a challenge to the validity of Bass' Ori. A fortiori, the extremely high correlation found between TO and IO scores would seem to indicate that task- and interaction-orientations are not mutually orthogonal, independent variables.

Ray considers that "leisure-orientation" is a far more suitable opposite to task-orientation than is Bass' conclusion that self- and interaction-orientations are (Ray, 1973).



Other investigators, using the LBDQ and the LOQ (see section 1.3) which yield measures of Initiating Structure and Consideration (which have been shown to be very similar to TO and IO) have also investigated the correlation between these two dimensions. In a review of 72 studies using the LBDQ and the LOQ, Weissenberg and Kavanagh (1972) found that in 51% of the studies, a significant positive correlation was found between the two dimensions. Significant negative correlations were reported in 10% of the studies whilst the remaining 39% showed non-significant correlations.

These results led the authors to question the conclusion of Fleishman (1969) that these dimensions were orthogonal. They then examined in more detail the conditions under which these dimensions are related; and the fact that the relationship differed according to the instrument used, the organisational level, etc., lends a word of caution to concluding that TO and IO (as measured in the present study) are unequivocally related.

Weissenberg and Kavanagh (1972) found that when the LBDQ (which measures how subordinates perceive their leader) was used, there were significantly more positive correlations than when the LOQ, which measures how a leader perceives his own behaviour was used. The Ray questionnaire, constitutes a measure of self-perception and is therefore closer to the LOQ, and as such does not support the findings of the above authors.

A sample consisting of only first year Psychology

students was used in the present study, so it is impossible to extend the findings to different occupational levels. Weissenberg and Kavanagh (1972) found that the two dimensions were not independent at lower levels but were at higher levels. Little difference was found when the results were examined across different occupational levels.

Korman (1966) in reviewing research using the LBDQ and LOQ concluded that the relationship between the variables might even be curvilinear. The Life Cycle Theory of Leadership (see section 1.3) rests on this assumption.

All that can be said from the results of the present study is that TO and IO are not independent variables for this particular sample.

#### The Meaning of TO and IO

The question arises to what Ray's questionnaire really is measuring. His instrument yields a single global score representing an individual's task-orientation and similarly a single score representing his interaction-orientation. There might perhaps be different types of combinations of TO and IO which Ray's questionnaire does not tell us about. If this is indeed the case, then perhaps Ray has defined TO and IO too loosely.

Ray sums up his definitions of TO and IO as follows : "Getting the job done vs. having a happy time with others" (Ray, 1973). If one looks at the questions

on his scale (see Appendix A), most of the items appear to relate to the definition in a simplistic manner - i.e. they do not refer to actions and reactions in a certain situation, but tend to consist of statements clearly relating to the above definition to which the respondent must either agree or disagree;

e.g. (4) People who need people are the happiest people in the world.

(5) My primary aim in life is to reach the top of the heap.

(21) A foreman does a more important job than a social worker.

These are statements considered in isolation from a situational context and hence are very broad in meaning. Many students expressed difficulty in answering the questionnaire for this reason as they considered that some of the statements needed to be qualified. The situation should be taken into account in order to make this questionnaire as meaningful as possible.

Furthermore, the particular combination of TO and IO is an important consideration as well. TO means more than "Getting the job done" depending on the combination of a TO score, with that of a corresponding IO score. Rather than having one basic and rather simplistic definition for TO and IO it might prove more fruitful to examine areas in which the

particular combination of TO and IO scores lead to certain behaviour patterns and hence to certain leadership styles.

#### 5.5 THE NASA GAME

A criticism of the present study is that situational variables were not taken into account in relating orientation to effectiveness. All that was done, was to give each sub-group the same decision-making exercise with the same normative decision-making instructions which it was hoped would define the small group culture and the expectations of members.

This is not a satisfactory arrangement. There was no means of ascertaining whether the normative decision-making instructions were effective and if so to what extent. Although the sub-groups were all presented with the same situation, this only allows us to say how they performed in that particular situation.

If work using the dimensions Initiating Structure and Consideration is examined, it is seen that "there is very little evidence that leadership behavioural and/or attitudinal variation, as defined by scores on the Leader Behaviour and Leadership Opinion Questionnaire, are predictive of later effectiveness and/or satisfaction criteria" (Korman, 1966). Korman considers that a probable reason for this is that most of these studies have not taken situation variables into account and Initiating Structure and Consideration scores have simply been correlated with a satisfaction or

performance variable.

This further points to the need for examining the relationships between variables in a wider context.

## 5.6 IPA ANALYSIS AND THE SUB-GROUPS

### Reliability of the Recordings

It was unfortunate that the tape recordings of some of the sub-group sessions were not clear enough to allow another observer to perform an interaction analysis on them. All the IPA recordings in the present study were done by the same observer.

This means that observer bias could have influenced the scoring. An attempt was made to avoid this by not labelling any of the four groups of students so that when the sub-groups were formed, it was not known which group they were drawn from. All analyses of the data were done only at the end of the study.

Thus there was no means of assessing whether the results obtained in the present study were due to the groupings of students or to the observer's method of recording the interactions.

### Homogeneous versus Heterogeneous Groups

Although work has been done using the IPA on groups of homogeneous orientation as constituted on the basis of the Ori, Bales himself appears to have studied heterogeneous groups from which the two types of

specialists - the task specialist and the socio-emotional specialist - were identified and the characteristic interaction patterns of these two types of specialists identified (Bales, 1958; Bales and Slater, 1958).

When Bales studied the performance of those he termed great men, he focussed on groups in which only one great man, who had been selected by prior observation, was present (Borgatta, Couch and Bales, 1954; Bales, 1956).

The above does not detract from the validity of having homogeneous groups when using the IPA (as Bass' and Penrod's work has shown) but it does point to a major difference in the way in which Bales drew up his groups and the way in which they were drawn up in the present study.

Bales observed his groups and from those he observed, a task and a socio-emotional specialist emerged. Occasionally one man, termed a great man, filled both these roles. Thus the method consisted in recording the ongoing behaviour and then categorising the individuals into task specialist, etc.

The present approach involved assessing orientations by means of a questionnaire and forming the groups on the basis of the orientations measured. Thus the former method begins from an analysis of behaviour and the latter from an analysis of orientations measured by an attitude scale. It might prove fruitful to utilise a behavioural measure similar to Ray's

attitude questionnaire in conjunction with his questionnaire.

### The Sub-Groups

The sub-groups in the present study were constituted of members who did not know one another and who came together for one brief meeting.

Thus we are faced with the problems of an ad hoc group, where there was no time for group members to get to know one another and for a common culture to develop. Normative intervention sanctioned and in fact encouraged certain behaviours but did not weld the group into one unit.

This problem is further exacerbated by the fact that as the groups were only seen once, there was no way of knowing whether the groups would have behaved in the same way if the NASA game had been given to them after they had met together several times and had formed a cohesive work unit.

To enhance comparisons between the four groups, heterogeneous groups (consisting of one member from each of the four groups) should have been studied as well. However, the small numbers of students in the H-H and L-L groups prevented this from being carried out.

Since the groups studied were all ad hoc, care must be taken in attempting to extrapolate these results

to groups in an organisational setting, who have worked together for a period of time.

### Power

Another major difference between the experimental task groups in this study and those studied within an organisational setting, is that the issue of power is present in the latter case but not in the former. Power structures within a group can radically alter the patterns of interaction within a group (Etzioni, 1965).

"Organisations differ from other collectivities in that within them power is, comparatively, more deliberately distributed and institutionalised. . . . In experimental task-groups leadership rests solely on the followers' attitudes and reciprocations, so that few discrepancies arise between leadership and power positions, but such discrepancies are common within complex organisations." (Etzioni, 1965).

Thus the issue of power and how it affects group functioning is not dealt with in the present analysis. The structural factors which can affect the degree of power available to an individual are obviously also not dealt with.

It is important to study the issue of power, especially in relation to different types of leaders. Etzioni has attempted to integrate the Bales-Parsons theory of small groups with his theory of complex organisations (Etzioni, 1965). It would prove



fruitful to examine the optimal relationship between the degree of structure, the power relationships and the task-and interaction-oriented leaders within an organisational setting.

Another important distinction between the present study and studies within organisational settings concerns the issue of leadership versus headship. Gibb (1969) has emphasised this point. Leadership involves the power that is granted to an individual in a group by members of that group, whereas the term headship implies that the power is derived from outside the group. The leader and the head may or may not be the same person within a group. If these two roles are filled by different people a great deal of conflict may result (Gibb, 1969). That the present study does not take these factors into account is a further indication that the results cannot be generalised without qualification to groups in an organisational setting.

#### Four-and Five-Man Groups

It was unfortunate that some of the sub-groups contained four members and others five, since certain differences in interaction patterns have been found to occur as the group increases in size or depending on whether the groups contain an odd or even number of members.

The changes occurring due to an increase in group size are unimportant in this study where there would only be negligible, if any, differences due to an increase in size of such a small magnitude.

It has been found that groups with even numbers tend to polarize into two equal parts - there is no majority and a situation of deadlock may persist and hence postpone reaching consensus and arriving at a decision. This conflict is manifested by high rates of interaction in categories 10 and 12 (Disagrees and Shows Antagonism). Such groups are low in Asking for Suggestion (category 9). They may be higher in Showing Solidarity (category 1) and possibly are lower in Showing Agreement (category 3). The profiles of the individuals tend to be more like each other in groups of even size because of the conflict and deadlock (Bales and Borgatta, 1962).

In the present study, both the four- and five-man sub-groups were considered together and certain subtleties of interaction may have been obscured. Hence the four groups may appear to be more alike than they really are.

Due to the small numbers of sub-groups within each larger group, it was not possible to analyse the results of the four- and five-man groups separately. However, this is a point well worth considering for further research in this field.

#### Phases in Group Problem-Solving

Some of the sub-groups spent only 15 or 20 minutes on the part of the NASA game which was done as a group, whereas other sub-groups spent as long as 40 or 50 minutes on the task. This means that in the former case only one set of interactions could be recorded

whereas in the latter case, two sets of recordings were obtained.

The problem does not relate to the number of sets of interaction recordings made for each sub-group, but to the problem-solving phase the sub-group was encountering at the time the recording of interactions was carried out and how this may have affected the interaction patterns during that particular phase.

Bales and Strodtbeck (1951) have shown that where the task involves a group decision, qualitatively different sub-periods or phases exist within the total continuous period of interaction. Three time periods or phases have been delineated, each with a different type of activity, reflecting the group's progress toward a decision.

The problems encountered in each phase are as follows :

- (1) Problems of orientation (what is it?)  
Members are busy gathering information.
- (2) Problems of evaluation (how do we feel about it?)  
The information gathered in Phase 1 is now evaluated.
- (3) Problems of control (what shall we do about it?)  
The members are pressing toward a decision.

The rate of acts of information decrease from Phase 1 to Phase 3. However, the acts of suggestion show a corresponding increase over the three phases. Acts

of opinion are found most in Phase 2, falling off again during Phase 3. Lastly, positive and negative acts increase in number from the initial to the final phase (Hare, 1962). The groups are continually striving to reach a position of equilibrium (Bales, 1953).

In the present study, where two sets of interactions were obtained for a sub-group, only the first was used in the final analysis. However, these two sets of interaction recordings are not directly comparable. It would not have helped if both the sets of recordings had been included as these would still represent qualitatively different problem-solving phases.

One can only speculate as to the extent that factors such as these might have obscured differences between the four groups.

#### 5.7 DIRECTIONS FOR FUTURE RESEARCH

The relationship between TO and IO as measured by Ray's questionnaire has been examined, as well as the way in which these scores could predict (albeit in a very limited way), the performance on the NASA game and the group processes as measured by Bales IPA.

As groups confront different situations and tasks, group needs and leadership roles change. In this study only one situation and one task have been examined.

It would prove more fruitful if a model incorporating

these factors could be used for future research in the field so that the results would have wider applicability and generalisability.

To a certain extent the Life Cycle Theory of Leadership (which is based on the assumption of a curvilinear relationship between task and relationships behaviour) as put forward by Hersey and Blanchard (1969) - see section 1.3 - incorporates these variables. Their more recent research (Hersey and Blanchard, 1974) includes the development of the Leader Adaptability and Style Inventory (LASI). This inventory requires the respondent to select one out of four alternative courses of action that he would adopt in twelve different situations. In each case the four alternatives correspond to those combinations of a task and a relationships orientation that correspond to the four Ohio State quadrants.

The quadrant chosen most frequently denotes that individual's dominant leadership style whilst the next most frequently chosen quadrant(s) denote his supporting style(s). The dominant and supporting styles together form the individual's style range. No one style is effective in all situations so the person must adapt his style within the limits of his style range.

Another advantage of this approach is that the LASI can be used to measure not only self-perceptions but perceptions as well. These two can be compared and thus give the person a better understanding of how others see him.

Although this approach uses the dimensions of a task- and a relationship-orientation in order to develop a theory of leadership style, it is not without its drawbacks as well.

The issue of power within an organisation is not dealt with, and the way in which this affects leadership and group behaviour are not dealt with. Personal power is only very briefly mentioned insofar as the group members determine the personal power of a leader but the ways in which this may occur are not elaborated on.

Had the Ray questionnaire proven to be a more valid measure of TO and IO, it would have been interesting to consider this questionnaire in the light of the framework provided by Hersey and Blanchard.

There are so many questionnaires and inventories purporting to measure task- and relationship-orientations and it is of the utmost importance first to establish just what each is measuring and to what extent the different investigators' perceptions of task- and relationship-orientations are congruent.

APPENDICES

APPENDIX A

- A.1 Ray Questionnaire
- A.2 Key to Ray Questionnaire
- A.3 Listing of Students in Each Group
- A.4 Computer Program for Computing TO  
and IO Scores and for Plotting  
Scatter Diagram



A.1 RAY QUESTIONNAIRE

OPINION AND ATTITUDE SURVEY

This survey is for research purposes only and forms part of my M.A. thesis.

There are no right or wrong answers. Please be frank and indicate what you personally feel, not how you think others would expect you to feel. Don't spend too long thinking over each question, just put down your first reaction.

Indicate your preference in each case by placing an X in the appropriate square to the right of the statement.

It would be appreciated if you could spare an hour to take part in a group discussion as a further part of this research. Please indicate in the space below which of the following times would be suitable for you.

	12 - 1	1 - 2	2 - 3	3 - 4
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				

Thank you for your cooperation and help.

Liane Schach.

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NAME:

SEX:

AGE:

FACULTY:

HOME LANGUAGE:

1. I learn best when I can discuss the subject with others.
2. I am happiest when I am getting things done.
3. Part of the working day in every factory should be set aside for group discussion.
4. People who need people are the happiest people in the world.
5. My primary aim in life is to reach the top of the heap.
6. Parties are good fun.
7. Schools should place more emphasis on teaching children to follow through on a job.
8. Friendship is the most important thing in life.
9. If I had more time I would like to work at my hobby or learn something new and interesting.
10. Meeting people is the only reason I like my job.
11. Workers should be allowed to spend more time discussing what they do.
12. If a job is worth doing, it is worth doing well.
13. The satisfaction I get from my performance is the main thing for me in anything I undertake.
14. I like a leader who makes himself easy to talk to.
15. Schools should put less emphasis on competition and more on getting along with others.

Strongly agree.	Agree.	Not sure.	Disagree.	Strongly disagree.
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16. Ambition is essential in leadership.
17. The best form of relaxation is conversation with friends.
18. Sentiment should not stand in the way of progress.
19. Schools should be places where one learns to mix with others.
20. Friends are more important than ambition in life.
21. A foreman does a more important job than a social worker.
22. I prefer team sports.
23. Your best friends are those who understand your problems.
24. Teachers should encourage discussion among their students.
25. The first task of leaders is to get the job done.
26. What gets done is more important than how pleasantly it gets done.
27. I would take a day off work to help my friends.
28. Supervisors should give more attention to interpersonal relations.
29. Getting things done is more important than keeping people happy.
30. The best part of a job is tea break with one's mates.
31. As a youngster I enjoyed just being with the gang.

Strongly agree.	Agree.	Not sure.	Disagree.	Strongly disagree.
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32. We should always persevere until we accomplish what we set out to do.
33. As a youngster I sought the feeling of accomplishment that comes only after doing something well.
34. Any extra spare time I got I would like to use in making more friends.
35. Useless people can still be lovable.
36. The newspapers never give enough space to people who complete worthwhile projects.
37. The best student at school is not necessarily the brightest.
38. At least with working mothers you know they don't waste all their time.
39. You can get a new job but you can't get new friends.
40. It is important to me that my friends should want to help others wherever possible.
41. The greatest satisfaction in life for me is the feeling of a job well done.
42. The only reason I take up hobbies is in order to meet other people.
43. The best friends are people who help you to get things done.
44. Even though you can't get a job done, it's worth talking about.

Strongly agree.	Agree.	Not sure.	Disagree.	Strongly disagree.
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45. People should keep themselves busy with some hobby during their leisure time.
46. The best friends are people who are easy to get along with.
47. Workers should concentrate on getting the job done.
48. I would not like to be known as a person who puts his work before his friends.
49. The best hobby is one that produces tangible results.
50. You can't be efficient unless you're friendly.
51. Outdated methods must be eliminated in spite of people's feelings.
52. Employers should subsidize social clubs for their workers.
53. Teachers who spend a lot of time keeping people happy seldom get anything taught.
54. It is important for musicians to be able to teach others as well as play themselves.
55. If at first you don't succeed try, try again.
56. Leaders should be more friendly.
57. Knowledge and initiative are the most important qualities a person can have.
58. Nothing is worse than losing your friends.

Strongly agree.	Agree.	Not sure.	Disagree.	Strongly disagree.
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59. If you've got friends and neighbours, you're the richest man on earth.
60. The sacred cows of India should be slaughtered for food regardless of opposition from the peasants.
61. The most important part of a party is the work that goes into it.
62. Leaders should put the welfare and satisfaction of people in the group first.

Strongly disagree.	Agree.	Not sure.	Disagree.	Strongly disagree.
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A.2 : KEY TO RAY QUESTIONNAIRE

The following item numbers yield the IO score :

1	14	24	37	50
3	15	27	39	52
4	17	28	40	54
6	19	30	42	56
8	20	31	44	58
10	22	34	46	59
11	23	35	48	62

The following item numbers yield the TO score :

2	16	32	45	57
5	18	33	47	60
7	21	36	49	61
9	25	38	51	
12	26	41	53	
13	29	43	55	

A.3 : LISTING OF STUDENTS IN EACH GROUP

<u>H - H</u>			<u>H - L</u>		
<u>Stud No.</u>	<u>Task Score</u>	<u>Interaction Score</u>	<u>Stud No.</u>	<u>Task Score</u>	<u>Interaction Score</u>
7	121	127	2	86	73
9	94	107	36	93	75
25	84	107	70	82	86
42	82	98	75	83	78
56	103	124	77	81	72
63	96	104	80	93	80
67	83	105	94	85	79
85	84	112	109	84	83
97	90	102	137	84	67
102	92	106	145	95	77
122	81	100	147	86	79
123	87	103	157	95	78
136	100	108	169	85	81
138	92	104	171	92	73
154	91	97	178	88	87
160	94	107	214	96	86
182	82	102	249	82	86
201	89	99	252	89	78
216	98	113			
217	84	102			
234	81	101			



A.3 (continued)

Stud No.	<u>L - H</u>		Stud No.	<u>L - L</u>	
	<u>Task Score</u>	<u>Interaction Score</u>		<u>Task Score</u>	<u>Interaction Score</u>
21	68	98	4	71	85
23	74	118	11	66	75
30	74	98	13	69	84
37	52	97	20	66	87
39	63	99	41	68	79
51	65	103	64	63	71
62	69	102	99	52	67
73	66	102	100	57	85
84	65	111	111	63	73
101	68	110	125	65	59
121	62	103	143	67	87
164	56	98	149	73	84
191	74	113	158	72	84
196	69	98	179	68	83
224	71	99	190	64	71
230	71	106	192	73	79
			208	67	80
			213	59	76
			215	65	86
			228	65	82
			229	56	74
			231	64	69
			232	70	78
			241	66	80

A.4 FORTRAN - IV COMPUTER PROGRAM TO COMPUTE THE RAY TO AND IO SCORES FROM RAW DATA AND TO PLOT THE SCATTER DIAGRAM

```

      DIMENSION HEAD1(3),HEAD2(3),HEAD3(3),HEAD4(3)
      PRINT 17
      FORMAT(1H1)
17  DATA HEAD1/'STUD  TASK INTER-'/
      DATA HEAD2/' NO   SCORE ACTION'/
      DATA HEAD3/'          SCORE  '/
      DATA HEAD4/'-----'/
      PRINT 70,(HEAD1,LL=1,5)
      PRINT 70,(HEAD2,LL=1,5)
      PRINT 70,(HEAD3,LL=1,5)
      PRINT 70,(HEAD4,LL=1,5)
70  FORMAT(1H ,5(3A6,6X))
C
C
      INTEGER A(62),NI(300),NT(300),NSTUD(300)
      K=0
2    K=K+1
      NTOT=0
      READ 3,A,NSTUD(K)
3    FORMAT(62I1,15X,I3)
      IF(A(1).EQ.9)GO TO 5
      DO 4 I=1,62
      NTOT=NTOT+A(I)
4    CONTINUE
      NI(K)=A(1)+A(3)+A(4)+A(6)+A(8)+A(10)+A(11)+A(14)+A(15)+A(17)+
1  A(19)+A(20)+A(22)+A(23)+A(24)+A(27)+A(28)+A(30)+A(31)+A(34)+
2  A(35)+A(37)+A(39)+A(40)+A(42)+A(44)+A(46)+A(48)+A(50)+A(52)+
3  A(54)+A(56)+A(58)+A(59)+A(62)
      NT(K)=NTOT-NI(K)
      GO TO 2
C
C
5    NROWS=K/5
      DO 77 I=1,NROWS
      NSTOP=I+4*NROWS
      PRINT 78,(NSTUD(I),NT(I),NI(I),L=I,NSTOP,NROWS)
78  FORMAT(1H ,1X,5(I3,3X,I3,3X,I3,9X))
77  CONTINUE
C
C
      DIMENSION XEXP(24),ANT(300),ANI(300)
      DATA XEXP/24*' '
      XEXP(5)='TASK '
      XEXP(6)='SCORES'
      DO 79 I=1,300
      ANT(I)=FLOAT(NT(I))
      ANI(I)=FLOAT(NI(I))
79  CONTINUE
      K=K-1
      CALL GRAPH(ANT,ANI,12HINTERACTION ,XEXP,40.,140.,40.,140.,K,0)
      STOP
      END

```

APPENDIX B

- B.1 NASA Moon Survival Problem
- B.2 NASA Group Decision Instructions
- B.3 Solution to NASA Moon Survival Problem
- B.4 List of Individual and Sub-Group NASA  
Scores

**B.1 NASA MOON SURVIVAL PROBLEM**

**LOST ON THE MOON**

Your spaceship has just landed on the moon. You were scheduled to rendezvous with a mother ship 200 miles away on the lighted surface of the moon, but the rough landing has ruined your ship and destroyed all the equipment on board except for the 15 items listed below.

Your crew's survival depends on reaching the mother ship, so you must choose the most critical items available for the 200-mile trip. Your task is to rank the 15 items in terms of their importance for survival. Place number one by the most important item, number two by the second most important, and so on through to number 15, the least important.

You and the other 4 people in your group should do this task individually without knowing each other's answers, and then perform the task as a group. Share your individual answers and reach a consensus - one ranking for each of the 15 items that best satisfies all group members.

NASA experts have in fact determined the best solution to this task.

Items	Your ranks	Group Ranks
Box of matches		
Food concentrate		
Fifty feet of nylon rope		
Parachute silk		
Solar-powered portable heating unit		
Two .45-calibre pistols		
One case of dehydrated milk		
Two 100-pound tanks of oxygen		
Stellar map (of the moon's constellation)		
Self-inflating life raft		
Magnetic compass		
Five gallons of water		
Signal flares		
First-aid kit containing injection needles		
Solar-powered FM receiver-transmitter		

## B.2 GROUP DECISION INSTRUCTIONS

### GROUP DECISION INSTRUCTIONS

All group members should now try and reach a consensus as to the ranking of the 15 items that will best satisfy you all. When your group reaches the point where each person can say, "well, even though it may not be exactly what I want, at least I can live with the decision and support it," then you have reached a consensus and can enter the judgement as a group decision. This means, of course, that any one of you can block a decision should you think it necessary.

#### Guidelines

1. Do not vote in order to reach a decision and so avoid conflict. Voting will split the group into "winners" and "losers", and encourages "either-or" thinking. Rather explore through discussion differences of opinion that will arise.
2. Differences of opinion are natural and expected. Disagreements can help the decision-making process as everyone is exposed to a wider range of information and opinions. In this way an objective and logical solution can be reached.
3. As well as presenting your own viewpoint, listen to others' reactions to what you have said, and also to their opinions. Remember, in this situation it is the group's performance and not the performance of individual members that is important.

Items	NASA's Reasoning	NASA's Ranks	Your Ranks	Group ranks
Box of matches	No oxygen on moon to sustain flame; virtually worthless	15		
Food Concentrate	Efficient means of supplying energy requirements	4		
Fifty feet of nylon rope	Useful in scaling cliffs, tying injured together	6		
Parachute silk	Protection from sun's rays	8		
Solar-powered portable heating unit	Not needed unless on dark side	13		
Two .45 calibre pistols	Possible means of self-propulsion	11		
One case of dehydrated milk	Bulkier duplication of food concentrate	12		
Two 100 pound tanks of oxygen	Most pressing survival need	1		
Stellar map (of the moon's constellation)	Primary means of navigation	3		
Self-inflating life raft	CO <sub>2</sub> bottle in military raft may be used for propulsion	9		
Magnetic compass	Magnetic field on moon is not polarized; worthless for navigation	14		
Five gallons of water	Replacement for tremendous liquid loss on lighted side	2		
Signal Flares	Distress signal when mother-ship is sighted	10		
First-aid kit containing injection needles	Needles for vitamins, medicines etc, will fit special aperture in NASA space suits	7		
Solar-powered FM receiver-transmitter	For communication with mother-ship; but FM requires line-of-sight transmission and short ranges	5		

### B.3 SOLUTION TO MOON SURVIVAL PROBLEM

B.4 : LIST OF INDIVIDUAL AND SUB-GROUP NASA SCORES

<u>H - H</u>		<u>H - L</u>		<u>L - H</u>		<u>L - L</u>	
<u>SubG.</u> <u>Score</u>	<u>Indv.</u> <u>Score</u>	<u>SubG.</u> <u>Score</u>	<u>Indv.</u> <u>Score</u>	<u>SubG.</u> <u>Score</u>	<u>Indv.</u> <u>Score</u>	<u>SubG.</u> <u>Score</u>	<u>Indv.</u> <u>Score</u>
40	48	36	42	54	46	42	49
	56		46		30		36
	40		38		46		50
	49		58		61		48
							44
38	52	40	46	30	30		
	44		56		34	28	26
	40		52		40		54
	42		56		46		40
			45				46
28	46			36	44		40
	42	38	42		32		
	45		59		40	48	50
	46		56		52		46
			62				46
34	34		46	38	44		44
	40				36		
	54	38	46		40	39	33
	40		36		52		48
	48		51				38
			36				50
24	40						
	40					50	64
	38						34
	52						60
							62
							44

APPENDIX C

- C.1      Bales IPA Scoresheet
  
- C.2      Computer Program for Verifying Bales  
Data and Computing Spearman Rank  
Correlation and Corresponding Matrix  
of t-Scores for Bales, Ray and NASA  
Data



C.1 BALES IPA SCORESHEET

	1	2	3	4	5		
SHOWS SOLIDARITY. Raises others esteem, gives help, reward.							
SHOWS TENSION RELEASE. Jokes, laughs, shows satisfaction.							
AGREES. Shows passive acceptance, understands, concurs, complies.							
GIVES SUGGESTIONS. Direction, autonomy for others.							
GIVES OPINION. Evaluation, analysis, expresses feeling, wish.							
GIVES ORIENTATION. Information, repeats, clarifies, confirms.							
ASKS FOR ORIENTATION. Information, repetition, confirmation.							
ASKS FOR OPINION. Evaluation, analysis, expression of feeling.							
ASKS FOR SUGGESTIONS. Direction, possible ways of action.							
DISAGREES. Shows passive rejection, formality, withholds help.							
SHOWS TENSION. Asks for help, withdraws.							
SHOWS ANTAGONISM. Deflates others status, defends or asserts self.							

C.2 FORTRAN - IV COMPUTER PROGRAM FOR VERIFYING BALES DATA AND COMPUTING SPEARMAN RANK CORRELATION AND CORRESPONDING MATRIX OF t-SCORES FOR BALES, RAY AND NASA DATA

```

PRINT 97
97  FORMAT(' STATE NO OF STUDENTS, NO OF VARIABLES')
PRINT 30
30  FORMAT(1H1)
    INTEGER SCORE
    DIMENSION SCORE(79,20),A(79),B(79),R(160),NUM(79),
1   CORREL(20,20),T(20,20)
    READ 99,NSTUD,NCOLS
99  FORMAT(1)
    DO 20 I=1,NSTUD
      READ 19,(SCORE(I,J),J=1,NCOLS),NUM(I)
19  FORMAT(12I2,9I3)
      PRINT 31,(SCORE(I,J),J=1,NCOLS),NUM(I)
31  FORMAT(1H ,12I4,7I5,16)
      M13=SCORE(I,1)+SCORE(I,2)+SCORE(I,3)+SCORE(I,10)
1   +SCORE(I,11)+SCORE(I,12)
      M14=SCORE(I,4)+SCORE(I,5)+SCORE(I,6)+SCORE(I,7)
1   +SCORE(I,8)+SCORE(I,9)
      IF((SCORE(I,13).NE.M13).OR.(SCORE(I,14).NE.M14).OR.
1   ((SCORE(I,13)+SCORE(I,14)).NE.SCORE(I,15)))
2   PRINT 49,NUM(I)
49  FORMAT(' ERROR ON CARD FOR STUDENT NO ',I3)
20  CONTINUE
    DO 21 K=1,NCOLS
      DO 21 L=1,NCOLS
        CORREL(K,L)=1.0
        IF(K.EQ.L)GO TO 21
        T(K,L)=T(L,K)
        CORREL(K,L)=CORREL(L,K)
        IF(K.GT.L)GO TO 21
      DO 22 I=1,NSTUD
        A(I)=FLOAT(SCORE(I,K))
        B(I)=FLOAT(SCORE(I,L))
22  CONTINUE
      CALL SRANK(A,B,R,NSTUD,CORREL(K,L),T(K,L),NDF,0)
21  CONTINUE
      PRINT 32,(N,N=1,NCOLS)
32  FORMAT('1SPEARMAN RANK CORRELATION MATRIX',///,3X,20I6)
      DO 41 I=1,NCOLS
        PRINT 33,I,(CORREL(I,J),J=1,NCOLS)
33  FORMAT(1X,I2,1X,20F6.3)
41  CONTINUE
      PRINT 34,NDF
34  FORMAT('1MATRIX OF T-SCORES',/, ' DEGREES OF FREEDOM=',I4)
      PRINT 37,(N,N=1,NCOLS)
37  FORMAT(3X,20I6)
      DO 42 I=1,NCOLS
        PRINT 35,I,(T(I,J),J=1,NCOLS)
35  FORMAT(1X,I2,1X,20F6.2)
42  CONTINUE
      STOP
      END

```

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