THE JOINT EFFECTS OF GROUP COMPOSITION AND INSTRUCTION IN CONSENSUS-SEEKING ON DECISION QUALITY

by

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(ABSTRACT)

The purpose of this study was to investigate whether group performance could be significantly improved by forming groups with members heterogeneous in information-processing preferences, as measured by the Myers-Briggs Type Indicator, and by providing those groups with instructions to facilitate consensus on the group's solution to a complex, multistage decision task. Comparisons of four performance measures among undergraduate student groups (N = 38) differing in composition (homogeneous vs. heterogeneous) and mode of consensual instruction (instructed vs. not instructed) were conducted through a series of statistical procedures. The performance measures, obtained from individual and group solutions to NASA's "Lost on the Moon" task, were: a) group scores, b) utilization of average member resources, c) utilization of the groups' best member's resources, and d) the proportion of groups achieving an assembly effect.

The results of the analyses supported only those hypotheses predicting that groups instructed in consensus would demonstrate better performance on each of the measures. The hypotheses predicting composition main effects for the performance measures were not supported, nor were hypotheses predicting significant interaction effects. Implications of the findings and suggestions for further research are offered.

DEDICATION

This dissertation is dedicated to the special people in my life. To my lovely wife, Billie Jo, who gave me strength when I felt weary. To my beautiful son, Tarren, who gave me joy when I felt down. To my wonderful parents, Jim and Lois, who gave me faith when I doubted myself. To all of you, I give you my love and thanks.

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CHAPTER I

Introduction

Background

In recent years, there has been a virtual explosion of foreign organizations vying for a share of the world's industrial markets. In response, American organizations have made concerted efforts to remain competitive through increased productivity, quality, and responsiveness to the needs of customers. Among these efforts is the replacement of traditional, autocratic management structures with self-managed work teams in the hopes that teams of personnel can more effectively solve the often complex and ambiguous problems faced in today's organizations (Bunning & Althisar, 1990; Wilgus, 1991).

Organizations' growing reliance on teams over individuals to solve organizational problems is likely based on the belief that teams can produce decisions of higher quality than those that could be achieved by any individual working alone. In general, groups do appear to produce both more and better decisions than the average individual (Hill, 1982). However, as Salazar (1995) notes, "the literature is replete with historical and laboratory examples of cases in which groups do not perform in a manner consistent with the abilities of their members" (p. 170). In fact, in many instances groups actually produce decisions of poorer quality than might be expected given the knowledge, skills, and abilities of its members. Thus, the actual benefit derived from establishing teams rather than relying upon its most capable member to make decisions remains in question.

Whether groups are capable of producing decisions of higher quality than individuals has been the focus of considerable research. Since Collins and Guetzkow (1964) first coined the term "assembly effect" to describe group performance beyond that of its most capable member working alone or by a combination of individual efforts, researchers have strived to produce this often elusive phenomenon. Indeed, as the history of that research shows, the assembly effect is often difficult to produce (for reviews, see Hill, 1982; Laughlin, 1980).

Typically, a group performs no better than its most capable member and often performs worse than might be expected given its members' capabilities. Yet, despite the numerous failures by researchers to consistently produce the assembly effect, on occasion there have been successes. Among these successful studies, there appears to exists a common thread of conditions and behaviors necessary to produce an assembly effect within groups.

In the following chapter, the findings from the literature will be reviewed for the purpose of exposing this common thread and drawing a theoretical conclusion upon which the present study is based. Specifically, the review will consist of two sections. The first, which concerns the effects of group composition on the quality of group decisions, will provide the foundation to the subsequent section, the effects of group process on the quality of group decisions.

Statement of the Problem

In light of the growing reliance on teams to solve the complex problems faced in organizations, research that demonstrates how team performance can be improved is warranted. Finding methods to improve the performance of problem-solving teams beyond the abilities of individuals will add credence to the notion that two or more heads are better than one, thereby justifying the millions of dollars spent on team training.

So far, research has shown that groups composed of members heterogeneous in information-processing preferences, as measured by the Myers-Briggs Type Indicator (MBTI), produce decisions of higher quality than homogeneous groups when faced with complex problems. There is also evidence that providing instruction in reaching consensus improves the capability of groups to produce quality decision. Yet, to date, no research which directly incorporates both of these factors to investigate their joint effects on decision quality exists.

The purpose of this study is to build upon the knowledge currently established in small-group research. This study seeks to demonstrate that while heterogeneous groups are necessary for the enhancement of quality solutions to the complex, multi-stage NASA "Lost on the Moon" survival problem, instruction that will facilitate group consensus is essential for the production of group decisions with higher quality than those of its most capable members.

The lessons learned from this study will, undoubtedly, be of value to professionals who conduct training for the purpose of improving the performance of problem-solving teams. Not only may these results reinforce the use of the MBTI when composing problem-solving groups, but these results may also highlight the importance of providing instruction to groups in reaching consensus, so that the resources brought to the group by its members will be shared and integrated into the final solution.

Hypotheses

Based on existing literature and the arguments that have been summarized, the following general, directional hypotheses are offered and will be tested in this study:

H_1: The performance of groups composed of members heterogeneous in their individual, information-processing preferences on a complex decision task is significantly more effective than groups composed of members homogeneous in information-processing preferences.

H_2: The performance of groups who receive instructions in reaching consensus on the complex decision task is significantly more effective than groups who receive no instructions.

H_3: An interaction effect will be evident in that the heterogeneous groups that receive instruction perform significantly more effectively than heterogeneous groups not receiving instruction, homogeneous groups receiving instruction, and homogeneous groups not receiving instruction.

CHAPTER II

Review Of The Literature

Introduction

The purpose of this chapter is to review the literature related to the factors shown to enhance the performance of problem-solving groups. The discussion will focus on two areas of small-group research, group composition and group process. The selected research in each of these areas, and its relationship to decision quality, was used to develop the theoretical relationship upon which the present study is based.

Group Composition and Decision Quality

Within any group, members are bound to differ on one or more dimensions. Members may differ, as Steiner (1972) notes, in abilities and/or dispositional qualities such as gender, age, or personality predispositions, to name a few. Whether the composition of groups based on these member differences ultimately affects a group's performance has been the focus of research for decades. Typically, such research takes the form of comparing the task performance of groups comprised of members similar to each other on a particular dimension (i.e., homogeneous groups) with groups comprised of members who differ on the dimension (i.e., heterogeneous groups).

The line of reasoning that has guided homogeneous versus heterogeneous group research is based on the proposition that heterogeneous groups will perform most tasks better than homogeneous groups, because these groups have available to them a greater variety of perspectives and abilities (Shaw, 1981). Along the dimensions of ability, gender, and various personality measures such as Guilford-Zimmerman Temperament Survey, Edwards Personality Preference Schedule, and the Geier's Personal Profile System, this proposition has generally been supported (Aamodt & Kimbrough, 1982; Goldman, 1965; Hoffman, 1959; Hoffman & Maier, 1961; Lampkin, 1972; Laughlin, Branch, & Johnson, 1969; Ruhe, 1978).

The evidence that heterogeneous groups perform problem-solving tasks more effectively than homogeneous groups has led to additional attempts to identify dimensions upon which to base a group's composition. One dimension that has shown particular promise is that of individual information-processing predispositions measured by the Myers-Briggs Type Indicator (MBTI).

<u>The Myers-Briggs Type Indicator</u>

Based on the theory of Carl Jung (Myers, 1962), the Myers-Briggs Type Indicator (MBTI) is a self-report instrument designed to classify individuals according to their cognitive predispositions. These predispositions take the form of the following four bipolar dimensions: extroversion (E) or introversion (I), sensing (S) or intuitive (N), thinking (T) or feeling (F), and perceiving (P) or judging (J). The instrument is based on Jung's postulation that people will naturally fall along each of these four dimensions resulting in the person being placed in one of 16 types.

The E - I dimension refers to where an individual prefers to focus attention. An E type prefers to focus attention on the external world of people and things, while an I prefers to focus on the internal world of ideas and feelings. The S - N dimension refers to the type of information an individual prefers to focus upon. A S type prefers detailed, factual information acquired through the senses, while an N prefers to focus on the theoretical relationships among facts, forming concepts and ideas relating to the "bigger picture". The T - F dimension refers to the method in which an individual prefers to make decisions. While T types prefer to base decisions on logic and reason, the F types prefer to base decisions on personal values and the impact that the decision will have on others. Finally, the P - J dimension refers to an individual's preferred orientation to the outer world. A P type prefers to be flexible and spontaneous, resisting confinement to plans and schedules. In contrast, a J type prefers schedules, resists spontaneity and seeks to establish order in his or her work and life.

The MBTI is recognized as a useful tool in team-building (Chance, 1989; Rideout & Richardson, 1989; Rome, 1990). The value of the Myers-Briggs instrument lies in its ability to provide insight into the differing ways individuals process information, particularly in terms of perceiving (S-N) and judging (T-F). Therefore, from the use of the instrument, teams are more capable of improving their performance through enhanced understanding of themselves and others, greater cooperation, and better communication.

The MBTI also provides indications of possible weaknesses due to highly homogeneous teams. Chance (1989) writes:

> Experts suggest that people who differ in personality may balance each others' weaknesses. Thinking types, for example, are often good at analyzing and organizing information, and they can see the flaws in an argument or a product and act accordingly - all things that Feeling types find difficult to do. Yet Thinking types are not usually adept at arousing enthusiasm, and they may lack the instincts for knowing when a product will appeal to the public or how to market it. These skills are the forte of Feeling types. One benefit of personality tests such as the MBTI,

> then, is to show team members that they need one another. (p. 22)

Indeed, the composition of groups based on the MBTI has been shown to affect the quality of group decisions, particularly when the task is ambiguous. For example, Brocato and Seaberg (1987) compared teams composed of members similar in psychological type with teams composed of members who differed in terms of the quality of their decisions reached during a structured task (i.e., clearly specified, verified, and programmed in a step-by-step manner) and ambiguous task (i.e., no clear-cut solutions and a multiplicity of possible approaches). The study found that, when completing the ambiguous task, teams composed of members who differ in psychological type produced decisions of higher quality than similarly composed teams. Brocato and Seaberg (1987) concluded that:

> Whereas the nature of the structured task may have limited individual participants from using both ends of the continuum of the four components of psychological type, the ambiguous task may have had the opposite effect. . . . The nature of the ambiguous task lends itself to resolution by allowing individuals to utilize the perceptual and decision making process they prefer. Complementary teams consisted of team members with

> perceptual and decision making differences. Because of these differences, complementary teams were able to view the "task" from a varied perceptual process, revealing data to the entire team which may have been overlooked or did not seem relevant to other team members. (pp. 14-15)

In a more recent study, Kandell (1992) added support that heterogeneous groups, based on the MBTI, produce better decisions than homogeneous groups when performing complex, ambiguous tasks. However, unlike Brocato and Seaberg (1987), who assigned individuals according to their preferences on each of the four bipolar dimensions, Kandell (1992) assigned individuals to groups solely on their preferences for perceiving (i.e., Sensing (S) - Intuition (N)) and judging (i.e., Thinking (T) - Feeling (F)). Kandell (1992) defends his method of assignment by arguing that these functions "relate most closely to the cognitive processes of problem solving and decision making". (p. 18) In light of his finding that heterogeneous groups outperformed homogeneous groups based on this assignment, Kandell's argument is convincing.

The Assembly Effect

It appears clear that composing groups with differing cognitive preferences enhances the quality of their solutions to complex and ambiguous problems. Yet optimal group composition has failed to consistently produce what Collins & Guetzkow (1964) term the "assembly effect" . . . i.e., "productivity which exceeds the potential of the most capable member and also exceeds the sum of the efforts of the group members working separately" (p. 58). For example, while Kandell's (1992) study demonstrated that groups comprised of members who are heterogeneous with respect to Myers-Briggs type perform better in terms of quality on a complex, decision-making problem than homogeneous groups, only three out of the thirteen heterogeneous groups performed better than their best member (i.e., an assembly effect). Thus, the remaining groups performed either equal to their best member or experienced an "assembly decrement" in performance (Stasson & Bradshaw, 1995).

Based on his review of literature, Hill (1982) concludes that two conditions seem necessary for groups to achieve assembly effects when solving difficult, abstract problems. The first involves "pooling pieces of information" in which individuals with skills, abilities, and knowledge that don't overlap but are essential to producing a decision of high quality are brought together as a group. As noted earlier, the value of composing groups heterogeneous in cognitive-processing preferences is that the group will have at its disposal the unique perspectives offered by its members. Without these unique perspectives, alternative considerations that would likely improve the quality of the group's decision are limited.

However, simply bringing heterogeneous members together to "pool their input" is not sufficient to produce the assembly effect. According to Hill (1982), the second condition needed is for a group to integrate the information provided by its members into the group's solution. Thus, the process by which groups integrate the input by members to arrive at a decision is an important aspect related to group performance. The relationship of group process to the assembly effect is discussed in the next section.

Group Process and Decision Quality

While heterogeneity in a group is desirable to solve complex problems, there is a potential for these differences to become debilitating, as noted by Blake and Mouton (cited in Kilmann & Seltzer, 1977):

> A group can be expected to have difficulty in completing its assignment if members do not have some similarity or compatibility of viewpoints to suggest what tasks are important. (p. 240)

Indeed, the "difficulty" among heterogeneous groups is evident in the relatively longer time it typically takes these groups to complete a task (Brocato & Seaberg, 1987). But more importantly, the quality of the solution may suffer as well, resulting in a what Steiner (1972) calls a "process loss," in which the performance of a group is poorer than might be expected given the capabilities of its members.

Several theorists warn that groups are particularly susceptible to "process loss" in decision quality when they are free to interact naturally. For example, Helmer (as cited in Burleson, Levine, & Samter, 1984, p. 558) warns that natural group interaction may lead to "unwarranted compromise among divergent views, unwillingness to abandon publicly expressed opinions, susceptibility to specious persuasion emanating from supposed authorities or loud-voiced members, and bandwagon effects resulting from unwarranted majority opinions". Lamm and Trommsdorf (as cited in Burleson et al., 1984, p. 558) add to Helmer's list by saying that natural interaction may lead to "time consuming irrelevant talk, the deflection of individuals' attention from their own ideas, reduced participation by relatively quiet group members, and the inhibition of the expression of ideas or evaluations due to the fear of criticism or social conflict". Consequently, alternative processes which limit the natural interaction of group members have been offered. These processes include the "staticized" procedure (Lorge, Fox, Davitz & Brenner, 1958) and the "nominal group technique" (Delbecq, Van der Ven, & Gustafson, 1975).

Staticized Procedure

In the staticized procedure, no communication is allowed to occur among group members. Thus, the debilitating communication patterns that may occur due to natural interaction are avoided. Instead, group members work independently to arrive at a decision to the problem. The individual decisions are then statistically averaged to produce a "group" decision. Thus, as noted by Burleson et al. (1984) "in accord with the principles of statistical sampling theory, the best 'group' judgment is assumed to be represented as the arithmetic mean of several individual judgments". (p. 558)

Nominal Group Technique

The nominal group technique is a somewhat less restrictive decision-making process in that it allows limited communication (typically in written form) among group members. Specifically, this technique begins with group members working individually to create a list, for example, of the advantages and disadvantages surrounding possible solutions to a problem. These individual lists are then presented to the group for review, followed by the members again working alone. During this final stage, individuals make any revisions to their original list that they deem necessary based on the solutions offered by other group members. The aggregated average of these revised lists serves as the group's collective decision.

In a study by Burleson et al. (1984), the decision quality between independent groups utilizing the staticized procedure, the nominal group technique, or free interaction in which groups are able to openly communicate was compared. The results indicated that the decision quality of the groups free to interact was superior to those of the staticized and nominal groups. Thus, allowing groups to interact freely, without restriction, appears warranted.

As noted by several theorists, there are a number of advantages to using a procedure which allows members to interact freely. Shaw (as cited in Burleson et al., 1984, p. 560) contends that free interaction allows: "(1) the summation of individual contributions (2) the rejection of incorrect suggestions and the checking for errors, (3) a greater influence of the ablest group member, (4) social influence of the most confident member, (5) a greater interest in the task aroused by group membership, and (6) a greater amount of information available to the group". Fisher (cited in Burleson et al., 1984) argues that interacting groups allow an easier exchange of ideas. Davis (cited in Burleson et al., 1984) believes that interaction "may stimulate new or different ideas" that would not be produced when members work alone.

Although not studied directly, Burleson et al. (1984) note that it is likely that the conditions listed above contributed to the results of their study. Yet, despite these convincing results that free interaction is the optimal procedure for producing quality solutions to complex problems, the solutions produced by the interacting groups were still no better than the solutions produced by the best individuals within the groups.

Theorists have offered several explanations as to why some groups fail to experience an assembly effect. For example, one explanation is that an assembly effect will only occur when a group has worked together for a long time in a realistic setting, and when members have a stake in the group's performance (Michaelsen, Watson, & Black, 1989). However, this explanation has since been refuted by Stasson and Bradshaw's (1995) research.

As discussed earlier, a second explanation is that an assembly effect will likely not occur in instances when the group consists of members with overlapping perspectives or abilities (Hill, 1982). Thus, composing groups heterogeneous in these dimensions is of value because the pool of group resources will be less restricted. However, in the study by Burleson et al. (1984), no attempt was made to ensure heterogeneous group composition. This may explain why no assembly effect occurred.

The third explanation, again noted by Hill (1982), is that an assembly effect requires that the unique resources brought to the group by its members be integrated into the group's final solution. As suggested in the Burleson et al. (1984) study, free interaction among members provides the greatest opportunity for member resources to be utilized. However, in light of their findings, free interaction by no means guarantees that member resources will be integrated.

<u>Consensus</u>

Clearly, what is required is a method which fosters the integration of each member's input into the final solution. Such a method is consensus. According to Wood (1988), decisions reached through consensus differ from those reached through alternative methods such as voting in that:

> Consensus decisions reflect the views of all members and have the acquiescence and, ideally, the support of all members. A consensus decision is one that all members have a part in shaping and that all find at least minimally acceptable as a means of accomplishing some mutual goal. (p. 186)

If groups approach consensus properly, many of the debilitating communication patterns noted by Helmer (1967) and others can be avoided. However, evidence suggests that neither researchers nor practitioners should take for granted that groups understand or are capable of reaching a "true" consensus without training. For example, Nemiroff and King (1975) found that groups that received instructions regarding how to arrive at a consensual solution to a complex problem reached consensus and produced decisions of higher quality than those groups that were not instructed and, subsequently, tended to resort to alternative, non-consensual methods such as majority voting, averaging, and trading to produce a solution. Thus, it appears that group consensus rarely comes naturally. . . Groups must be taught how to reach consensus.

The results obtained by Nemiroff and King (1975) also provide evidence that groups instructed in reaching consensus are more capable of achieving an assembly effect. Seventy-two percent of the instructed groups surpassed the achievement of their most proficient member, while only 33 percent of the uninstructed groups achieved the assembly effect. Nemiroff and King conclude that the "consensual techniques employed by instructed groups were superior because they promoted a fuller sharing of ideas among participants" (p. 18). Thus, the consensual technique appears to provide a method by which the resources of members are effectively integrated.

Summary

A review of the small-group research in the areas of group composition and group process identifies heterogeneous composition and a consensual approach to reach a group decision as the condition and behavior necessary to optimize group performance. One method of composition, shown empirically to improve group performance, is forming groups with members who differ in S-N, T-F information-processing preferences as measured by the Myers-Briggs Type Indicator.

Through a heterogeneous composition, the greater variety of input needed to produce an optimal solution is available to the group. However, a consensual approach is required to effectively integrate the group members' input. Through a consensual approach, the likelihood that the groups can achieve an assembly effect will increase. Thus, it is reasonable to predict that heterogeneous groups utilizing a consensual approach will demonstrate performance superior to homogeneous groups and groups utilizing non-consensual approaches. In the following chapter, the method in which this prediction was tested is discussed.

CHAPTER III

Method

Subjects

The subjects in the present study were undergraduate students enrolled in General Psychology and Psychology of Personality courses during the fall semester of 1996 at a medium-sized Middle Atlantic university. Specifically, one class consisting of 37 students enrolled in a General Psychology course and 165 students enrolled in five Psychology of Personality courses participated in Phase I of the study by completing Form G of the Myers-Briggs Type Indicator during the first week of class. Thus, 202 completed MBTI answer sheets were collected, as well as a brief questionnaire (shown in Appendix A) to gather demographic information.

The students' MBTI results were, subsequently, computed and students were placed into groups with classmates based on MBTI type and gender, resulting in the formation of 51 groups designated to participate in the experimental phase of the study (i.e., Phase II). However, because 13 students failed to report for Phase II, several students were reassigned prior to beginning the phase in order to produce as many four-member groups as possible.

Forty-eight groups participated in the experimental phase of the study (i.e., Phase II). However, 10 of the 48 groups were not included in the statistical analysis. The reasons for the exclusion of these groups from the analysis were as follows: a) inability to place four students with homogeneous S-N, T-F functions and with preference scores greater than 8 in a group (n = 4 groups, 16 individuals), b) fewer than four students in a group (n = 3 groups, 7 individuals), c) greater than four students in a group (n = 2 group, 10 individuals), d) inability to include at least one student of the opposite gender in a group (n = 1 group, 4 individuals).

Method of Group Formation

The method by which groups were formed and the criterion by which decisions concerning whether a group would be included in the statistical analysis were largely drawn from those established by Kandell (1992). Kandell notes that the optimal criteria for the construction of homogeneous groups is that members exceed a moderate preference score of 15 points for both the SN and TF functions, citing that the test-retest agreement for these functions over a five-week span is 94% and 96%, respectively, when preference scores range between 16 and 29 (Howes, cited in Myers & McCauley, 1985). However, because of the relatively low percentage of individuals scoring preferences greater that 15 on both the SN and TF functions, Kandell found it necessary to include individuals with scores of 9 or greater in order to obtain a sufficient number of homogeneous groups.

The present study experienced a situation similar to Kandell's. Only forty-five percent of those students who participated in Phase II had preference scores on both the S-N and T-F functions greater than 15. Therefore, as in the Kandell study, it was necessary to include individuals with scores of 9 or greater in the homogeneous groups, with the exception of one group in which a member who scored a 7 on the T-F function was included to preserve an adequate cell size. The result was the formation of 17 homogeneous groups.

Again noted by Kandell (1992) who cites Howes, the test-retest reliability of preference scores below 16 remains adequately stable, with at least a 71% agreement on these functions over a five-week span. Further, students with weaker preference scores were placed in groups with members showing stronger preferences scores on the same function. Kandell argues that this placement would "likely induce the individuals to act and react in ways more consistent with the type, thus strengthening the preference." (p. 54)

For the heterogeneous groups, attempts were made to compose the groups with members who differed in function pairings. . .i.e., a S-T member, a S-F member, a N-T member, and a N-F member, and whose preference scores on both functions equaled or exceeded 9. However, because of the unequal distribution of function types among the students and the large percentage of students with at least one preference score below 9, it was necessary to adopt Kandell's approach and assign students with preference scores below 9 to heterogeneous groups, with no groups having members all scoring below 9 on the same function. The result was the formation of 21 heterogeneous groups.

The final criteria established by Kandell (1992) and adopted in the present study was that all the groups, regardless of their composition, would have at least one member opposite in gender. The purpose of mixing the gender composition was to minimize the effects of gender homogeneity. However, the present study deviates from Kandell's in the number of members in each group. While Kandell created groups with 5-6 members, groups in the present study consisted of only 4 members. Thus, the ratios of males to females, as well as the ratios of differing functions in the heterogeneous groups, cannot be compared.

Method of Group Assignment

Prior to Phase II, the 51 groups originally formed were randomly assigned to one of two experimental conditions: instructed in reaching consensus and not instructed in reaching consensus. The assignment of each group to a condition was based on coin-tosses in which a "head" would result in the group being assigned to the instructed condition and a "tail" would result in the group being assigned to the not-instructed condition.

The assignment of groups to the experimental condition was unaffected by the subsequent reassignment of subjects due to the absence of individuals during Phase II. The remaining assignments left 26 groups in the instructed condition and 22 groups in the not-instructed condition. However, after the exclusion of groups from analysis because of their failure to meet one of the criteria noted earlier, only 20 groups in the instructed condition and 18 groups in the not instructed condition were included in the analysis. Thus, combined with group composition, the following four cells were produced: a)homogeneous/instructed (N = 8), b)homogeneous/not instructed (N = 9), c)heterogeneous/instructed (N = 12), d)heterogeneous/not instructed (N = 9).

Measures

Myers-Briggs Type Indicator

Form G of the Myers-Briggs Type Indicator (MBTI) is a 126-item instrument designed to measure type preferences on each of the four following dimensions: Extrovert (E) - Introvert (I), Sensing (S) - Intuition (N), Thinking (T) -

Feeling (F), and Judging (J) - Perceiving (P). The bipolar aspects of these dimensions are described below:

Extrovert - Introvert

- Extrovert - prefers to focus attention on the external world of people and things.
- Introvert - prefers to focus on the internal world of ideas and feelings.

Sensing - Intuition

- Sensing - prefers detailed, factual information acquired through the senses.
- Intuition - prefers to focus on the theoretical relationships among facts, forming concepts and ideas relating to the "bigger picture".

Thinking - Feeling

- Thinking - prefers to base decisions on logic and reason.
- Feeling - prefers to base decisions on personal values and the impact that the decision will have on others.

Judging - Perceiving

- Judging - prefers schedules, resist spontaneity and seeks to establish order in their work and in their lives.
- Perceiving - prefers to be flexible and spontaneous, resisting confinement to plans and schedules.

Psychometric properties of the MBTI. Having been used in over one thousand studies, the MBTI is one of the most widely administered instruments in human research. In general, the psychometric properties of the MBTI is considered to be acceptable by current social science standards (Murray, 1990). As noted by Carlson (1989), although relatively few test-retest reliability studies of the MBTI currently exist, those that have been conducted demonstrate favorable findings, with the majority of studies showing test-retest correlations ranging from .75 to .89 over a four week to twenty-one month span for the E-I, S-N, and J-P scales. The T-F scale shows slightly lower test-retest correlations typically ranging from .55 to .79 over the same time period (Carskadon, 1977; Carskadon, 1979; Levy, Murphy, & Carlson, 1972, presented in Myers and McCaulley, 1985).

Further evidence for the reliability of the MBTI is provided through split-half, product-moment correlation coefficients of continuous MBTI scores. Most relevant to the present study, male and female "traditional college students" (N = 11,908) administered Form G of the MBTI produced split-half reliability coefficients of .82 on the E-I scale, .81 on the S-N scale, .82 on the T-F scale, and .86 on the J-P scale (Myers & McCaulley, 1985).

Studies utilizing factor analysis and correlation have generally supported the content and construct validity of the MBTI. For example, after performing a factor analysis of data collected from 200 undergraduate students, Carlyn (1977) found that the MBTI items loaded appropriately and independently on the four dimensions. More recent studies have reaffirmed Carlyn's findings (e.g., Thompson & Borrello, 1986). After reviewing 20 studies incorporating a variety of populations including undergraduate students, Myers and McCauley (1985) observed that the MBTI significantly correlated with similar personality and interest measures such as the Adjective Check List, Minnesota Multiphasic Personality Inventory, Strong-Campbell Interest Inventory, and the Kuder Occupational Interest Survey, thereby supporting the instruments construct validity.

The NASA "Lost on the Moon" Decision Task

The NASA "Lost on the Moon" decision task (Hall & Watson, 1971) explains that the reader is a crew member of a spaceship that has crash-landed on the surface of the Moon. From the crash, only 15 items in working condition were salvaged from the wreckage. The task for the reader is "to rank the fifteen items listed in terms of their importance for survival.'' The problem is shown in Appendix B.

The NASA "Lost on the Moon" Decision Task has been used in several previous group decision-making studies, including the study by Nemiroff and King (1975) who successfully produced the assembly effect in a majority of their groups created from 216 undergraduate students. The popularity of the NASA task appears to lie in its novelty and complexity as a multistage problem situation, similar to those faced in organizations. Also, because there is a correct solution to the problem, researchers have the ability to objectively assess the performance of individuals or groups. The calculation and descriptions of the various performance measures which served as the dependent variables are discussed in the next section.

Performance measures. Following the procedures conducted by Nemiroff and King (1975), four measures of performance were calculated. The method in which each performance measure was obtained and its meaning are described below.

Group score. The group score represents the group's solution to the "Lost on the Moon" decision task. The score is calculated by subtracting the group's ranking of the 15 items from the correct solution provided by NASA experts and then summing the absolute deviations. For example, if a group ranks three items 1, 3, 2, but the correct ranking is 2, 3, 1, the group's score would be 2 ((1-2) + (3-3) + (2-1)). Thus, a low score indicates superior performance. The correct rankings for the "Lost on the Moon" decision task is shown in Appendix C.

Utilization of average resources index (UARI). Also of concern in the present study is whether groups in the various cells differ in their effectiveness to utilize their members' resources for the purpose of reaching an optimal group solution. As noted by Nemiroff and King (1975), one method to examine procedural effectiveness is to calculate a "utilization of average resources index" (UARI) which indicates the degree to which a group's performance deviates from the mean performance of its members, based on the first administration of the decision task. The UARI is calculated by subtracting the group score from the mean individual error score (IES), which is derived by subtracting each group member's ranking from the correct ranking to obtain a error score for each member and, then, averaging the individual error scores. Thus, a positive index indicates effective utilization of average resources while a negative index indicates an ineffective, or lack of average, resource utilization.

Utilization of best-member resources index (UBRI). The third area of concern in the present study is whether groups in the various cells differ in their effectiveness in utilizing the resources of their best member for the purpose of reaching an optimal group solution. Citing McGregor (1967) and Hall and Williams (1970), Nemiroff and King (1975, pp. 15-16) note, "It is believed that the extent to which a group is able to approach the performance of its most proficient member has implications not only for decision quality, but for continued member commitment as well". Thus, a "utilization of best-member resources index" (UBRI) was obtained to indicate the extent in which the resources of the group member who performed best (scored lowest on the decision task during the individual exercise) was utilized by the group during the group exercise. This index is calculated by subtracting the group score from the score of the lowest individual error score by a group member. A positive index indicates that the group effectively utilized the resources of its best member while a negative index indicates that the group failed to effectively utilize its best member's resources to produce an optimal group solution to the decision task.

Assembly effect. The final area of concern in the present study was whether groups in the various cells differ in their ability to produce the "assembly effect". . . i.e., group performance that exceeds the performance of any member working alone. Again following the procedure of Nemiroff and King (1975), groups whose performance on the NASA decision task exceeded the performance of their best member during the individual exercise were assigned a value of one (1), while groups that fail to perform better than their best member received an assignment value of zero (0).

Decision-style questionnaire. A decision-style questionnaire (developed from the Nemiroff & King (1975) study) was administered to each group member. The questionnaire (shown in Appendix D) consisted of three questions designed to measure the frequency in which groups resorted to non-consensual techniques during the group decision exercise. These techniques include majority voting, averaging rankings, and trading (i.e., compromising in which a member offers to concede one opposing rank in return for the acceptance of another). Thus, the questionnaire served to check whether the consensual instructions given to the groups in the instructed condition were effective in reducing the frequency of non-consensual techniques.

Procedures

Experimental Phase

Room preparation. The experimental phase of the study took place during the third week of the 1996 Fall semester. Prior to the subjects arriving, the desks in the classroom were arranged in 8-9 groups with four desks in each group. Placed on the chair of each desk was a 3 x 5 index card showing the name and group number of a subject. Three 9 x 12 envelopes marked "A", "B", and "C", as well as the group number, were placed in the book carriage under one of the desks in each group. Envelope "A" contained four "Lost on the Moon" task sheets with a member's name placed at the top of each task sheet so he/she could be notified of his/her score once the study was completed. Envelope "B" contained one "Lost on the Moon" problem and the instructions for reaching consensus (shown in Appendix E) for only those groups assigned to the instructed condition. Envelope "C" contained four decision-style questionnaires.

Individual exercise. When subjects arrived, they were instructed to sit at the desk marked by their name tag. Informed consent forms (shown in Appendix F) were distributed and its content explaining the purpose of the research, procedures, confidentiality. . .etc., were then read to the subjects. None of the subjects declined to participate in the experimental phase.

After collecting the signed informed consent forms, the group members seated at the desk with the envelopes were instructed to open envelope "A" and distribute a "Lost on the Moon" task sheet to the group member whose name appeared at the top. The subjects were instructed to follow along as the directions to the task were read aloud. The subjects were directed that they should complete the task without discussion with group members. Once all the subjects had completed the task, the groups were instructed to return the problems to envelope "A" and the envelopes were collected.

Group exercise. Groups randomly assigned to the not-instructed condition were directed to leave the room. The remaining groups assigned to the instructed condition were told to open envelope "B" containing one "Lost on the Moon" problem and four copies of the "Instructions for Reaching Consensus." The researcher explained that the members were to complete the "Lost on the Moon" problem again, but as a group. Therefore, the subjects were directed to choose a member of the group to serve as a recorder and to distribute an "Instructions for Reaching Consensus" form to each member. The "Instructions for Reaching Consensus" were then read aloud as the subjects followed along.

The groups assigned to the not-instructed condition were asked to return to their seats, open envelope "B" containing only one "Lost on the Moon Problem," choose a recorder, and complete the problem as a group. These groups received no instruction in consensus. Instead, they were left to their own devices to arrive at a group solution.

The researcher then informed the groups that they were not to interact with any other group, and that they would have the remainder of the period (approximately 40 minutes) to produce a group solution. Considering the amount of time required for the undergraduate students to complete the NASA problem in the Nemiroff and King (1975) study, 40 minutes was considered, and found to be, sufficient. All of the groups completed the decision task within the 40-minute time period, with most finishing within 30 minutes. The subjects were then instructed to return the materials to envelope "B" and the envelopes were collected.

Decision-style questionnaire. Following the group exercise, the groups were directed to open envelope "C" containing the "Decision-Style Questionnaires" and to answer each question. Once all the subjects had completed the questionnaire, they were instructed to return them to envelope "C". The envelopes were then collected and the subjects were dismissed.

Data Analysis

Preliminary Analysis

Demographics. Prior to testing the hypotheses, demographic information obtained through a questionnaire was assessed for the purpose of defining the population in the present study. The information obtained included each subject's age, gender, academic major, academic level, and ethnicity.

Effectiveness of treatment. Working with groups of upper-management personnel from small business organizations, Hall (1971) found that a list of guidelines read by the group members, as opposed to a lengthy group-dynamic training program, was sufficient to facilitate consensus-seeking behaviors among the members during the "Lost on the Moon" group decision task. Nemiroff and King (1975) experienced similar success during their study when they found that undergraduate students who received consensus instructions exhibited alternative decision-making behaviors such as majority voting, averaging, and trading significantly less often than those students who received no instructions.

Although the consensus-seeking instructions incorporated in the present study have a successful history, it was still deemed necessary to test whether the instructions were effective in promoting a consensual approach. Thus, the nonparametric Mann-Whitney Two Sample Test was employed to determine if the mean frequencies of alternative decision approaches (i.e., majority voting, averaging, and trading) among groups receiving the instructions were significantly different from the frequency of alternative approaches taken by groups receiving no instructions.

Interrater agreement. An analysis was conducted to determine if members within the groups differed in their approximation of the number of times their group resorted to majority voting, averaging, and trading during the group decision task, as reported on the decision-style questionnaire. Specifically, the percentages of members within the groups that agreed on the frequencies of majority voting, averaging, and trading were calculated.

Nemiroff and King (1975) concluded from their analysis that group members were aware and capable of reporting the decision styles employed during the group decision task. However, an analysis of interrater agreement among the subjects in the present study remained prudent.

Primary Analysis

As described in an earlier section of this chapter, four separate measures of group performance on the decision task were calculated. As a result, procedures to analyze the data and test the specific hypotheses related to each performance measure varied. The analysis related to each performance measure is described below.

Comparison of group scores. To detect significant group score main and interaction effects, a 2 x 2 ANCOVA incorporating the group scores as the dependent variable was conducted. The first nominal factor of the ANCOVA represented group composition (homogeneous vs. heterogeneous) and the second nominal factor represented mode of instruction (instructed vs. not instructed). To control for possible confounding effects due to inequality between groups in terms of available member resources, the means of each group's individual error scores and the best member's score served as covariates.

Utilization of average resources. The procedure to detect significant main and interaction effects in the utilization of average resources consisted of a 2 x 2 ANOVA, with the utilization of average resources index scores serving as the dependent variable. The nominal factors in the analysis were, again, group composition (homogeneous vs. heterogeneous) and mode of instruction (instructed vs. not instructed).

Utilization of best-member resources. A 2 x 2 ANOVA was performed to detect significant main and interaction effects in the utilization of the best member's resources. Thus, the utilization of best-member resources index scores served as the dependent variable. As before, the nominal factors in the analysis were group composition (homogeneous vs. heterogeneous) and mode of instruction (instructed vs. not instructed).

Assembly effect. A final procedure, utilizing a Two-Sample Proportion Test, was conducted to determine if the percentages of groups that achieved an assembly effect between groups in opposing compositions and/or modes of instruction significantly differed. Thus, the respective percentages, Z values, and probabilities are reported in the next chapter.

Limitations

Absence of a Control Group

A potential limitation of the present study is the absence of a control group. Exclusion of a control group makes it impossible to identify the influence of practice effects on the results. As noted by Stasson and Bradshaw (1995, p. 299), "after answering questions on a pretest, people may do better when retested on the same material". As a result, it may be inaccurate to conclude that a significant improvement in group performance over its best member (based on pretest scores) is evidence for the assembly effect.

However, to date there is no direct evidence suggesting that individuals improve their performance on the NASA problem with repeated attempts. In fact, evidence that the opposite appears true comes from Burleson, Levine, and Samter (1984) who administered the NASA problem to a group of undergraduate students twice. The first administration produced a mean individual performance score of 43.93 while the second administration given to the same students produced only a slightly better mean individual performance score of 43.58 resulting in a test-retest correlation coefficient of .75. Thus, it is reasonable to assume that a practice effect, which may confound the results, is of little concern in the present study. As such, control groups were not deemed necessary.

Use of One Decision Task

While the decision task in the present study has been used extensively in small-group research, the task should not be considered an adequate representation of all problems addressed by problem-solving groups. At best, the results of this study can only be applied to situations in which groups are working to solve a multi-stage rating tasks. Further, the use of only one decision task eliminates the possibility of making a direct performance comparison with a task substantively different in nature.

Delimitations

Confounding Effects of Consensual Instructions

The purpose of the present study was to join two lines of research to examine possible interaction effects. Thus, a replication of the procedures and treatments conducted in the earlier studies was necessary.

It is possible, however, that the necessity for replication may have confounding results. Specifically, one of the consensual instructions read by the group members in the instructed condition stated that members should "Approach the task on the basis of logic." As a result, group members who are "Feeling" types as measured by the MBTI and, therefore, prefer to base decisions on personal values may abandon their preferred style and, instead, make decisions as a logical, "Thinking" type. Thus, alternative viewpoints available to heterogeneous groups, that could enhance the quality of the solution, would be limited.

Generalizability to Other Populations

The desire to remain systematic by replicating the studies upon which the present hypotheses were based necessitated the use of subjects from a similar subject pool. In both the Kandell (1992) study and the Nemiroff and King (1975) study, undergraduate students served as subjects. Significantly deviating from these earlier studies by utilizing subjects from a markedly different population would have made non-significant results difficult to interpret. For instance, it would be difficult to determine whether the non-significant findings were the result of ineffective experimental treatments or a treatment-population interaction. Therefore, undergraduate students served as the subjects in the present study so results could be more clearly delineated.

It must be noted, however, that while the subjects in the present study consisted of individuals who were diverse in their academic majors, ages, and academic levels, they were not randomly drawn from the undergraduate population. Therefore, they should not be considered an accurate representation of the undergraduate population enrolled at the university. As such, inferences of results to this population, or others, should be made with caution.

CHAPTER IV

Results

Demographics

One hundred and fifty-two students participated as subjects in the present study. Eighty-three of the subjects were female (55%) and 69 were male (45%). The ages of the subjects ranged from 17 to 43 years with a mean of 20.28 years and a standard deviation of 2.67.

The ethnic make-up of the subjects consisted of 150 Caucasians (99%) and 1 Asian (1%). One subject failed to disclose his ethnicity.

The academic majors of the subjects were diverse, with 22 majors represented. Only 5 of the subjects (3%) failed to report their major. The majors, number of subjects in the majors, and the subsequent percentages are shown in Table 1.

Table 1

Academic Majors, Number of Subjects and Percentages

Major	Number of Subjects	Percentage
Criminal Justice	34	22%
Psychology	33	22%
Social Work	5	3%
Biology	7	5%
Marketing	10	7%
Business Adm.	3	2%
Computer Science	1	.7%
Communication	6	4%
Elementary Educ.	7	5%
History	3	2%
Sociology	7	5%
Accounting	2	1%
Political Science	3	2%
Pre-Medical	2	1%
Real Estate	1	.7%
Art	1	.7%
Public Relations	1	.7%
Economics	1	.7%
English	2	1%
Math	1	.7%
Secondary Educ.	1	.7%
Undeclared	16	10%

Note. Percentages are based on 152 subjects

The academic levels of the subjects were primarily sophomores and juniors. Specifically, among the subjects there were 11 freshman (7%), 61 sophomores (40%), 62 juniors (41%), and 17 seniors (11%). One subject did not indicate her academic level.

The composition of the groups is shown in Appendix G. Of the 8 homogeneous groups in the instructed condition, 2 of the groups comprised members classified by the Myers-Briggs Type Indicator as Intuitive-Feeling (NF) types, 2 groups as Sensing-Thinking (ST) types, 1 group as Intuitive-Thinking (NT) types, and 3 groups as Sensing-Feeling (SF) types. In the not-instructed condition, 4 of the nine homogeneous groups comprised members classified as Intuitive-Feeling (NF) and 5 groups as Sensing-Thinking (ST) types.

Performance Measures

As discussed in the previous chapter, the primary interest in this study is the decision-task performance of groups differing in composition and mode of instruction. Several performance measures were calculated for each group. The performance measures were the group scores on the "Lost on the Moon" decision-task, the utilization of average resources index (UARI), the utilization of best-member's resources index (UBRI), and the occurrence/no occurrence of an assembly effect (AE). The performance measure scores for each group are shown in Appendix G.

The performance of the groups as measured by the group scores on the "Lost On The Moon" task ranged from 20 to 54, with lower scores indicating better performance. The average group score was 34.10 with a standard deviation of 8.04.

The utilization of average resources index (UARI) is an indication of the group's effectiveness in utilizing its members' resources to reach an optimal group solution, with negative scores indicating adverse utilization of resources and positive scores indicating effective utilization of resources. The range of the UARI was from -8 to 26 ($\underline{M}$ = 12.72, $\underline{SD}$ = 8.03)

The utilization of best-member's resources index (UBRI) is an indication of the group's effectiveness in utilizing the resources of its best member to reach an optimal group solution. Again, negative scores indicate an adverse utilization of resources while positive scores indicate the effective utilization of resources. The range of the UBRI was -14 to 20 ($\underline{M}$ = 3.08, $\underline{SD}$ = 8.67)

Preliminary Analysis

Effectiveness of Consensual Instructions

The Mann-Whitney Two Sample Test was employed to determine if the groups that received instruction in reaching consensus prior to the group exercise resorted to majority voting, averaging, and trading to reach a group solution to the decision task significantly less often than groups that received no instructions. The means, standard deviations, and Z values resulting from the analysis are shown in Table 2.

Table 2

Mann-Whitney Two Sample Test Comparing Mean Responses Between Instructed and Not-Instructed Groups to Questions 1)Frequency of Majority Vote, 2)Frequency of Averaging, 3)Frequency of Trading

	Q1	Q2	Q3
Instructed Groups			
M	.06	0.00	.01
SD	.24	0.00	.11
Not Instructed Groups			
M	4.26	.25	.72
SD	5.57	.96	1.54
Z Values	-5.30**	-.89	-2.40*

*p < .05, **p < .01

As shown in Table 2, the groups that received no instruction in reaching consensus resorted to alternative methods to reach a decisions on the task more often than the groups that received instruction. The most frequent approach incorporated by the groups in the not-instructed condition was the majority vote ($\underline{M}$ = 4.26) followed by trading ($\underline{M}$ = .72). Both of these means are significantly greater than the means of the instructed groups, with the first beyond the .01 level and the second beyond the .05 level.

The groups in the not-instructed condition also resorted to averaging with greater frequency than the instructed groups. However, the difference between these means was not statistically significant. Thus, the consensus instructions appear to have produce the desired effect of facilitating consensual behaviors.

To test a possible interaction effect, a post-hoc analysis utilizing the Mann-Whitney Whitney Two Sample Test to compare the mean frequency of majority voting, averaging, and trading between cells was conducted. The results of the analysis are presented in Table 3.

Table 3

Mann-Whitney Two Sample Test Comparing Mean Responses Between Cells to Questions 1) Frequency of Majority Vote, 2) Frequency of Averaging, 3) Frequency of Trading

Comparisons	Q1 M	Q1 SD	Q1 Z	Q2 M	Q2 SD	Q2 Z	Q3 M	Q3 SD	Q3 Z
Homog/Instr with	0	0		0	0		0	0	
Homog/Not-Instr	1.44	3.04	-1.97*	.33	1.07	-.79	.81	1.60	-2.16*
Homog/Instr with	0	0		0	0		0	0	
Heter/Instr	.10	.31	-.79	0	0	0	.02	.14	-.16
Homog/Instr with	0	0		0	0		0	0	
Heter/Not-Instr	7.08	6.10	-5.50**	.17	.85	-.39	.64	1.50	-1.18
Homog/Not-Instr with	1.44	3.04		.33	1.07		.81	1.60	
Heter/Instr	.10	.31	1.58	0	0	.87	.02	.14	2.26*
Homog/Not-Instr with	1.44	3.04		.33	1.07		.81	1.60	
Heter/Not-Instr	7.08	6.10	-4.25**	.17	.85	.40	.64	1.50	.76
Heter/Instr with	.10	.31		0	0		.02	.14	
Heter/Not-Instr	7.08	6.10	-5.89**	.17	.85	-.43	.64	1.50	-1.17

$*p < .05$, $**p < .01$

As expected, significant differences were found between instructed and not-instructed cells, regardless of group composition. However, a significant difference was also detected between the majority voting frequency of homogeneous/not instructed groups (M = 1.44) and heterogeneous/not instructed groups (M = 7.08), Z = -4.25, p = .000.

Interrater Agreement

To determine the extent to which members within the groups disagreed with the frequency in which their group resorted to majority voting, averaging, and trading during the group exercise, the percentage of members within the groups who agreed on the frequencies was calculated. The results of this analysis found that 89 percent of the group members agreed on the frequency of majority voting, 96 percent agreed on the frequency of averaging, and 89 percent agreed on the frequency of trading. Thus, a high degree of interrater agreement among members within the groups was found.

Primary Analysis

The analyses conducted to test the hypotheses in the present study compared several mean performance measures among groups differing in composition (i.e., homogeneous vs. heterogeneous) and experimental condition (i.e., received consensus instructions vs. received no consensus instructions). The means and standard deviations of these performance measures, as well as cell sizes, are summarized in Table 4.

Table 4

Summary Data of Cell Sizes, Means and Standard Deviations for Performance Measures

		Group Scr		UARI		UBRI	
Groups	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Homogeneous	17	32.27*	7.81	13.98	7.36	5.29	7.78
Heterogeneous	21	35.75*	8.28	11.69	8.58	1.29	9.13
Instructed	20	31.11*	6.66	15.15	7.61	5.75	9.06
Not Instructed	18	36.91*	8.79	10.01	7.81	.11	7.37
Homogeneous/Instructed	8	28.75*	4.14	17.72	3.90	10	5.76
Homogeneous/Not Instructed	9	35.78*	9.53	10.67	8.28	1.11	7.08
Heterogeneous/Instructed	12	33.47*	7.84	13.44	9.07	2.92	9.94
Heterogeneous/Not Instructed	9	38.03*	8.37	9.36	7.76	-.89	7.94

Note. Asterisk indicates mean adjusted by best-member scores

Comparison of Group Scores

A comparison of performance as measured by group scores was conducted to determine if significant differences existed between homogeneous-heterogeneous groups, instructed-not instructed groups, and/or the respective group cells after controlling for possible inter-group inequalities due to members' individual abilities. To control for inter-group inequalities, the mean individual scores and the lowest score (i.e., best-member's score) within each group obtained during the individual exercise served as the covariates. The specific hypotheses tested are as follows:

H_1: Controlling for differences in ability, the group scores of heterogeneous groups are significantly lower (i.e., better) than the group scores of homogeneous groups.

H_2: Controlling for differences in ability, the group scores of instructed groups are significantly lower than the group scores of not-instructed groups.

H_3: An interaction effect is evident in that, controlling for differences in ability, the group scores of heterogeneous/instructed groups are significantly lower than the group scores of heterogeneous/not-instructed groups, homogeneous/instructed groups and homogeneous/not-instructed groups.

The results of an initial 2 x 2 ANCOVA to test the hypotheses indicated that the mean individual scores did not significantly influence the results, $F(1,33) = 3.31$, $p = .08$. Thus, the mean individual scores were removed as a covariate and the analysis was repeated with the best members' scores as the sole covariate.

The second analysis found that the best member's score (BMS) was a significant covariate, $F(1,33) = 4.34$, $p = .04$. Therefore, only the second analysis was used to test the hypotheses listed above. The corresponding F ratios are reported in Table 5.

Table 5

2 x 2 Analysis of Covariance for Group Decision-Making Performance Scores With Best Member Scores as Covariate

Source	*df*	*SS*	*MS*	*F*
A (Composition)	1	109.56	109.56	1.97
B (Mode)	1	309.97	309.97	5.56*
A x B	1	13.55	13.55	.24
Within	33	1839.89	55.75	

Note. Composition refers to homogeneous vs. heterogeneous groups.

Mode refers to groups receiving instruction in reaching consensus vs. groups not receiving instruction in reaching consensus.

* $p < .05$

Following the adjustment of the mean group scores to control for the influence of the covariate, only the main effect of mode of instruction was found to be statistically significant. Specifically, the adjusted mean performance of the groups who received instruction ($\underline{M}$ = 31.11) was significantly better than the adjusted mean performance of the groups receiving no instructions in consensus ($\underline{M}$ = 36.91) $\underline{F}(1,33) = 5.56$, $\underline{p} = .02$. The remaining main effect of group composition comparing the adjusted mean performance of homogeneous groups ($\underline{M}$ = 32.27) with heterogeneous groups ($\underline{M}$ = 35.75) was not statistically significant beyond the .05 level. Neither was the interaction effect comparing the adjusted means of homogeneous groups in the instructed condition ($\underline{M}$ = 28.75), homogeneous groups in the not-instructed condition ($\underline{M}$ = 35.78), heterogeneous groups in the instructed condition ($\underline{M}$ = 33.47), and heterogeneous groups in the not-instructed condition ($\underline{M}$ = 38.03) statistically significant. Thus, only hypothesis 2 is supported.

Utilization of Average Resources

The utilization of average resources index (UARI) refers to a group's effectiveness to utilize the resources brought to the group by its members. The index indicates the degree of improvement or loss in group decision performance compared to the average performance of the group's members. Thus, the UARI was calculated by subtracting each group's score from the mean of the individual scores obtained from the group's members during the individual exercise. The specific hypotheses related to the UARI performance measure are offered:

H_4: The decision quality improvement of group performance over the average performance of the group's members is significantly greater among the heterogeneous groups than the homogeneous groups.

H_5: The decision quality improvement of group performance over the average performance of the group's members is significantly greater among the groups receiving instruction to reach group consensus than groups not receiving instruction.

H_6: An interaction effect is evident in that the decision quality improvement of group performance over the average performance of the group's members is significantly greater among the heterogeneous/instructed groups than the heterogeneous/not-instructed groups, the homogeneous/instructed groups, and the homogeneous/not-instructed groups.

As specified earlier, a 2 x 2 ANOVA was conducted to test the hypotheses. The resulting F ratios from the analysis are shown in Table 6.

Table 6

2 x 2 Analysis of Variance for Utilization of Average Resources Index (UARI)

Source	*df*	*SS*	*MS*	*F*
A (Composition)	1	72.49	72.49	1.21
B (Mode)	1	287.64	287.64	4.79*
A x B	1	20.57	20.57	.34
Within	34	2042.459	60.07	

Note. Composition refers to homogeneous vs. heterogeneous groups.

Mode refers to groups receiving instruction in reaching consensus vs. groups not receiving instruction in reaching consensus.

* $p < .05$

As shown in Table 6, only the main effect of mode of instruction was found to be statistically significant. The mean UARI for the groups that received instruction in reaching consensus (M = 15.15) was significantly greater than the groups that received no instruction in reaching consensus (M = 10.01), $F(1,34) = 4.79$, $p = .04$. The main effect of group composition which compared the UARI means of homogeneous groups (M = 13.98) with heterogeneous groups (M = 11.69) was not statistically significant, nor was the interaction effect comparing the following UARI means: a) homogeneous/instructed (M = 17.72) b) homogeneous/not-instructed (M = 10.67) c) heterogeneous/instructed (M = 13.44) d) heterogeneous/not-instructed (M = 9.36). Thus, only hypothesis 5 was supported.

Utilization of the Best Member Resources

While the previous analysis was concerned with the level in which the groups in differing conditions effectively utilized the resources of all the group members, the present analysis is concerned with whether these groups differ in their utilization of their best group member's resources. The designation of the best group member involves identifying the member in each group who produced the best score (lowest) on the individual administration of the "Lost on the Moon" decision task. The utilization of the best member's resources index (UBRI) was calculated by subtracting the group score from the best group member's score. Thus, the UBRI served as the dependent variable in the 2 x 2 ANOVA conducted to test the following specific hypotheses:

H_7: The decision quality improvement of group performance over the group's best member is significantly greater among the heterogeneous groups than the homogeneous groups.

H_8: The decision quality improvement of group performance over the group's best member is significantly greater among the groups receiving instruction to reach group consensus than groups not receiving instruction.

H_9: An interaction effect is evident in that the decision quality improvement of group performance over the group's best member is significantly greater among the heterogeneous/instructed than the heterogeneous/not-instructed groups, the homogeneous/instructed groups, and the homogeneous/not-instructed groups.

Shown in Table 7 are the F ratios resulting from the analysis.

Table 7

2 x 2 Analysis of Variance for Utilization of Best-Member Resources Index (UBRI)

Source	*df*	*SS*	*MS*	*F*
A (Composition)	1	191.63	191.63	2.93
B (Mode)	1	374.28	374.28	5.72*
A x B	1	60.02	60.02	.92
Within	34	2224.69	65.43	

Note. Composition refers to homogeneous vs. heterogeneous groups.

Mode refers to groups receiving instruction in reaching consensus vs. groups not receiving instruction in reaching consensus.

* $p < .05$

The analysis results provide support for only hypothesis 8. As shown in Table 7, only the main effect of mode of instruction was statistically significant, with the mean UBRI for the groups receiving instruction in reaching consensus (M = 5.75) significantly greater than the mean for the groups receiving no instruction in reaching consensus (M = .11), $F(1,34) = 5.72$, $p = .02$. The main effect of group composition which compared the UBRI mean of the homogeneous groups (M = 5.29) with heterogeneous groups (M = 1.29) was not statistically significant, nor was the interaction effect comparing the following UBRI means: a) homogeneous/instructed (M = 10) b) homogeneous/not-instructed (M = 1.11) c) heterogeneous/instructed (M = 2.92) d) heterogeneous/not instructed (M = -.89).

Assembly Effect

The purpose of this final analysis was to determine if the proportion of assembly effect occurrences differ among the groups in various experimental conditions. The specific hypotheses tested are as follows:

H_{10}: The proportion of heterogeneous groups achieving the assembly effect is significantly greater than that of the homogeneous groups.

H_{11}: The proportion of instructed groups achieving an assembly effect is significantly greater than that of the not-instructed groups.

H_{12}: An interaction effect is evident in that the proportion of heterogeneous/instructed groups achieving the assembly effect is significantly greater than that of the heterogeneous/not-instructed groups, homogeneous/instructed groups, and homogeneous/not-instructed groups.

To test the hypotheses, a Two Sample Proportion Test comparing the proportions of groups who achieved an assembly effect was performed. Included in Table 8 are the percentages of the respective groups achieving an assembly effect and Z values from comparisons.

Table 8

Two Sample Proportion Test Comparing Proportions of Groups Achieving Assembly Effect.

Comparison	Z Value
Homogeneous (71%) - Heterogeneous (62%)	.56
Instructed (80%) - Not Instructed (50%)	1.95*
Homogeneous/Instructed (100%) - Homogeneous/Not Instructed (44%)	2.51**
Heterogeneous/Instructed (67%) - Heterogeneous/Not Instructed (56%)	.52
Homogeneous/Instructed (100%) - Heterogeneous/Instructed (67%)	1.83*
Homogeneous/Not Instructed (44%) - Heterogeneous/Not Instructed (56%)	.47
Homogeneous/Instructed (100%) - Heterogeneous/Not Instructed (56%)	2.15*
Homogeneous/Not Instructed (44%) - Heterogeneous/Instructed (67%)	1.09

$*p<.05$, $**p<.01$

As indicated in Table 8, only hypothesis 11 was supported. Specifically, the proportion of groups in the instructed condition producing an assembly bonus (80%) was found to be significantly greater, statistically, than that of groups in the not-instructed condition (50%), $\underline{Z} = 1.95$, $\underline{p} = .03$.

In addition to the significant main effect of mode of instruction, a significant interaction effect was also observed. Specifically, a significantly greater proportion of homogeneous/instructed groups (100%) achieved an assembly bonus effect compared to the homogeneous/not-instructed groups (44%), $\underline{Z} = 2.51$, $\underline{p} = .006$; heterogeneous/not-instructed groups (56%), $\underline{Z} = 2.15$, $\underline{p} = .02$; and the heterogeneous/instructed groups (67%), $\underline{Z} = 1.83$, $\underline{p} = .03$.

Summary

A preliminary analysis found that, while the consensual instructions were effective in reducing the occurrence of non-consensual techniques during the group decision task, there was a significant interaction between the majority voting frequencies for homogeneous and heterogeneous groups in the not-instructed condition. Interrater agreement on the reported frequency of majority voting, averaging, and trading by members within the groups was found to be satisfactory.

The primary analysis tested a series of directional main and interaction effect hypotheses related to four measures of performance. The results found support for only the main effect hypotheses predicting that the groups instructed in a consensual approach to solve the decision task would perform more effectively than the groups who were not instructed. Specifically, compared to the not-instructed groups, the instructed groups produced better group scores, were more effective at utilizing the resources of all the members and the best member in their groups, and achieved an assembly effect in greater proportion.

CHAPTER V

Discussion

Introduction

This chapter is divided into four sections. In the first section, the findings of the study are reviewed, as well as their implications. The discussion in this section is divided into the two primary factors upon which this study was based. These factors are the mode of instruction and the composition of the group.

In the second section, the importance of the findings will be discussed. In particular, the section will focus on how the results may be of interest to practitioners and researchers searching for methods to improve group problem-solving performance.

The final sections will offer suggestions for further research and further considerations. Certainly, much research is needed to answer the many questions about how group performance can be significantly improved. Listing the work that remains to be done would be beyond the scope of this discussion. Therefore, the suggestions that are made in this section were derived directly from the limitations and delimitations of the study, as well as the findings.

Review and Implications of Findings

Mode of Instruction

Earlier research has produced evidence that groups which utilize a consensual approach to solve problems produce better solutions than groups which fail to reach consensus (Nemiroff & King, 1975). In this study, the instructions provided to groups randomly assigned to the treatment condition promoted the use of a consensual approach when working to solve NASA's "Lost on the Moon" decision task. As a result, the groups that received consensual instructions and, subsequently, employed consensus during the group task significantly outperformed the groups that received no instructions.

The use of consensus techniques during group problem-solving is commonly recognized by researchers as the optimal approach when quality solutions are desired. Unlike non-consensual techniques, consensus more fully integrates the resources of each member into the final solution. Thus, there is a greater probability that the group will select the correct solution.

The results of this study imply that the superior performance of the instructed groups are attributable to the greater integration of member resources. Both the average and best resources provided to the group by its members were utilized to a greater extent by the instructed groups than the uninstructed groups. Further, the greater utilization of resources through consensus also appears to have contributed to a significantly greater proportion of instructed groups, compared to uninstructed groups, achieving the assembly effect.

Group Composition

Also considered in this study was whether the group's composition would differentially affect group performance. Earlier research indicates that groups composed of members heterogeneous in Myers-Briggs Type outperform groups composed of homogeneous members (Kandell, 1992). However, the results of the present study failed to concur with the earlier findings. No significant group score differences between the homogeneous and heterogeneous groups were evident. Nor were the utilization of resources between the homogeneous and heterogeneous groups significantly different. Thus, varying the composition of groups based on the S-N, T-F functions had little impact on the decision performance of groups.

Among the instructed groups, however, the group's composition did appear to significantly influence its probability of achieving an assembly effect. Specifically, all of the homogeneous groups that received consensual instructions achieved an assembly effect, compared to only 67% of the heterogeneous-instructed groups. Stated differently, none of the homogeneous-instructed groups experienced a process loss while 33% of the heterogeneous-instructed groups experienced a process loss.

A more significant discrepancy was detected between the homogeneous groups that received instruction and the heterogeneous groups that received no instructions, with only 56% of these groups achieving an assembly effect. But the largest proportional difference was found between the homogeneous/instructed groups and the homogeneous/not-instructed groups. Only 44% of these groups achieved an assembly effect.

The finding that a significantly greater proportion of homogeneous groups instructed in consensus achieved an assembly effect than heterogeneous/instructed, homogeneous/not-instructed, and heterogeneous/not-instructed implies that practitioners could facilitate group performance beyond the performance capable by its members working alone by, first, composing the group with members who share S-N and T-F preferences and, second, providing the groups with guidelines to facilitate consensual behaviors.

However, it must be remembered that the occurrence, or non-occurrence, of an assembly effect was a nominal variable and, therefore, does not indicate the degree of improvement in performance. In other words, the measure was based on the percentage of groups that produced a group solution better in quality than the solution of the groups' best members. Thus, the measure provides no information about the extent to which the group's solution improved beyond the best member's solution.

For information concerning the extent of improvement, one must consider the utilization of the best member's resources index, which is a direct measure of the degree in which the group score deviates from the best member's score. Returning to the results of the analysis which incorporated the utilization of best members resources index as the dependent measure, it appears that composing groups with homogeneous members and instructing them in consensus does improve the extent to which group performance exceeds the performance of the groups' best members, although the improvement is not statistically significant.

It is interesting to note that not only did all the homogeneous/instructed groups experience a process gain and superior performance measures, but this was the only cell in which all the groups reported that they did not utilize majority voting, averaging, or trading to reach a group decision on the task. Groups in the heterogeneous/not-instructed cell, on the other hand, reported the greatest frequency of non-consensual majority voting during the group exercise. These groups also demonstrated the poorest performance as measured by group scores, utilization of average resources, and utilization of the best member's resources. This finding implies that heterogeneous groups would benefit most from a structured, consensual intervention.

Perhaps heterogeneous groups are predisposed to adopt majority voting as a means of reducing the intragroup conflict that may result from opposing perspectives. However, given the fact that intragroup conflict was not directly measured, and the evidence that group composition failed to significantly influence the performance of groups, this assumption is tenuous.

Importance of The Findings

The primary importance of these findings is the added evidence supporting the incorporation of consensual guidelines during group decision-making on multistage tasks. This research has demonstrated that group decisions, as well as group functioning, can be improved if groups utilize a consensual approach to reach a solution.

However, reaching consensus in group situations appears not to come naturally, particularly within groups whose members differ in personality type. If left to their own devices, groups will frequently resort to less than optimal techniques upon which to derive solutions such as majority voting, averaging, and trading. Clearly, a structured training intervention is required to promote consensual behaviors.

Also of importance are those findings which failed to support the hypotheses predicting superior performance among heterogeneous groups. Relatively unexplored, the efficacy of basing group composition on Myers-Briggs Type functions for the purpose of expanding the perspectives available to the group, and optimizing group performance, remains in question.

Certainly, the factors present in this study may have confounded the intended results. First, the consensual instructions, noted as a delimitation in Chapter 3, may have prompted a more homogeneous approach to the decision task among heterogeneous group members. Hence, the relatively equal performance between the two could be easily explained.

Second, the particular decision task used in the present study may have failed to elicit the preferred responses of certain types. For example, Feeling types may have interpreted the nature of the NASA task as requiring a logical approach to reach an optimal solution. Thus, they may have abandoned their preferred style of decision-making. And, in light of the fact that Kandell (1992) found significant composition effects favoring the performance of heterogeneous groups on the "Winter Survival Exercise," (developed by Johnson & Johnson, 1975) a decision-task interaction is possible.

However, one must not preclude the possibility that assigning individuals to groups based on their S-N and T-F functions has little effect on the range of perspectives and abilities available to the group. Instead, group composition may only impact the ability of the group to reach consensus. Specifically, groups whose members do not have compatible types may experience intragroup conflict due to the personality differences. They may have difficulty integrating each member's input into the final solution. As a result, they may resort to non-consensual methods of compromise such as majority voting, averaging, and trading to produce a solution.

A measure to directly assess the levels of intragroup conflict was not incorporated into the present study. However, the greater frequency to which heterogeneous groups resorted to alternative methods to reach a group solution to the decision task provides an indirect indication that intragroup conflict possibly occurred.

Suggestion For Further Research

The role that consensual behaviors play in improving group decision quality on complex, multistage tasks, such as the one used in this study, appears well grounded. Further, given that the research methods and procedures conducted in the present study largely replicate those performed by Nemiroff and King (1975), it is not surprising that the results of both studies concur. For example, both studies used NASA's "Lost on the Moon" decision task as the dependent measure, undergraduate students as subjects, and identical consensual instructions.

Notable differences do exist, however, between the present study and the Kandell (1992), from which the hypotheses regarding group composition were derived. Whether these differences confounded the results is unclear without further research. Following are specific suggestions for further research.

Group Decision Task

In the Kandell (1992) study, the "Winter Survival Exercise" (Johnson & Johnson, 1975) served as the decision task. This task is similar to the "Lost on the Moon" task in that both require the ranking of fifteen items salvaged from wreckage in terms of their survival value. However, the tasks differ in the situation in which the decision-maker is placed. . . i.e., stranded on the moon versus stranded in the wilderness.

It is certainly possible that the two tasks elicit different response patterns or behaviors from the group members. However, it is unclear if the situational difference between these tasks are substantial enough to confound the results. Research which incorporates both tasks is needed to determine if differences do, indeed, exist.

Alternative Populations

Group performance research has primarily used undergraduate students as subjects. As was mentioned in Chapter 3, undergraduate students were used in the present study to ensure a systematic replication of earlier studies. However, the use of a student population makes inferring the findings to alternative populations unwarranted. Thus, research investigating the main effects of group composition and instruction in consensus, as well as their joint effects, should be conducted with alternative populations, particularly workforce populations.

Vary the Treatment

A delimitation of the present study was the use of consensual instructions that may have prompted "Feeling" types to abandon their preferred style and behave in a more logical "Thinking" manner. As a result, the heterogeneous groups may have been more homogeneous than intended. Thus, there is a need to replicate the present study, but modifying the consensual instructions by eliminating the statement, "Approach the task on the basis of logic." Such an approach would help to identify the confounding effects of this statement.

Further Considerations

The utility of any research endeavor lies in its findings being applicable to real-world events. The impetus to conduct this research was to provide empirical evidence supporting a particular method and means by which an optimal group solution could be reached. However, the application of these findings to the real-world events experienced in today's organizations are not without caveats.

Organizational problem-solving groups would rarely experience the carefully controlled conditions that were present in this study. Indeed, groups within organizations are undoubtedly confronted with a variety of conditions that affect their ability to function effectively and produce optimal solutions. For instance, organizational politics, personal agendas, member status, and/or prior history with group members are conditions that would likely influence a group's ability to function effectively. When such conditions are present, training the group in consensus may not be sufficient to optimize group performance. Supplemental training in the areas of conflict resolution, group dynamics, or team building, for example, may be necessary to promote the free interaction necessary to reach consensus.

Further, given the fast-paced nature of today's workplace, the time afforded groups to make decisions is often constrained. Thus, due to the relatively lengthy time required to reach group consensus to a decision, non-consensual methods of decision-making may be a more appropriate strategy.

Also controlled in the present study but beyond control in the organizational setting is the nature of the problem itself. Rarely do organizational problem-solving groups enjoy the knowledge that a correct solution to the problem at hand exists, and that their only task is to find the correct solution by manipulating the information that has been provided.

In reality, the complexity of problems faced by organizations often extend far beyond the problem presented in this study. Organizations may have little knowledge that a correct solution exists or what information should be gathered to make a decision. Thus, it is the task of the organization to compose a group with members who are capable of gathering needed information and competent to make thoughtful judgments in the face of uncertainty. To this end, relevant knowledge and level of experience solving similar problems in the past may serve as the most desirable qualities upon which to select group members. In fact, in circumstances requiring a timely solution, the organizations may be best served by delegating the production of a solution to one, exceptional individual.

In any event, it is hoped that this research has added to the knowledge currently known about the conditions and behaviors needed to optimize group problem-solving performance. Of course, much remains unknown. Research will certainly continue.

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Appendix A

Demographic Questionnaire

DEMOGRAPHIC QUESTIONNAIRE

PLEASE ANSWER EACH OF THE FOLLOWING QUESTIONS:

Name (please print):____

(First Name) (Last Name)

Address:____

(box #/apt. #) (Street)

____________________ __________ ____________

(City) (State) (Zip Code)

Home Phone Number:______________________________

Age:____________ Gender: ___ Male ___ Female

Major:________________________________

Class: ___ Freshman ___ Sophomore ___ Junior ___ Senior
___ Master's Level ___ Doctoral Level

Ethnicity: ___African-American/Black ___American Indian or Alaskan Native
___Asian or Pacific Islander ___Caucasian ___Latino, Latina/Hispanic
___Other (please specify):____________________________

In which class have you been given this MBTI instrument :

____

(Title of Class) (Days & Time Class is Held)

____

(Name of Professor Teaching Class)

Appendix B

"Lost on the Moon" Decision Task

Group#________

LOST ON THE MOON

The situation

Your spaceship has just crash-landed on the moon. You were scheduled to meet with the 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 aboard, except 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 (1) by the most important item, number two (2) by the second most important, and so on through number fifteen (15), the least important.

Box of Matches	_____
Food Concentration	_____
50 ft. of Nylon Rope	_____
Parachute Silk	_____
Solar-Powered Portable Heating Unit	_____
Two .45 Caliber Pistols	_____
One Case of Dehydrated Pet 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	_____

Hall, J. (1971, November). Decisions, decisions, decisions. Psychology Today, 51-54, 86, 88.

Appendix C

"Lost of the Moon" Correct Rankings

CORRECT RANKINGS

Box of Matches	15
Food Concentration	4
50 ft. of Nylon Rope	6
Parachute Silk	8
Solar-Powered Portable Heating Unit	13
Two .45 Caliber Pistols	11
One Case of Dehydrated Pet Milk	12
Two 100-Pound Tanks of Oxygen	1
Stellar Map (of the Moon's Constellation)	3
Self-Inflating Life Raft	9
Magnetic Compass	14
Five Gallons of Water	2
Signal Flares	10
First-Aid Kit Containing Injection Needles	7
Solar-Powered FM Receiver-Transmitter	5

Hall, J. (1971, November). Decisions, decisions, decisions. Psychology Today, 51-54, 86, 88.

Appendix D

Decision-Style Questionnaire

DECISION-STYLE QUESTIONNAIRE

<u>Please read each question carefully before answering.</u>

While our group was working together to solve the Moon problem, our group voted on the ranking of items approximately _____ times. (Please fill in the blank with a number)

While our group was working together to solve the Moon problem, our group averaged the rankings of members approximately _____ times. (Please fill in the blank with a number)

While our group was working together to solve the Moon problem, group members traded rankings (i.e., compromised by giving up the wanted rank of an item in return for another item being ranked as wanted) approximately _____ times. (Please fill in the blank with a number)

Appendix E

Instructions For Reaching Consensus

INSTRUCTIONS FOR REACHING CONSENSUS

The task on which you are about to begin involves group decision-making. Your group is to employ the method of Group Consensus in reaching its decision. This means that the prediction of each of the fifteen (15) ranks must be agreed upon by each group member before it becomes a part of the group decision.

Consensus is difficult to reach. Therefore, not every ranking will meet with everyone's complete approval. Try, as a group, to make each ranking one with which all group members can at least partially agree. Here are some guides to use in reaching consensus:

1. Avoid arguing for your own individual judgments. Approach the task on the basis of logic.

2. Avoid changing your mind only in order to reach agreement and avoid conflict. Support only solutions with which you are able to agree somewhat at least.

3. Avoid 'conflict-reducing' techniques such as majority vote, averaging, or trading in reaching decisions.

4. View differences of opinion as helpful rather than as a hindrance in decision-making. Differences of opinion are natural and expected. Seek them out and try to involve everyone in the decision process.

5. Disagreements can help the group's decision because with a wider range of information and opinions, there is a greater chance that the group will hit upon more adequate solutions.

Nemiroff, P. M., & King, D. C. (1975). Group decision-making performance as influenced by consensus and self-orientation. Human Relations, 28, 1-21.

Appendix F

Informed Consent Form

INFORMED CONSENT FOR PARTICIPANTS OF INVESTIGATIVE PROJECTS

Title of Project: The Effect Of Group Decision-Making On Decision Quality
Investigator: C. Keith Waugh

The Purpose of this Research
You have probably heard the old saying, "Two heads are better than one". Is this saying really true? The purpose of this study is to find out the answer. In other words, are groups of people really any better at solving a problem than individuals working alone?

Procedures
The procedures that will be taken to find the answer to this question are simple, requiring two sessions. During the first session, which will be held during class of the Fall semester, I will ask you and 200 other students enrolled in psychology courses to complete the Myers-Briggs Type Indicator (MBTI). This is an instrument (not a test, there is no right or wrong / good or bad answers) that is used to figure out how you prefer to attack a problem and reach a solution. During the second session which will be held during a subsequent class of the Fall semester, I will give you a problem to work on, first alone and then with a group of people. Once you have completed the second session, I will give you some information about yourself that was gained from the MBTI which you will find interesting. That is all there is to it!

Confidentiality
To reduce any risks to you, please be assured that your results on the MBTI and problem will be kept strictly confidential, only you will know your results. So, don't be afraid that others will know anything you don't want them to know.

Benefits
I am sure that you will find this experience both enjoyable and interesting. Not only will you have an opportunity to learn about yourself, you will get a chance to practice your skills as a group member. If you have any questions or concerns prior to the night of the study, please don't hesitate to contact me at one of the numbers below.

Freedom to Withdraw
Subjects are free to withdraw from this study at any time without penalty. However, at the discretion of your professor in this class, early withdraw may result in the forfeit of any extra credit you would otherwise receive as a result of completing this study. Further, failure to complete the study will make you ineligible to participate in any drawings for prizes.

Approval of Research
This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University, and by the Department of Teaching and Learning.

Subject's Responsibilities
I voluntarily agree to participate in this study. I have the following responsibilities:

-To arrive at the location of the study promptly.
-To remain at the location of the study until dismissed by the investigator.
-To not discuss the procedures or content of this study with anyone unless given permission by the investigator.

Subject's Permission

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project.

______________________________ ____________

Signature of Subject Date

Should you have any questions about this research or its conduct, you may contact:

C. Keith Waugh Investigator	(540) 381-1875 Phone
K. Kurt Eschenmann Faculty Advisor	(540) 231-8198 Phone
E. R. Stout Chair, IRB Research Division	(540) 231-9359 Phone

Appendix G

Individual and Group Performance Scores

Group #1 - Homogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 27	F 11	46
#2	N 11	F 15	48
#3	N 13	F 43	46
#4	N 19	F 23	68

Group Score	30
UARI	22
UBRI	16
AE	1

Group #2 - Homogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 17	F 37	60
#2	N 33	F 19	44
#3	N 41	F 25	48
#4	N 33	F 11	50

Group Score	38
UARI	12.5
UBRI	6
AE	1

Group #3 - Homogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 43	T 9	46
#2	S 29	T 13	52
#3	S 27	T 19	42
#4	S 11	T 9	50

Group Score	34
UARI	13.5
UBRI	8
AE	1

Group #4 - Homogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 13	T 45	46
#2	S 27	T 11	46
#3	S 57	T 11	42
#4	S 41	T 49	50

Group Score	26
UARI	20
UBRI	16
AE	1

Group #5 - Homogeneous/Instructed (General Psychology)

Member	SN	TF	Individual Score
#1	N 21	T 27	54
#2	N 29	T 31	52
#3	N 11	T 29	46
#4	N 23	T 47	48

Group Score	28
UARI	22
UBRI	18
AE	1

Group #6 - Homogeneous/Instructed (General Psychology)

Member	SN	TF	Individual Score
#1	S 19	F 21	52
#2	S 31	F 13	58
#3	S 27	F 15	40
#4	S 29	F 7	36

Group Score	28
UARI	18.5
UBRI	8
AE	1

Group #7 - Homogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 9	F 21	37
#2	S 43	F 15	60
#3	S 23	F 31	44
#4	S 19	F 17	34

Group Score	30
UARI	13.75
UBRI	4
AE	1

Group #8 - Homogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 19	F 19	30
#2	S 17	F 17	36
#3	S 49	F 9	68
#4	S 33	F 15	48

Group Score	26
UARI	19.5
UBRI	4
AE	1

Group #9 - Homogeneous/Not Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 19	F 11	30
#2	N 27	F 33	32
#3	N 21	F 33	42
#4	N 11	F 23	63

Group Score	32
UARI	9.75
UBRI	-2
AE	0

Group #10 - Homogeneous/Not Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 17	T 15	40
#2	S 51	T 15	70
#3	S 51	T 41	44
#4	S 37	T 27	54

Group Score	26
UARI	26
UBRI	14
AE	1

Group #11 - Homogeneous/Not Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 23	T 29	40
#2	S 13	T 19	42
#3	S 37	T 59	40
#4	S 25	T 39	50

Group Score	34
UARI	9
UBRI	6
AE	1

Group #12 - Homogeneous/Not Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 35	T 13	59
#2	S 17	T 43	46
#3	S 17	T 29	54
#4	S 41	T 43	34

Group Score	34
UARI	14.25
UBRI	0
AE	0

Group #13 - Homogeneous/Not Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 11	F 9	32
#2	N 23	F 25	60
#3	N 15	F 27	42
#4	N 33	F 35	38

Group Score	26
UARI	17
UBRI	6
AE	1

Group #14 - Homogeneous/Not Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 23	F 23	60
#2	N 13	F 23	54
#3	N 33	F 13	44
#4	N 37	F 37	46

Group Score	54
UARI	-3
UBRI	-10
AE	0

Group #15 - Homogeneous/Not Instructed (General Psychology)

Member	SN	TF	Individual Score
#1	S 19	T 41	56
#2	S 43	T 45	42
#3	S 19	T 25	52
#4	S 33	T 27	52

Group Score	48
UARI	2.5
UBRI	-6
AE	0

Group #16 - Homogeneous/Not Instructed (General Psychology)

Member	SN	TF	Individual Score
#1	N 35	F 41	52
#2	N 23	F 19	30
#3	N 35	F 31	48
#4	N 19	F 15	36

Group Score	30
UARI	11.5
UBRI	0
AE	0

Group #17 - Homogeneous/Not Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 33	T 27	42
#2	S 25	T 35	38
#3	S 29	T 15	60
#4	S 47	T 53	40

Group Score	36
UARI	9
UBRI	2
AE	1

Group #18 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 25	T 35	58
#2	S 1	F 31	40
#3	N 25	T 11	42
#4	N 47	F 27	52

Group Score	34
UARI	14
UBRI	6
AE	1

Group #19 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 15	T 11	44
#2	S 3	F 5	28
#3	N 15	T 33	36
#4	N 17	F 37	28

Group Score	42
UARI	-8
UBRI	-14
AE	0

Group #20 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 43	F 1	38
#2	N 1	T 21	48
#3	S 13	F 25	40
#4	S 39	F 3	64

Group Score	24
UARI	23.5
UBRI	14
AE	1

Group #21 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 5	F 23	42
#2	N 25	T 19	50
#3	S 39	T 7	52
#4	N 33	F 11	60

Group Score	42
UARI	9
UBRI	0
AE	0

Group #22 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 3	F 25	60
#2	S 9	F 15	60
#3	N 17	T 3	50
#4	S 11	T 11	40

Group Score	38
UARI	14.5
UBRI	2
AE	1

Group #23 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 39	F 7	36
#2	S 55	F 27	52
#3	N 29	T 37	32
#4	S 7	T 5	56

Group Score	24
UARI	20
UBRI	8
AE	1

Group #24 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	S 33	T 7	28
#2	N 3	T 29	28
#3	S 51	F 23	58
#4	S 25	F 7	44

Group Score	26
UARI	13.5
UBRI	2
AE	1

Group #25 - Heterogeneous/Instructed (General Psychology)

Member	SN	TF	Individual Score
#1	S 13	T 37	56
#2	S 15	F 5	44
#3	N 31	F 23	40
#4	S 5	T 27	40

Group Score	20
UARI	25
UBRI	20
AE	1

Group #26 - Heterogeneous/Instructed (General Psychology)

Member	SN	TF	Individual Score
#1	S 47	T 13	58
#2	S 27	F 3	40
#3	N 19	T 21	44
#4	N 15	F 37	56

Group Score	30
UARI	19.5
UBRI	10
AE	1

Group #27 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 27	F 33	62
#2	S 37	T 15	66
#3	S 15	F 5	36
#4	S 3	T 13	32

Group Score	40
UARI	9
UBRI	-8
AE	0

Group #28 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 7	F 27	30
#2	S 65	T 51	46
#3	N 11	T 3	52
#4	S 7	F 11	50

Group Score	40
UARI	4.5
UBRI	-10
AE	0

Group #29 - Heterogeneous/Instructed (Psy. of Personality)

Member	SN	TF	Individual Score
#1	N 31	F 31	50
#2	S 33	T 19	48
#3	N 21	T 25	39
#4	S 25	F 23	66

Group Score	34
UARI	16.75
UBRI	5
AE	1

Group #30 - Heterogeneous/ Not Instructed (Psy. of Person.)

Member	SN	TF	Individual Score
#1	S 15	T 7	42
#2	S 21	F 35	50
#3	N 19	T 45	48
#4	N 25	F 3	60

Group Score	40
UARI	10
UBRI	2
AE	1

Group #31 - Heterogeneous/Not Instructed (Psy. of Person.)

Member	SN	TF	Individual Score
#1	S 9	T 1	66
#2	S 13	F 37	38
#3	N 3	F 5	50
#4	N 9	T 35	28

Group Score	26
UARI	19.5
UBRI	2
AE	1

Group #32 - Heterogeneous/ Not Instructed (Psy. of Person.)

Member	SN	TF	Individual Score
#1	S 7	T 9	36
#2	S 11	F 5	38
#3	N 37	F 25	76
#4	N 35	T 13	48

Group Score	28
UARI	21.5
UBRI	8
AE	1

Group #33 - Heterogeneous/Not Instructed (Psy. of Person.)

Member	SN	TF	Individual Score
#1	S 13	T 33	52
#2	S 23	F 31	48
#3	N 43	F 23	32
#4	N 25	T 5	52

Group Score	46
UARI	0
UBRI	-14
AE	0

Group #34 - Heterogeneous/ Not Instructed (Psy. of Person.)

Member	SN	TF	Individual Score
#1	N 23	F 5	54
#2	S 11	F 9	52
#3	N 13	T 31	54
#4	S 3	T 7	46

Group Score	48
UARI	3.5
UBRI	-2
AE	0

Group #35 - Heterogeneous/Not Instructed (Gen. Psychology)

Member	SN	TF	Individual Score
#1	N 3	F 3	40
#2	S 43	T 13	50
#3	S 37	T 41	46
#4	N 23	F 19	30

Group Score	42
UARI	-.5
UBRI	-12
AE	0

Group #36 - Heterogeneous/ Not Instructed (Gen. Psychology)

Member	SN	TF	Individual Score
#1	S 49	T 15	54
#2	S 19	T 29	50
#3	N 19	T 7	59
#4	N 9	F 9	50

Group Score	42
UARI	11.25
UBRI	8
AE	1

Group #37 - Heterogeneous/Not Instructed (Psy. of Person.)

Member	SN	TF	Individual Score
#1	S 17	T 9	40
#2	S 7	F 21	38
#3	N 39	F 3	32
#4	S 17	F 5	48

Group Score	28
UARI	11.5
UBRI	4
AE	1

Group #38 - Heterogeneous/ Not Instructed (Psy. of Person.)

Member	SN	TF	Individual Score
#1	N 19	F 17	56
#2	S 55	T 43	46
#3	N 9	T 1	58
#4	S 19	F 7	38

Group Score	42
UARI	7.5
UBRI	-4
AE	0

VITA

C. Keith Waugh was born on October 23, 1965. After graduating from Juniata High School, in Mifflintown, Pennsylvania, he attended Juniata College and received a Bachelor of Arts Degree in Business Management in 1988. Having worked several years in industry, he returned to academic work and received a Master of Science Degree in Psychology from Shippensburg University in May of 1993.

In the Fall of 1993, Keith began his doctoral work in Vocational Education at Virginia Polytechnic Institute and State University. His areas of specialization include workforce training and development and educational research, and he has developed expertise as a practitioner in these areas by working in the department as a research associate and a private consultant to numerous organizations who provide training to area businesses and industries.

Keith is a member of Omicron Tau Theta, serving as vice president in 1994, the American Society of Training and Development, the American Vocational Association, the Virginia Employment and Training Association, and the American Psychological Association.