THE EFFECTS OF AN EXPERT ON THE SMALL-GROUP CONSENSUS PROCESS

by

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(ABSTRACT)

This research tested the effects of an expert on strength of consensus and decision quality when the expert is a member of a consensus group. The purpose of this research is to help managers effectively use experts to increase decision quality without reducing consensus. If the expert gives the group relevant information, decision quality should increase. If group members believe the expert's information is accurate, they'll perceive their decision is high in quality. If the group members perceive the decision is high in quality and perceive they had an opportunity to express their views, strength of consensus should be high.

Subjects (110 total) in this experiment were placed in 22 groups of 5. Eleven experimental groups had one expert; 11 control groups had no expert. Experts were selected from a pool of astronomy students. The experts' level of expertise was assessed by their score on a pre-test and score on the Lost on the Moon exercise.

I measured the first dependent variable, strength of consensus, with a post-task questionnaire and two statistical measures of the closeness of rankings. I measured the second dependent variable, decision quality, by the closeness of the group's ranking to the ranking developed by NASA experts. I measured perceptions of

opportunity to express views and perceptions of decision quality with a post-task questionnaire. I also measured group members' use of expert power and leadership emergence with a post-task questionnaire.

Experts had no effect on decision quality, largely because the expert manipulation was unsuccessful. Perceptions of decision quality were correlated with strength of consensus. Perceptions of the opportunity to express views were only marginally correlated with consensus. Finally, experts tended to emerge as leaders. I concluded that experts will increase decision quality unless they give the group the wrong information or no information. I also concluded that experts won't hurt consensus unless they dominate the group discussion. Perceptions of decision quality and perceptions of the opportunity to express views are important variables for achieving consensus.

ACKNOWLEDGEMENTS

This research was funded by U.S. Department of Energy Special Research Grant No. DE-FG02-88DP48058 entitled "Research and Development of Methods and Tools for Achieving and Maintaining Consensus Processes in the Face of Change Within and Among Government Oversight Agencies," with Management Systems Laboratories (MSL) of the Industrial and Systems Engineering Department of Virginia Polytechnic Institute and State University. I'd like to thank the Department of Energy's Office of Environmental Restoration and Waste Management for sponsoring this research and for giving me an opportunity to supplement this research with observations of real-world consensus groups.

I'd like to thank my advisor, Dr. Harold Kurstedt, for his support, advice, and patience as I worked through MSL's new research process. I'd also like to thank my other committee members, Dr. Pat Koelling and Dr. Roseanne Foti, for their encouragement and feedback. Pat was one of the reasons I went into Management Systems Engineering in the first place. Roseanne was especially patient during my many visits to her office as I struggled with my data analysis.

The many people at MSL who supported this research also deserve my thanks. Various people have prepared figures and tables, formatted documents, been subjects in my pilot study, and helped me run my experiment. Jim Hughes deserves to be singled out for his help with logistics and administrative details. The graduate students at MSL were especially helpful with comments and criticisms throughout the research process.

Dr. John Broderick, physics professor, and Ron Zellar, president of the astronomy club, were invaluable in helping me recruit experts on short notice. Dr. Broderick also helped me create the quiz I used to test my experts.

My parents are the two people most responsible for this work. Their support, guidance, and love are greatly appreciated. Finally, I'd like to thank my fiance, Marty, for patience, support, and mileage.

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INTRODUCTION

I begin this introductory chapter with a statement of the problem. This problem statement is detailed and specific to my experiment. In the next two sections, I describe the relevance of the study and who will use its results. These sections take a much broader look at what I aim to accomplish with this research. I then set out the general questions this research answers. From this broad picture, I again narrow my focus until I state the specific hypotheses tested in this research.

PROBLEM STATEMENT

This research aims to characterize, conceptualize, demonstrate (test), and generalize the effects of an expert on strength of consensus and decision quality when the expert is an integral part of a consensus group trying to reach a ranked-list decision using Hall's consensus guidelines.

RELEVANCE OF STUDY

Most consensus groups are created when a manager brings together people who have a stake in a mutual problem to solve that problem. These stakeholders often possess knowledge or expertise on one or more aspects of the problem. Other consensus groups are created when a manager brings together a group of recognized experts (who aren't necessarily stakeholders) to solve a problem. This study examines the situation where one member of a group is an expert and the other

group members have some knowledge related to the problem. I've assumed the expert is a member of the consensus group rather than simply an advisor; therefore, *the presence of an expert* is my independent variable. I believe consensus groups are convened for two reasons: 1) to get people to come to consensus on a decision and 2) to reach a high-quality decision. Therefore, *consensus* and *decision quality* are my dependent variables. Managers want the expert to give the group information to improve decision quality without hindering consensus. If the manager responsible for the group knows how experts affect consensus and decision quality, he or she can choose to bring in or identify an expert to get the desired effects--or control the expert to avoid undesired effects. A related topic is whether or not the expert *emerges* as a leader. If the expert emerges and takes strong control, other members may perceive they had little opportunity for input and won't accept the decision. If the expert doesn't emerge as a leader, his or her information may not be properly considered and the quality of the group decision may suffer.

WHO WILL USE THIS RESEARCH?

This research is designed to help managers, convenors, and facilitators of consensus groups. Managers have work groups who solve problems or make decisions and need expert advice both from within the group and outside the group. Convenors bring together consensus groups and need to know what role an expert should play (e.g., group member, advisor). Facilitators are responsible for controlling the consensus process. They must ensure experts give the group valuable information without dominating the discussion or the decision. The term "managers" is used to refer to managers, convenors, and facilitators.

RESEARCH QUESTIONS

I had two research questions in mind when I began this research. The first question is theoretical. The second question asks how this theory can be practically applied by managers. The terms used in these questions are defined in Appendix A.

1. How does an expert affect strength of consensus and decision quality when he or she is part of a consensus group? This question is addressed experimentally.

2. What can managers do to ensure an expert contributes his or her knowledge and experience to a consensus group without dominating the discussion or the final decision? This question is addressed by combining knowledge gained from my experiment with knowledge found in the literature.

RESEARCH PURPOSE

The consensus decision-making process is often used 1) to increase the quality of decisions affecting stakeholders, and 2) to increase the acceptance of, agreement with, and commitment to those decisions. When non-expert stakeholders don't possess all the information necessary to make a high-quality decision, they may rely on an expert. Managers need to know the best way to manage or facilitate groups with an expert so the expert introduces important information without taking complete control of the group and the resulting decision. Before managers can decide how to run groups with experts, they must understand how experts affect the small-group consensus process. Therefore, the purpose of this research is twofold:

1. To help managers understand the effects of an expert on strength of consensus and decision quality in a small consensus group. My experiment addressed this purpose.

2. To help managers weave an expert into the small-group consensus process in a way that increases decision quality without decreasing the strength of consensus. My experimental results along with my review of the literature let me develop recommendations for managers on how to manage and facilitate experts to increase consensus and decision quality.

DELIMITATIONS

To reduce the scope of this research, I made three delimitations. Appendix B describes several scenarios and how they are, or are not, addressed by this research. These scenarios also help delimit this research.

1. I don't consider how the expert became a part of the group. Regardless of how the expert is introduced, the group members must recognize the expertise of the expert and use it to their advantage.

2. I studied groups with only one expert having expertise on the subject area of the problem. Situations in which there is more than one expert in the group (e.g., a national task force on education) is a related but separate problem.

3. Although many consensus groups use a facilitator, my groups have no facilitator.

CONCEPTUAL MODEL

Figure 1 depicts the conceptual model for this study. The conceptual model shows the relationships between constructs. The model shows a consensus group consisting of one expert and some number of other group members. Although the expert is a member of the group, I've shown the expert as a separate entity to highlight the importance of the expert to this research. The expert and the other group members come together in a meeting and interact to come up with a decision. The expert, group members, and the group interaction have several associated sub-constructs important for this study. These sub-constructs are listed in Figure 1 and discussed in the literature review. Out of the group interaction comes a decision. Two outcomes are associated with the group's decision: strength of consensus (group members accept, agree with, and are committed to the decision to some degree) and decision quality (the decision conforms to a "right" decision to some degree). Each of these constructs, sub-constructs, and outcomes is discussed later in the literature review.

Figure 2 is a global conceptual model for decision-making groups. This model is used by the Management Systems Laboratories (MSL) to study consensus. The model is also useful for understanding existing groups or designing new groups. As I describe the model, I'll use a machine breakdown in a manufacturing organization as an example. In this example, the first-line supervisor is the manager. The first component in Figure 2, the *precipitator*, is the person, condition, information, or event that causes a manager to form a group. In my example, the precipitator is the breakdown of the machine. The machine has broken down three times in the past month. The first-line supervisor decides to call a group together to figure out how to

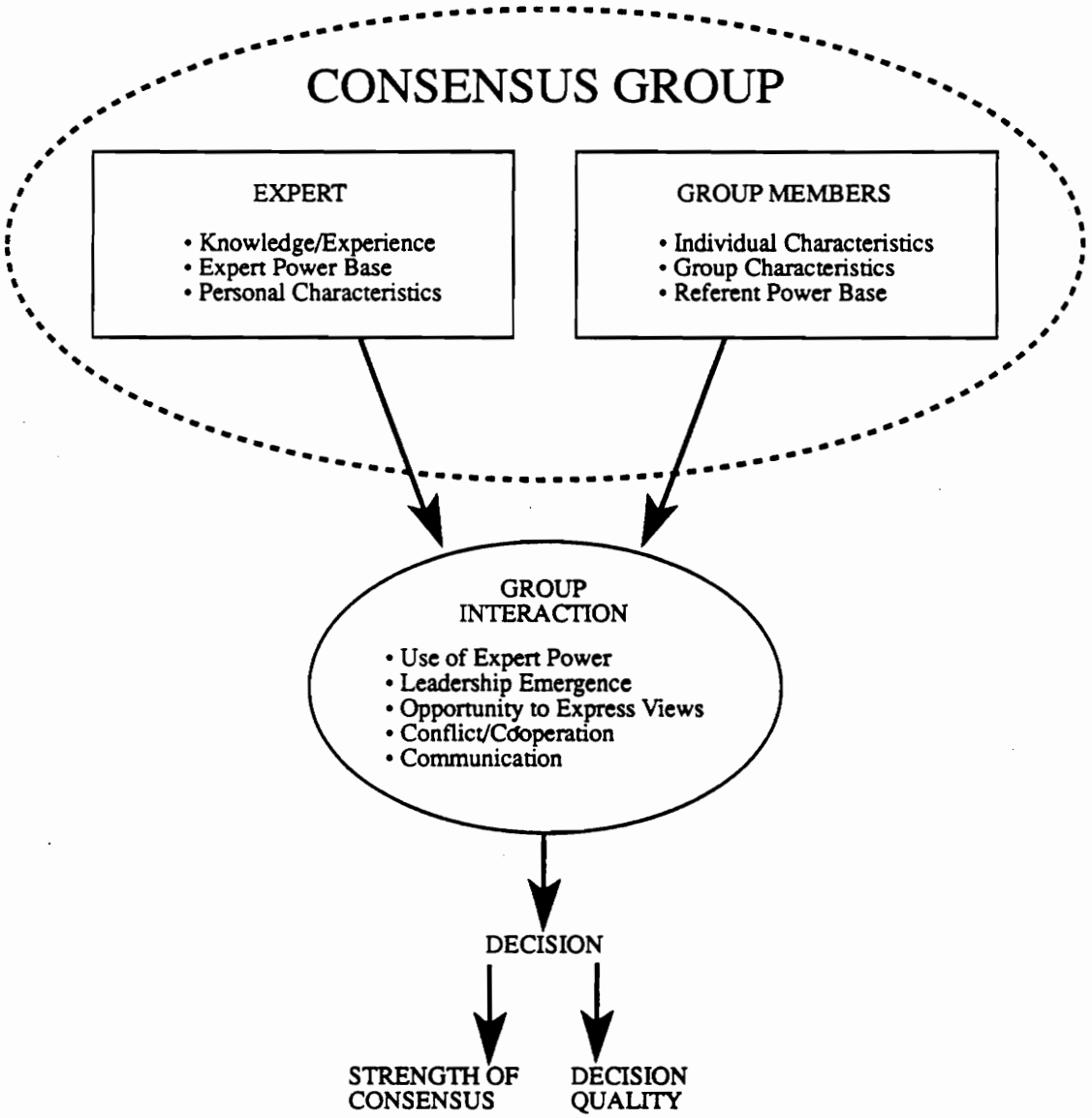


Figure 1: Conceptual Model Relating Consensus Groups, Group Interaction, and Outcomes Associated with a Decision

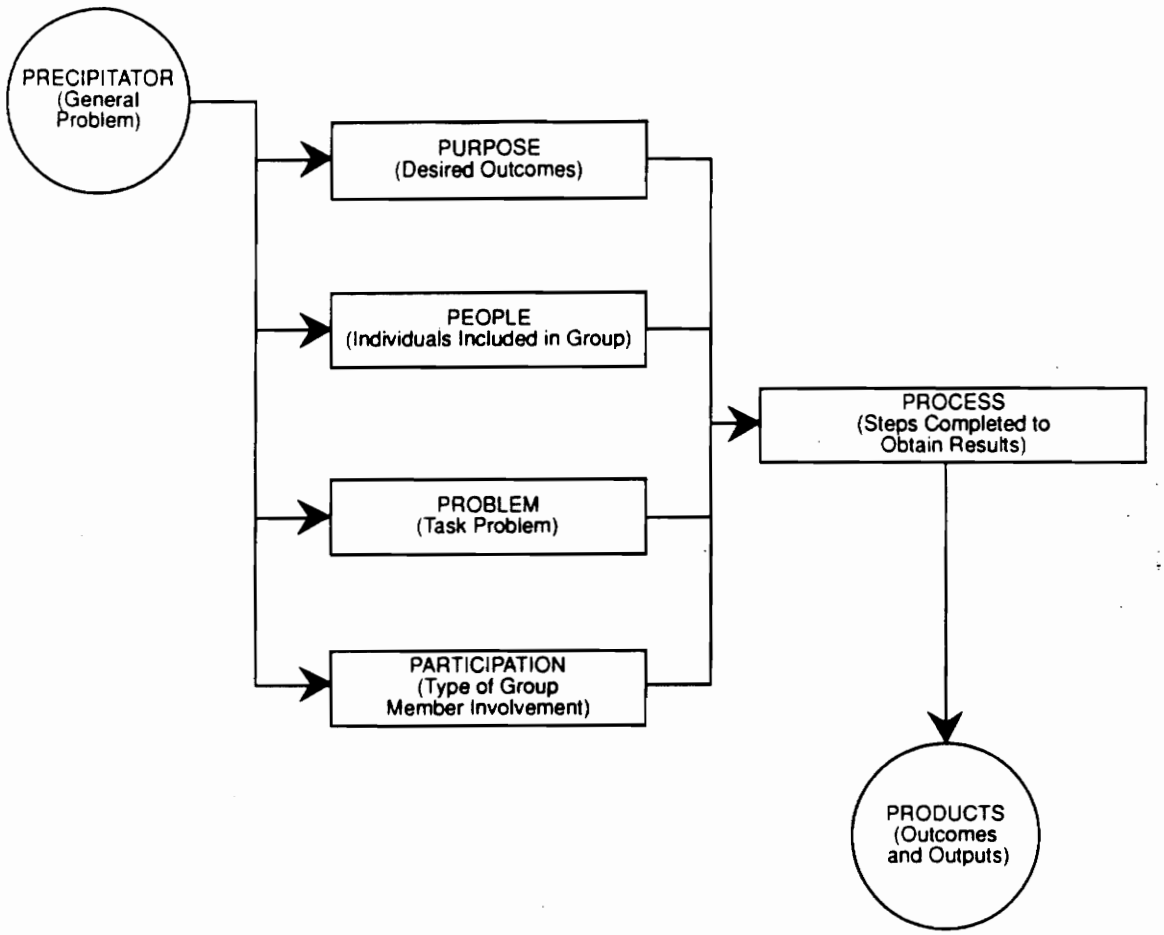
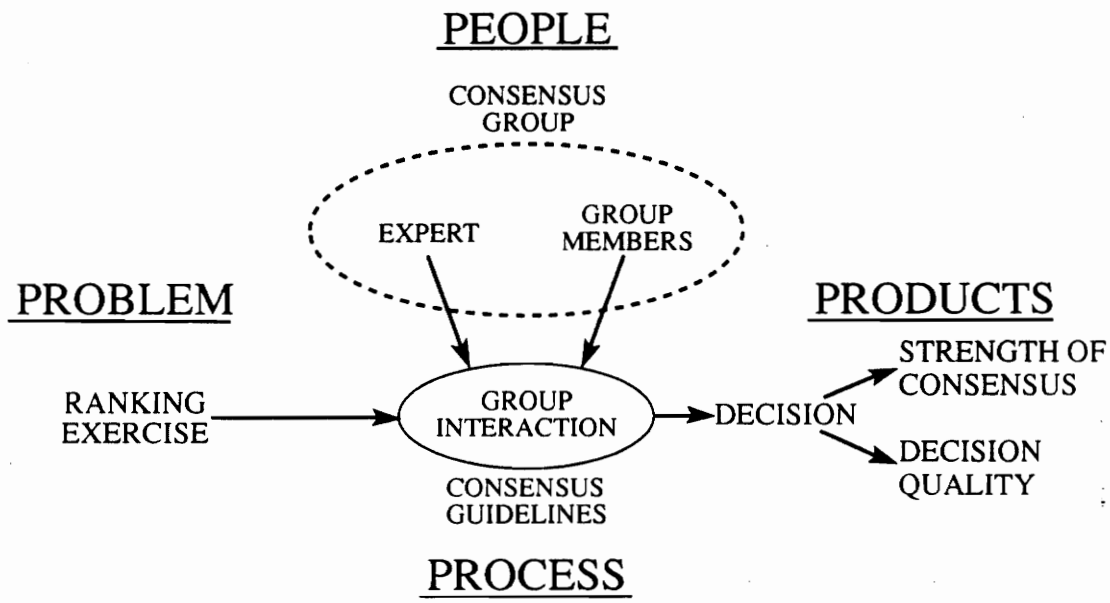


Figure 2: MSL's Conceptual Model for the Study of Consensus

reduce the number of machine break-downs. The precipitator determines which of the next four components in Figure 2 is set next. In this case, the precipitator sets the second component, the purpose of the meeting. The *purpose* is what the group expects to accomplish. The purpose answers the question, "What do we want to come out of this meeting?" Example purposes include: to reach a decision, to develop a list of ideas, and to share information. In my manufacturing example, the purpose of the meeting is to find out the cause of the break-downs and find a way to reduce the number of break-downs. *People* are all the individuals associated with the group. The convenor, facilitator, group leader, group members, and advisors to the group are all examples of people. Following my example, the people are the first-line supervisor who calls the meeting, an outside facilitator brought in to run the meeting, the employees who work with the machine, a mechanic who is responsible for maintaining the machine, and an expert on this type of machine. The *problem* is the specific task the group works on. Improving performance on an assembly line, replacing a retired employee, and solving the Lost on the Moon exercise are three examples of problems a group might work on. In my example, the specific problem is to reduce the downtime of the machine. *Participation* describes the way the people interact. Participation includes the degree to which the decision will be made by one group member or all group members, the amount of conflict to be allowed, and how much group members will get to express their views during group interaction. In my example, the group members will have the final say in what solutions are implemented. Conflict will be encouraged, but kept constructive by the facilitator. All group members will be encouraged to speak their mind. Once purpose, people, problem, and participation are determined, the *process* can be chosen. Process includes techniques, guidelines, and rules groups use to make a decision. The

process should be chosen based on the preceding components of the model. In my example, the manufacturing group will brainstorm possible causes and solutions and then interact to come to a consensus on the probable causes and the best solutions. *Product* is the outputs and outcomes of the group process. *Outputs* are tangible results of the meeting such as decisions, ranked lists, or plans. In the manufacturing example, the output will be ranked lists of the causes and solutions. *Outcomes* are intangible results of the meeting such as group cohesion, consensus, or group commitment. In the manufacturing example, the desired outcome will be strong consensus so the group members will be committed to implementing their solutions. The components of the model in Figure 2 also have time phases associated with them. The precipitator occurs at time zero. The purpose, people, problem, and participation components are all design issues the manager sets before the meeting occurs. The process occurs during the meeting. Hopefully, the process goes according the manager's design. The products occur at the end of the meeting and after the meeting.

Figure 3 shows how my conceptual model fits into the MSL group decision-making conceptual model. This figure is my conceptual model (in a slightly modified form) with the components of MSL's conceptual model labelling the corresponding parts of my model. Components of the MSL model not included in my model are listed at the bottom of the figure. These extra components aren't essential parts of my study and have been fixed to control my experiment. I discuss each component in the order it's presented in MSL's conceptual model. The scenario presented in the group exercise asks the group to imagine a spaceship crash is the precipitator. In reality, I am the precipitator; I bring the groups together to solve a problem for research purposes.



NOTE: PRECIPITATOR: A crash landing on the moon.
PURPOSE: To reach consensus on a high quality ranked list.
PARTICIPATION: Consensus decision making.

Figure 3: My Conceptual Model Merged With MSL's Conceptual Model

For this study, the group's purposes are to reach the highest quality solution to a ranking exercise and to reach the strongest consensus on that solution. The people in this study are an expert and other group members. The problem is fixed at a ranking exercise. For most research on consensus, participation is fixed at consensus decision-making. The process for this study is group interaction based on Hall's consensus guidelines. The products of this interaction are an output (a ranked-list decision), and two outcomes (consensus and decision quality).

SUB-PROBLEMS

Sub-problems divide the problem statement into more-manageable parts. I've formulated my sub-problems by dividing the conceptual model into parts. Figure 4 is a simplified version of my conceptual model, showing how different parts of the model correspond to different sub-problems.

1. Determine some of the important characteristics of experts that affect consensus-group interaction.

2. Describe how an expert, interacting in a consensus group, affects strength of consensus and decision quality.

3. Determine some of the important characteristics of group members that affect consensus-group interaction and how these characteristics affect strength of consensus and decision quality.

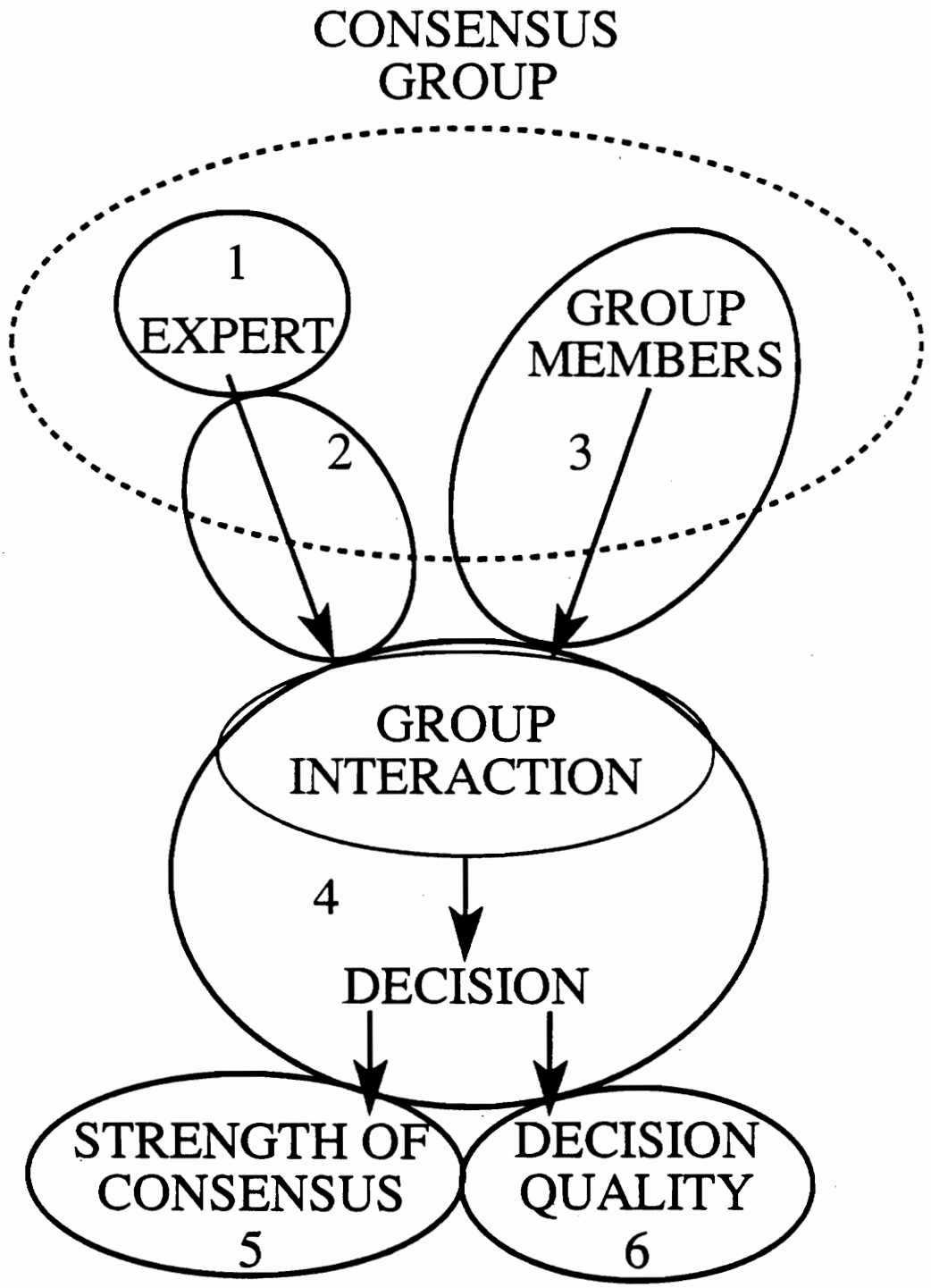


Figure 4: My Conceptual Model Partitioned by My Sub-Problems

4. Determine some of the important characteristics of consensus-group interaction and the relationships between consensus-group interaction characteristics and strength of consensus and decision quality.

5. Operationally define the construct of consensus to identify which aspects of consensus are affected by experts.

6. Operationally define the construct of decision quality to identify which aspects of decision quality are affected by experts.

OUTPUTS

From each sub-problem, I've identified one or more outputs I expected to have at the end of this research effort. Outputs are the tangible results of this research. Outputs result from reviewing the literature or experimentation. I'll identify each output in the appropriate section of this document.

1a. A list of characteristics of experts that affect the small-group consensus process.
1b. A taxonomy of experts.

2. Expressions of the relationships between characteristics of experts and strength of consensus and decision quality.

3. A list of characteristics of group members that affect the small-group consensus process.

4a. A list of the characteristics of the small-group consensus process.

4b. Expressions of the relationships between characteristics of consensus-group interaction and strength of consensus.

5. An operational definition of the construct of consensus.

6. An operational definition of the construct of decision quality.

RESEARCH HYPOTHESES

The following two research hypotheses are the overall suppositions of my study. They address the two dependent variables I'm interested in, strength of consensus and decision quality. These research hypotheses lead to my specific, testable hypotheses.

1. The presence of an expert in a consensus group will only decrease the strength of consensus if that expert dominates the group process, preventing other members from having the opportunity to express their views.

2. The presence of an expert in a consensus group will increase decision quality unless that expert doesn't contribute information to the group process or dominates the group process.

ASSUMPTIONS

Leedy (1989, p. 7) defines assumptions as conditions "taken for granted, without which the research situation would be impossible." Although an assumption can't be proven, I investigated the validity of some of my assumptions.

1. My experts will be able to communicate their knowledge to other group members.

2. Non-expert group members will have *some* knowledge or insight to contribute to the group task.

3. The intelligence of the other group members may affect the group interaction. However, I'm going to assume all subjects are of similar intelligence.

4. If all groups use Hall's Consensus Guidelines, group interaction won't vary significantly within condition (expert and non-expert).

5. All groups will be able to reach a group decision in the time allotted.

6. Individuals won't refuse to accept or agree with the decision solely because they think the decision will affect them adversely or they think the decision is not in their best self-interest. This shouldn't be a problem in the laboratory but may be in the real world.

7. There are no differences between male groups and female groups.

8. When studying consensus, it's more realistic to measure how individuals perceive the group process and its outcomes than to measure the true nature of the group process and its outcomes. This is because group members decide their level of consensus based on their perceptions.

9. Members of groups with an expert won't perceive they had less opportunity to express their views than members of groups without an expert.

10. Time to decision will not be a factor in this study.

11. My questionnaire measures strength of consensus, perceptions of decision quality, perceptions of opportunity to express views, use of expert and referent power, and leadership emergence accurately.

12. Consensus can be measured statistically by comparing post-discussion individual rankings to a group ranking or by comparing post-discussion individual rankings to each other.

13. The three measures of consensus (one questionnaire measure and two statistical measures) measure the same construct.

VARIABLES

Dependent Variables

The dependent variables for this study are strength of consensus and decision quality. I operationally defined strength of consensus three ways. The first operational definition is the sum of the absolute differences between the individual group members' post-discussion rankings (on the Lost on the Moon exercise) and the group's ranking. I'll refer to this measure as the *difference* measure. The second operational definition is a post-task questionnaire addressing acceptance of, agreement with, and commitment to the group decision by group members. I'll refer to this measure as the *questionnaire* measure. For all questionnaire measures, I summed individual ratings to get group measures. The complete questionnaire is Appendix C. The third operational definition is a statistical measure of the closeness of individual rankings (Kendall's coefficient of concordance). See the Data Analysis section (under "Materials and Methods") for a discussion of this measure. I'll refer to this measure as the *concordance* measure.

I operationally defined the second dependent variable, decision quality, as the closeness of the group's ranking to the ranking developed by NASA experts. "Closeness" is computed by summing the absolute differences between the group's rank for an item and NASA's rank for that item. Lower scores indicate higher quality. I also computed individual decision quality by comparing individual rankings to the NASA ranking. I used this measure as a control check to see if expert groups and non-expert groups had the same original talent.

Independent Variable

The independent variable for this study was the presence of an expert. I placed one expert in each experimental group. I operationally defined expertise three ways. First, the experts had to have a background in astronomy and general physics. Experts were chosen based on their having taken one or more classes covering the moon. Second, experts had to score well on a subject test. The subject test is a measure of subject expertise. Third, experts had to score well on the pre-discussion ranking. The pre-discussion ranking is a measure of task expertise. The difference between subject and task expertise is discussed in the Review of the Literature under "Categorizing Experts." I used the first operational definition to choose experts. I used the last two operational definitions as manipulation checks to determine if the experts were truly expert. Several variables that intervene in or moderate the relationships between the independent variable and the dependent variables are discussed next.

Intervening and Moderating Variables

Intervening Variables Associated With Strength of Consensus. Stone (1981) defines an intervening variable as "an unobservable process and/or state that helps to explain the linkages between an independent variable and a dependent variable" (p. 24). Without the intervening variable, the relationship between the independent and dependent variables will likely disappear. I proposed two variables that intervene in the relationship between presence of an expert and strength of consensus. I believe the presence of an expert *only* affects consensus if it affects other variables associated with consensus. In this study, I look at two variables associated with consensus, group members' perceptions of opportunity to express views and group members'

perceptions of decision quality. I operationally defined these variables with a post-task questionnaire (Appendix C). In addition to the two perception measures, I believe the experts' use of expert power is also an intervening variable. If experts overuse their power, strength of consensus may suffer. I operationally defined the use of expert power with a subset of a 20-item scale developed by Hinkin & Schriesheim (Hinkin, 1989). I didn't specifically test the effect of the use of expert power because I didn't believe I'd get a wide variation in the use of expert power. Figure 5 shows the variables, their operational definition, and their relationships in a research model. I didn't test these variables as intervening variables. Rather, I tested the relationships between the independent variable and the intervening variables, and the relationships between the intervening variables and the dependent variables.

Moderating Variables Associated With Decision Quality. Stone (1981) defines a moderating variable as "any variable which when systematically varied causes the relationship between two other variables to change" (p. 26). I proposed that degree of leadership emergence, use of expert power, degree of expertise, and communication skills moderate the relationship between the presence of an expert and decision quality. In other words, I believe these four variables change the relationship between the presence of an expert and decision quality. If the experts aren't perceived as leaders or don't use their expert power, the group members may not believe or accept the information the experts present and decision quality may suffer. If the experts don't have the necessary expertise, they may give the group incorrect information, decreasing decision quality. Finally, if experts can't communicate their knowledge effectively, group members won't consider the

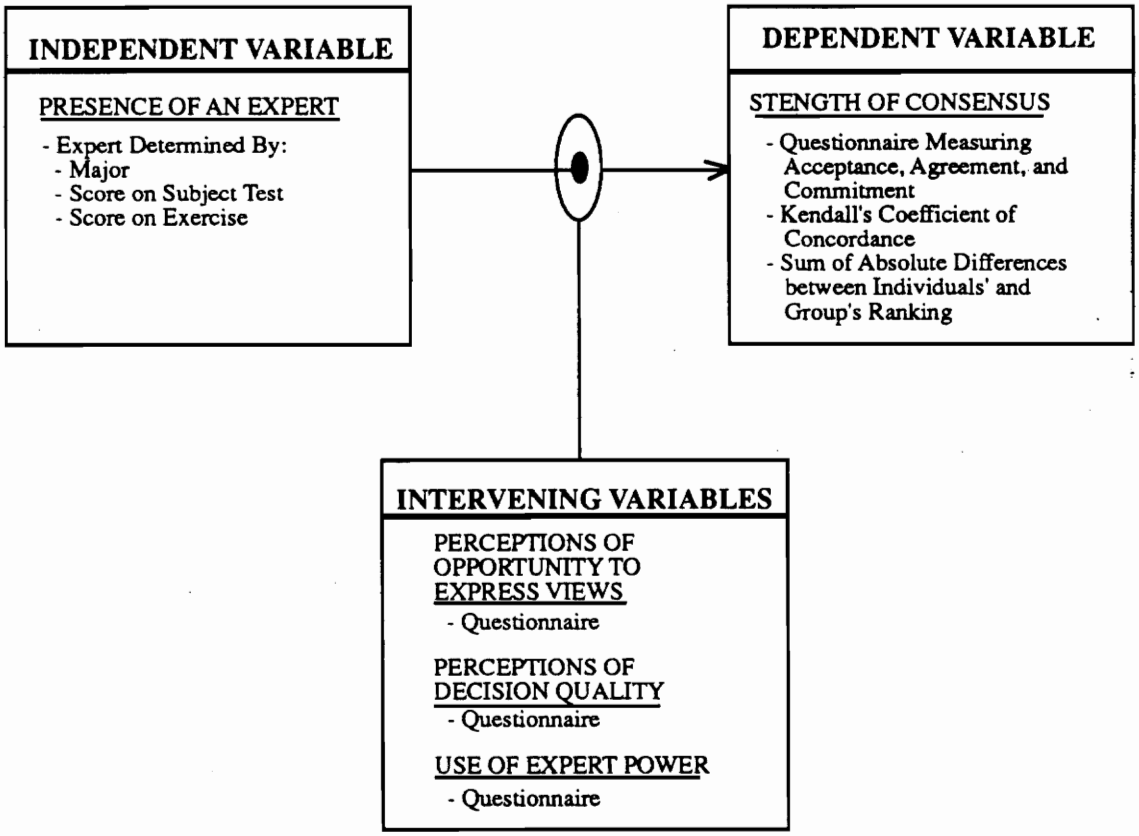


Figure 5: Research Model Associated With Strength of Consensus

information. I operationally defined leadership emergence with a scale developed by Foti and Lord (1987). I operationally defined the use of expert power with a subset of a 20-item scale developed by Hinkin & Schriesheim (Hinkin, 1989). I operationally defined degree of expertise as having taken relevant courses, scoring well on a subject test covering facts about the moon, and scoring well on the Lost on the Moon exercise. I didn't try to measure communication skills. I didn't test these variables as moderating variables. Rather, I tested the relationships between the independent variable and the dependent variable directly. In the case of leadership emergence, I tested the relationship between the independent variable and the moderating variable. In the case of the use of expert power and the degree of expertise, I used the moderating variables to help me explain the relationship between the independent variable and the dependent variable. Figure 6 shows the variables, their operational definitions, and their relationships in a research model.

SPECIFIC HYPOTHESES

Because my research model contains many variables, I've chosen only a few of the more important relationships to test. To test all the relationships I've proposed in my research models would increase the probability of Type I error. The hypotheses are pictured in Figure 7. Hypotheses 3-5 don't deal with experts explicitly. However, they examine variables associated with consensus that may be affected by experts.

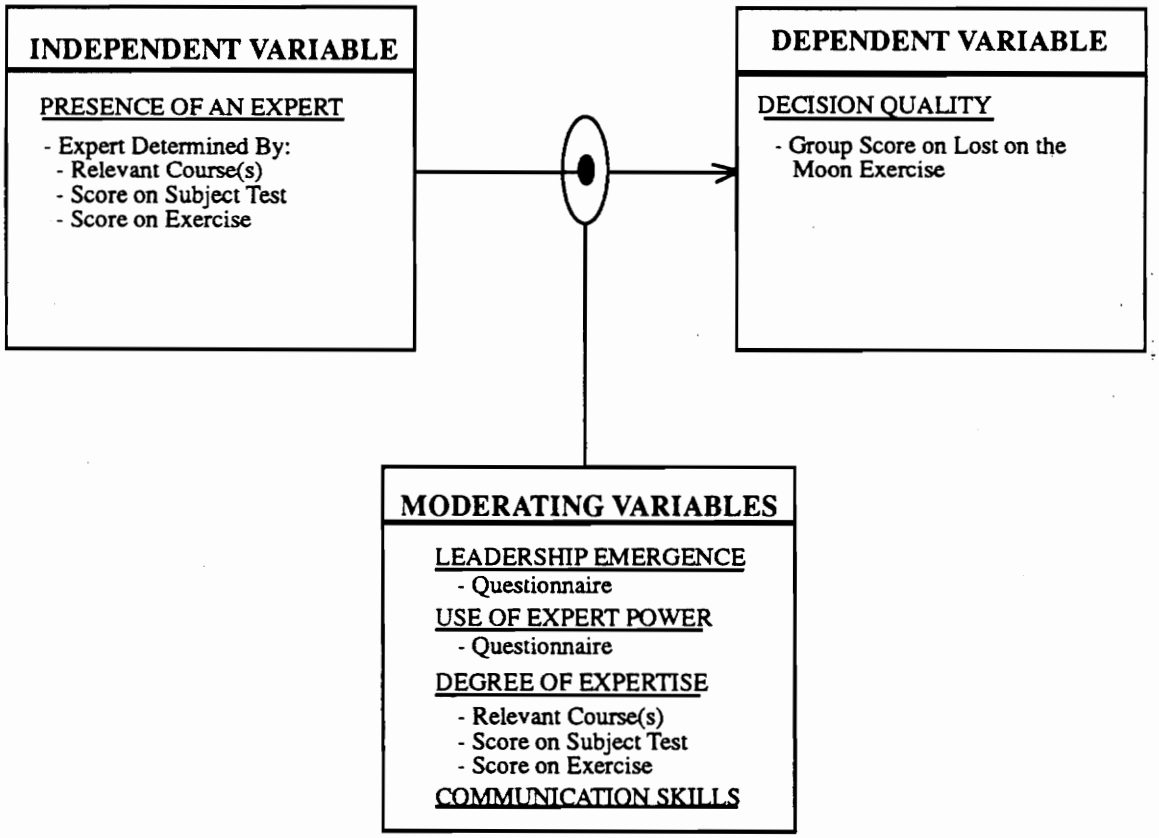


Figure 6: Research Model Associated With Decision Quality

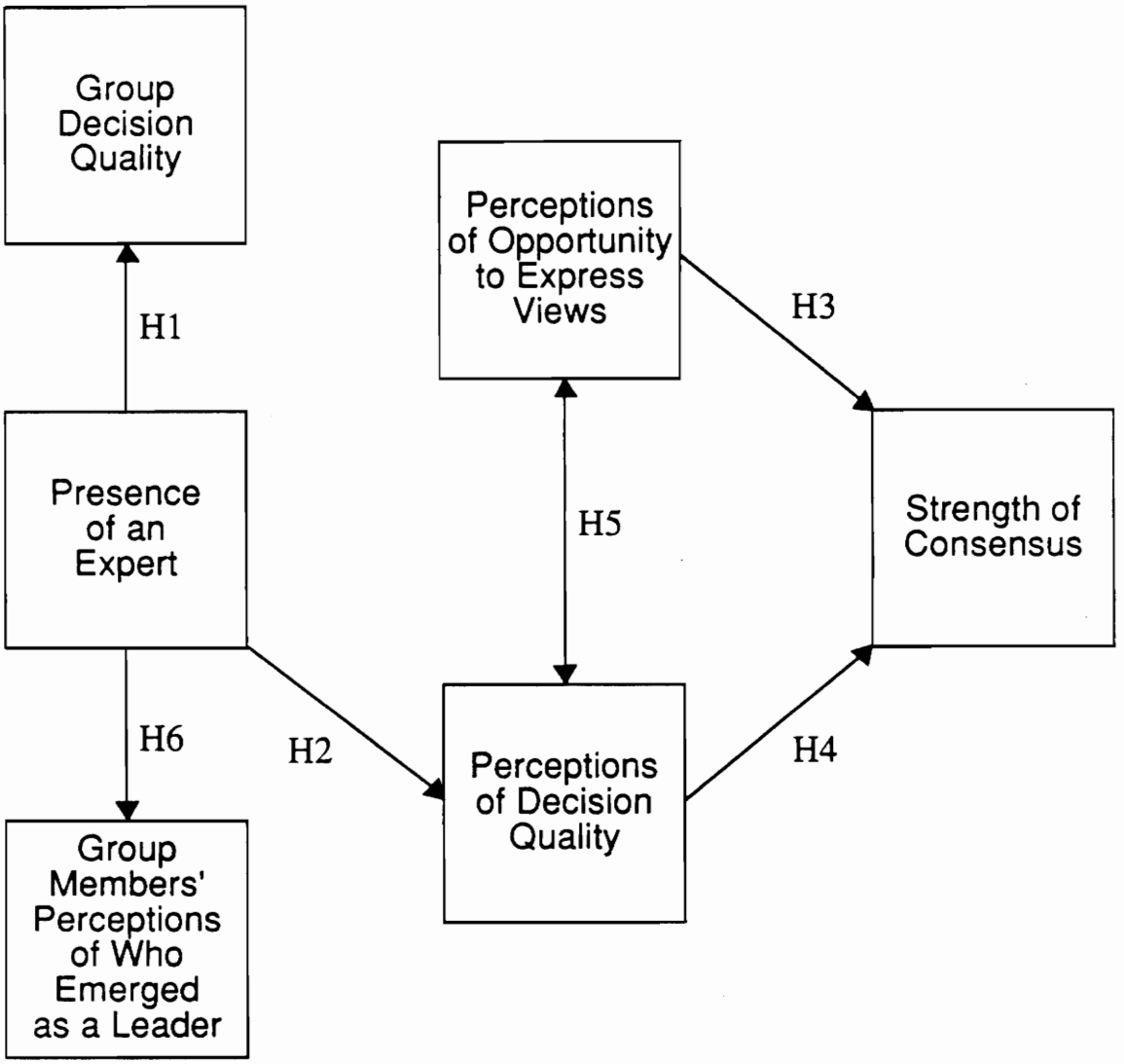


Figure 7: Specific Hypotheses

H1: Groups with a member who is an expert will have better decision quality scores on the Lost on the Moon exercise than groups without an expert.

H2: Members of groups with an expert will have higher perceptions of decision quality than members of groups with no expert.

H3: The higher group members' perceptions of the opportunity to express their views, the stronger the consensus.

H4: The higher the group members' perceptions of decision quality, the stronger the consensus.

H5: The higher the group members' perceptions of the opportunity to express their views, the higher their perceptions of decision quality.

H6: Experts will be perceived as being group leaders.

REVIEW OF THE LITERATURE

This chapter is organized by sections related to the six partitions of my conceptual model (Figure 4): experts, how experts affect consensus-group interaction, consensus-group members and their effects on consensus-group interaction, group interaction and its effects on consensus and decision quality, strength of consensus, and decision quality. In each section, I define terms and give an overview of the relevant literature. I also point out how different researchers support my specific hypotheses. In addition to the six conceptual model partitions, I include a section where I discuss one more topic not a part of my conceptual model but part of MSL's conceptual model. This topic, task type, fits under "problem" in MSL's conceptual model.

EXPERTS

Defining Experts

Webster (1984) defines an expert as "a person with great knowledge, skill or experience in a specific subject." Looking at this definition more closely we find three important considerations. First, expertise can be based on knowledge, skill, or experience. Second, expertise must be related to some subject. No one is an expert on everything. Finally, Webster says expertise is in a "*specific* subject." However, the level of specificity can vary. For example, someone can be an expert in Industrial Engineering (IE) or in plant layout. IE is more broad than plant layout. A final point Webster doesn't imply is expertise can only be judged relative to other people.

For example, an IE student may be considered an expert by non-IE's but not by IE faculty.

Categorizing Experts

I developed a taxonomy of experts with two dimensions. The first dimension distinguishes experts who have knowledge from experts who have experience. I call this dimension the source of expertise. The second dimension distinguishes experts who have broad expertise from experts who have more specific expertise. I call this dimension the level of specificity. Combining these dimensions results in four types of experts arranged in a two-by-two taxonomy. When reading this discussion, keep in mind that I define an expert as someone who has knowledge or experience relative to someone else. For example, I am an expert on the subject of experts to someone who has never studied experts, but not to someone who has studied experts all their life. Figure 8 shows my taxonomy of experts. This taxonomy is output number 1b.

Degree experts have a broad expertise based on learned knowledge. I call them degree experts because someone with a college degree is usually considered an expert in their field of study. People with other types of certification (e.g., certificates, academic honors, and licenses based upon examinations), also fit this category. "The educational background and record of the expert is a reasonable symbol of expert authority" (Benne, 1944, p. 47). For example, someone with a degree in IE from Virginia Tech could be considered an expert in IE. The level of expertness attributed to this person also depends on the person's performance as a student (e.g., grades), how far the person has gone in his or her studies (e.g., a doctoral degree), and the status of Virginia Tech's IE Department. *Position*

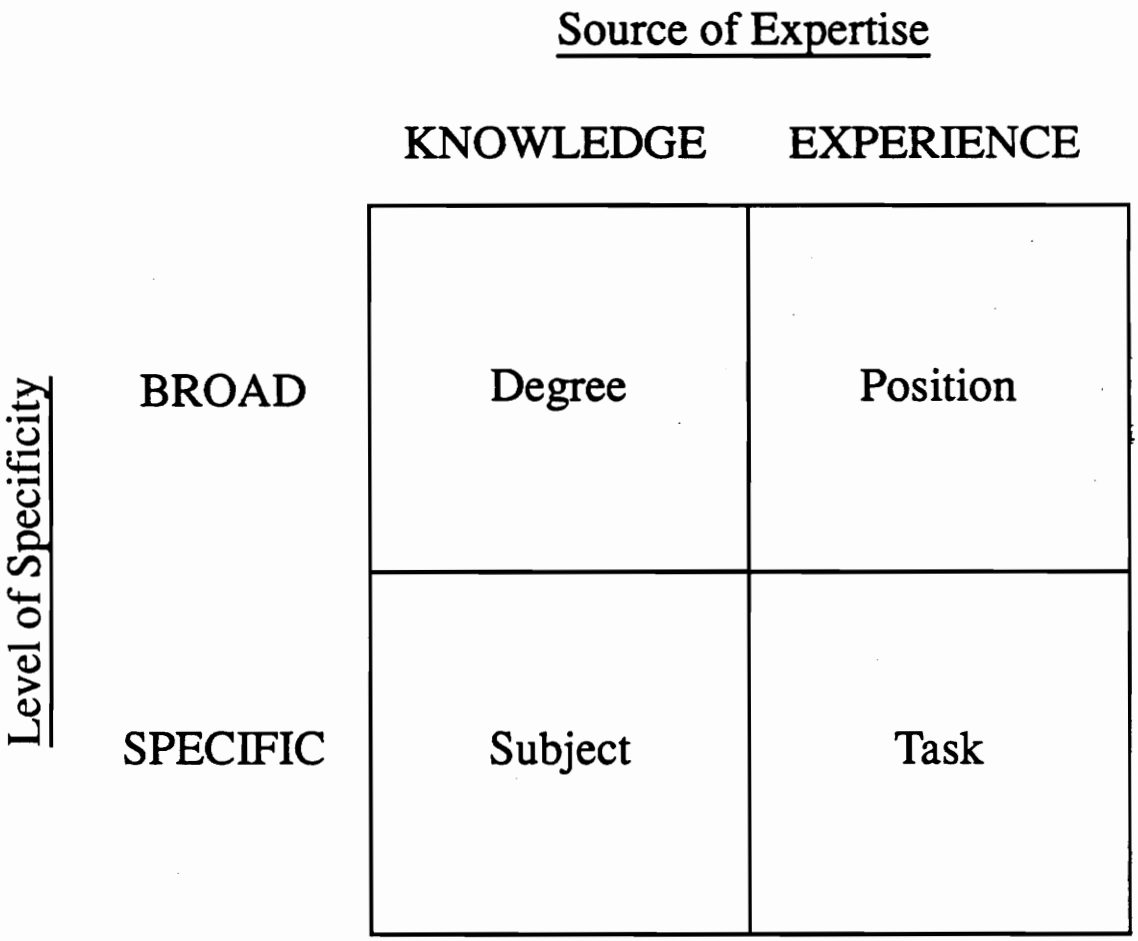


Figure 8: A Taxonomy of Experts

experts have broad expertise based on experience. I call them position experts because they usually hold a job in the area in question. For example, an IE at Corning Glass Works would be considered an expert in IE. People with titles (real or implied) signifying expertise also fit this category. Perceptions of *position* expertise vary based on years and performance in that position. *Subject* experts have a specific expertise based on knowledge. For example, someone who has done his or her thesis on plant layout or taken a series of classes on plant layout would be considered an expert on the subject of plant layout. *Task* experts have a specific expertise based on experience. For example, someone who has actually performed a plant layout and solved problems associated with laying out a plant would be considered an expert in plant layout. This categorization supports the inclusion of knowledge and experience (as two sub-constructs associated with an expert) in my conceptual model (Figure 1). In my study, I chose subject experts and tested them on their task expertise.

The Expert's Power Base

An expert has a base of power over other group members because group members need the expert's knowledge or information to solve their problem. Expert authority stems from the dependence of people on the assistance of other people possessing greater resources for meeting those needs (Benne, 1944). This power base will be discussed in the "Expert Power" section below.

Personal Characteristics of Experts

All experts are not created equal. Various personal characteristics affect the expert's ability to influence others. These personal characteristics also affect how other group members perceive the expert. I must understand these characteristics so I can

control for them. Persuasion skills, combining logical arguments with good communication, affect the expert's ability to influence others. Intelligence, masculinity, and gender affect how the expert is perceived by other group members. These personal characteristics will be discussed in the "Leadership Emergence" section. This list of the characteristics of experts affecting the small-group consensus process is output number 1a.

HOW EXPERTS INFLUENCE CONSENSUS GROUP INTERACTION

Expert Power

Experts can use their expertise as a source of power. A patient accepts a doctor's influence to take a certain treatment because the doctor is seen as an expert. To understand expert power, we must first understand power.

Defining Power. Yukl (1989, p. 14) defines power as "an agent's potential influence over the attitudes and behavior of one or more designated target persons." Influence is simply the effect of an agent on a target. In this study, I'm only concerned with influence over attitudes. Defining power as potential influence implies sources of power. I consider sources, or bases, of power next.

Sources of Power. French and Raven (1959) developed a taxonomy of power bases (Table 1). This taxonomy has been widely used in power research. Yukl (1989) expanded on French and Raven's taxonomy to include other sources of power. However, for my study, the French and Raven taxonomy is sufficient because I'm interested only in expert power. Podsakoff and Schriesheim (1985) found that expert

Table 1: French and Raven's (1959) Taxonomy of Power Bases

Power Base	*Definition*
Reward power	The ability to mediate the distribution of positive or negative reinforcers
Coercive power	The capacity to dispense punishments to those who do not comply with requests or demands
Legitimate power	Authority that derives from the powerholder's legitimate right to require and demand compliance
Referent power	Influence over others that is based on their identification with, attraction to, or respect for the powerholder
Expert power	Power that derives from others' assumption that the powerholder possesses superior skills and abilities

(Source: French & Raven, 1959)

and referent power were associated with subordinate satisfaction and performance. Legitimate, reward, and coercive power were either associated with lower satisfaction and performance, or weren't associated with satisfaction or performance.

Power Behaviors. Kipnis, Schmidt, Price, and Stitt (1981) looked at behavior types used to exercise influence. They found five categories of influence corresponding roughly to French and Raven's (1959) bases of power. Their rational persuasion category of influence corresponds to expert power. Rational persuasion is defined as "the use of logical arguments and factual evidence by the agent to persuade the target person that a proposal or request is viable and likely to result in attainment of desirable task outcomes" (Yukl, p. 38).

Defining Expert Power. Hinkin and Schriesheim (1989, p. 562) define expert power as "the ability to administer to another information, knowledge, or expertise." This definition is more behaviorally based than French and Raven's (1959) definition. (See Table 1.) "Expert power is based on a knowledge differential between the leader and the target person" (Yukl, 1989, p. 35). The target person must recognize the expertise and perceive the expert is reliable for expertise to be a source of power (Yukl, 1989). The subject's judgment of the reliability of the expert's information depends somewhat on how convincing the expert's arguments are. Targets also must *need* the information. For certain tasks, group members need an expert's information to perform the task effectively and efficiently. Expert power is commonly exercised as rational persuasion. The expert uses logical arguments with supporting evidence to convince targets of the "correctness" of a decision. Successful

use of expert power depends on the expert's communication skills and logical ability (Yukl, 1989).

Criticisms of Power Research. Power research has been criticized for being limited to field studies and for using primarily single-item ranking scales (Yukl, 1989; Podsakoff & Schriesheim, 1985). The present study addresses both of these criticisms by using a laboratory setting and a multi-item scale questionnaire. Power research has also failed to deal with confounding among different sources of power (Yukl, 1989). For example, although legitimate, coercive, and reward power are theoretically distinct, it's hard to separate legitimate power from coercive and reward power in practice. In this study, I controlled all sources of power except expert power.

Experts and Perceptions of Decision Quality

Hypothesis 2 states that members of groups with an expert will have higher perceptions of decision quality than members of groups with no expert. The more experts use their expert power, the more their information is injected into the group decision. If group members perceive the expert's knowledge is accurate, they will perceive that using this knowledge will result in a higher quality decision. Perceptions of accuracy will depend on how salient the expertise is and whether or not the expert's information conflicts with other group members' knowledge. In this study, the expert's knowledge base will be salient because the expert will tell the group he or she recently took an astronomy class. Whether or not the expert's knowledge conflicts with other group members' knowledge will depend on the accuracy of both parties' knowledge. Hovland and Weiss (1951) found that subjects' opinions were changed in the direction advocated by a communication to a

significantly greater degree when the material was presented by a credible source than when presented by a non-credible source.

GROUP MEMBERS AND THEIR EFFECTS ON GROUP INTERACTION

Personal Characteristics of Group Members

The same characteristics associated with experts (described in the "Experts" section above) can also determine how group members affect group interaction. Intelligence, masculinity, and gender can affect who emerges as a leader. Communication skills will affect how much influence a member has over the group. Personality of members can also affect group interaction. Hoffman & Smith (1960) concluded that group members respond differently to problem demands according to the individuals' characteristics. Bouchard (1969) found sociability (outgoing, enterprising, forward) to be related to performance on a brainstorming task. Haythorn (1953) found that individuals who are chosen by other group members as good leaders or persons they like to work with facilitate group functioning. The individual characteristics related to group goal facilitation (cooperativeness, prestige, efficiency, and insight) were positively related to effective group functioning (morale, productivity, cohesiveness, and motivation). Personality traits involving maturity, adaptability, and acceptance of others were also positively related to effective group functioning. Vroom (1959) found people with authoritarian personalities or weak independence needs were unaffected in their attitudes toward the job by the opportunity to participate in making decisions. The characteristics described in this section constitute output number 3, a list of characteristics of group members that affect the small-group consensus process.

Referent Power Base

With referent power, the target of influence complies because he or she admires the influencer and wants approval (French & Raven, 1959). (See Table 1.) Referent power causes compliance without the negative attitude changes associated with coercive power (Yukl, 1989). A referent power base could be considered a personal characteristic. However, I discuss it separately from the personal characteristic discussion because I want to highlight the importance of referent power to this study. I'm concerned with referent power because a group member who uses referent power can emerge as a leader. When groups are new and the members are strangers, group members will probably not have a referent power base.

Group Characteristics

Several group characteristics are worthy of note here. Hackman and Morris (1975) list group structure, level of cohesiveness, and group size as representative group characteristics. Homogeneity is another important group characteristic.

Group Structure. Groups can develop several types of structure, including role differentiation and attraction patterns (Forsyth, 1983). Group members take on different roles because no one person can fill all roles. Roles are often divided into task roles and socioemotional roles (Benne & Sheats, 1948). The effectiveness of group members who fill task roles can influence decision quality. The effectiveness of group members who fill socioemotional roles can influence the strength of consensus. As groups interact, group members develop liking and disliking for other group members, forming a network of stable social relationships (Doreian, 1986). When one person is liked by other group members, that person has a base of referent power. (See "Referent Power Base" section above.)

Level of Cohesiveness. Forsyth (1983, p. 10) defines cohesiveness as "the strength of the relationships linking the members to one another and to the group as a whole." In a review of the literature, Forsyth (1983) found that, in comparison to members of less-cohesive groups, members of highly-cohesive groups are more satisfied, participate more fully in group interaction, and are less likely to leave the group. However, high cohesion isn't always functional. Cohesive groups are more susceptible to groupthink (Janis, 1972).

Group Size. In general, smaller groups are easier to coordinate. As group size increases, communication becomes more difficult because less time is available for each member to speak (Yukl, 1989). Therefore, members of larger groups have less opportunity to express their views. However, larger groups have the advantage of greater resources, increasing decision quality on most tasks (Forsyth, 1983). Larger groups also have the benefit of a greater variety of perspectives on the problem (Yukl, 1989). As groups get larger, cliques and coalitions develop. Consensus is more difficult to achieve with larger groups. In my study, group size was fixed at five group members. This was small enough to avoid the negative outcomes associated with large groups.

Homogeneity. Homogeneity is a measure of how similar group members are. Discussions of homogeneity often look at homogeneity with respect to personality (e.g., Hoffman, 1959; Hoffman & Claggett, 1960; Wanous & Youtz, 1988). Hoffman (1959) found heterogeneous groups perform better on problems where quality was important because they are more likely to explore all aspects of the problem. He found no difference in decision acceptance between homogeneous and

heterogeneous groups. However, he suggested this may not be the case if heterogeneous groups can't resolve conflict.

GROUP INTERACTION AND ITS EFFECTS ON CONSENSUS AND DECISION QUALITY

In the "Group Members" section, I described how variables associated with group members affect strength of consensus and decision quality through the group interaction. I discuss four group-interaction variables affecting consensus and decision quality: use of expert power, leadership emergence, conflict, and communication. I also discuss Hall's Consensus Guidelines. The characteristics of group interaction described here constitute output number 4a.

Use of Expert Power

As I stated earlier, expert power depends on the expert having more knowledge than the target relative to a given subject. This knowledge difference can cause two types of problems if the expert acts superior or flaunts his or her expertise. First, targets may resist influence even if they agree with the expert's position. Second, even when the expert is acknowledged to have more relevant information, the rest of the group usually has some relevant information or ideas the group should consider. This argument supports the contention that quality may decline if experts use their power too much. McClelland (1975, p. 266) offers further support for this contention: "If [the leader] takes no initiative, he is no leader. If he takes too much, he becomes a dictator."

Leadership Emergence

Defining Leadership Emergence. Leadership emergence is the concept that, in leaderless groups, one individual will be seen as a leader by group members. Yukl (1989, p. 28) says this occurs because "some people will appear to have more competence at the task than others." The emergent leader gains status in the group and is allowed to have greater influence over group decisions. The amount of influence is proportionate to the group's evaluation of the person's potential contribution to the group. These contributions may take the form of control over scarce resources, access to vital information, or skill in dealing with critical task problems. In my study, the only potential contributions take the form of access to vital information. The task doesn't involve resources, and all groups used the same task instructions. However, because the task instructions are only guidelines, individuals skilled at group problem solving or interpersonal relationships may emerge as leaders even if they don't have access to critical information.

Hollander's Concept of Idiosyncrasy Credits. Hollander (1960) proposed the concept of idiosyncrasy credits to explain emergent leadership. A person gains idiosyncrasy credits by showing competence and by conforming to group norms. These credits can then be used to deviate from nonessential group norms and to be more innovative. In this study, emergence is explained largely by competence (knowledge of the subject). However, the conformance argument can also be applied. If someone is an expert on the subject at hand, his or her ideas are more likely to match certain ideas of each group member. Both conceptualizations of emergent leadership support the contention that the expert will emerge as a leader.

Traits Associated With Leadership Emergence. Early leadership researchers looked for traits associated with effective leaders. Lord, De Vader, and Alliger (1986) suggest that this earlier research pertains to the relation of leadership traits to leadership emergence rather than leadership effectiveness. In their meta-analysis, they found support for relationships between group members' perceptions of the individual's leadership and the individual's traits, intelligence, masculinity-femininity, and dominance.

Opportunity to Express Views

Hypothesis 3 says group members will be more likely to accept a decision if they believe their views were considered by the group. Most consensus guidelines (Hall, 1971; Hare, 1952; Johnson, 1975) stress the importance of group members expressing their views and being listened to and understood. "It is generally recognized that the acceptance of decisions by group members is increased through their participation in making the decision" (Maier & Hoffman, 1960). I believe the more individual group members perceive they had input into the group process, the stronger the consensus. Individuals who have input into a decision tend to identify with it and perceive it to be "their decision" (Yukl, 1989).

Conflict

Conflict is "disagreement, discord, and friction that occur when actions and/or beliefs of one individual or group of individuals are incompatible with those adopted by another individual or group of individuals" (Forsyth, 1983). If conflict isn't managed properly, it may be dysfunctional for both consensus and decision quality (Katz & Kahn, 1978). However, conflict can improve both decision quality (by considering

more ideas) and consensus (by increasing understanding of issues). "Conflict itself does not invariably harm relationships and can, when skillfully managed, contribute to effective organizational work" (Tjosvold, 1987, p. 184).

Communication

Groups with little communication will likely have low consensus and quality. Communication is necessary for the exchange of information. Without necessary information, decision quality may suffer. Without communication of this information to all parties, consensus may also suffer. As stated before, influence depends on persuasive, logical arguments. Good ideas won't improve decision quality without being communicated to the rest of the group. Opportunity to express views (discussed above) is an important facet of a group's communication.

Managing the Group Process

Hall (1971) created a set of rules for groups to follow to gain consensus. Hall defines consensus as a decision-making process that makes full use of all group resources and resolves conflicts creatively. Groups are instructed not to vote to resolve conflict nor to average their individual solutions to reach a group solution because voting and averaging would defeat the purpose of the exercise. Hall's guidelines are listed in Appendix D. Even when following Hall's guidelines, groups have considerable leeway in running the process.

CONSENSUS

Defining Consensus

Consensus has been defined as a process (Hall, 1971) and as a state (Shils, 1968). In this study, I investigate consensus as a state. However, my groups used a consensus process (shaped by Hall's consensus guidelines) to reach the state of consensus. Webster (1984) defines consensus as "general agreement." My questionnaire measure of consensus measures consensus as an aggregate of *acceptance* (how much group members can "live with" or "go along with" the decision), *agreement* (how much group members think the group's answer is the best answer), and *commitment* (the effort group members will carry out to implement a decision). This consensus questionnaire (described further in the "Instruments" section of my Research Plan) is output number 5, an operational definition of consensus.

Strength of Consensus

Some authors define consensus as unanimous agreement (Forsyth, 1983; Hirokawa, 1984; Rawlins, 1984). In their view, if all parties don't agree completely, there is no consensus. Other authors recognize degrees of consensus (Kaprzyk & Fedrizzi, 1988; Price, 1972). I believe there are degrees of consensus, and I call this strength of consensus.

DECISION QUALITY

I define decision quality as a measure of how close a decision is to the correct or best answer. Some problems, such as mathematical problems, have one correct answer.

In situations where there is no one correct answer, decision quality can be gauged by experts or by comparing the decision to similar decisions made previously. Many decisions can only be judged after time has passed. I've chosen a problem where there is a "correct" solution developed by experts. For this task (the Lost on the Moon exercise), decision quality is operationally defined as the sum of the absolute differences between the individual's or group's ranking and the expert (NASA) ranking. This operational definition of decision quality is output number 6. The grant that sponsored this research is focused on consensus rather than decision quality. However, I believe strong consensus on a poor quality decision is dangerous. Janis (1972) described the dangers of consensus on a poor decision in his Victims of Groupthink.

TASK TYPE

The Lost on the Moon Exercise

The experimental task for this experiment was the Lost on the Moon exercise. This exercise was developed by Hall (1971) to study consensus groups. The exercise has subjects assume they are crew members who have just crash landed on the moon. They are then asked to rank (individually and as a group) fifteen items according to their importance for survival. When groups discuss the problem, they are told they must reach a consensus because they must stick together for survival. The Crew Equipment Research Section of the NASA Manned Spacecraft Center at Houston, Texas generated an expert answer for the exercise. Decision quality can be measured by how close a ranking matches this expert ranking. Other researchers who have used the Lost on the Moon exercise or similar survival exercises include

Hall and Watson (1970), Herbert and Yost, (1979), Tjosvold and Field (1983), and Wanous and Youtz (1986). Appendix E shows the Lost on the Moon Exercise.

The Importance of Considering Task Type

I control task type by having all groups work on the same task, the Lost on the Moon Exercise. Although I didn't study the effects of task type on any variable, it's important to understand the effects task type may have on my study. The first reason task type is important is that effects may show up for one task but not another. For example, Hoffman and Maier (1961) compared homogeneous and heterogeneous (with respect to personality) groups on five different problems. Differences between the groups appeared on only four of the five problems. Bouchard (1969) found significant effects on brainstorming processes due to the type of task. The second reason task is important is that the task must tap the variables the researcher is interested in. As I discuss the following task typologies, I'll show how task type relates to the variables I'm interested in.

Hoffman and Smith's Task Typologies

Hoffman and Smith (1960) classify tasks two ways. First, they distinguish between decision-making (choosing among several alternatives) and problem-solving (generating new solutions) tasks. Individuals were more satisfied with problem-solving tasks. The Lost on the Moon exercise is a decision-making task. If I were comparing decision-making groups and problem-solving groups, I might find a difference in strength of consensus. Second, Hoffman and Smith distinguish between quality and acceptance problems. Quality problems have solutions that can be evaluated by some external criteria. Acceptance problems have solutions that don't

have this criteria; therefore, the quality is determined by the solution's ability to satisfy group members. The Lost on the Moon exercise taps both types of problems. NASA's expert ranking is the external criterion against which we can judge quality, but because the crash survivors must stick together, reaching a consensus is also important. "The fact that these two measures [decision quality and acceptance] are important and need to be combined is generally recognized" (Miner, 1972, p. 87).

Kaplan and Miller's Task Typology

Kaplan and Miller's (1987) intellective/judgmental distinction is similar to Hoffman and Smith's quality/acceptance distinction. With intellective tasks, groups try to find the correct answer; with judgmental tasks, groups try to find the moral position. Kaplan and Miller found on intellective tasks, group members relied on *informational influence* (influence based on sharing facts or persuasive arguments about the task). On judgmental tasks, group members relied on *normative influence* (influence based on desire to conform to the expectations of others). The Lost on the Moon exercise is an intellective task; therefore, informational influence will be prevalent. The experts will be in the best position to use informational influence because they possess greater knowledge about the subject.

Steiner's Task Typology

Steiner (1972, 1976) developed a typology of group tasks. Table 2 defines and gives examples of each type of task. Using Steiner's typology, the Lost on the Moon exercise is unitary, optimizing, and discretionary. The task is unitary because the group can't break the exercise into parts. Different group members contribute different pieces of information, but the group couldn't have each member rank five

Table 2: Steiner's Task Typology

Question	*Answer*	*Task Type*	*Examples*
Can the task be broken down into sub-components, or is division of the task inappropriate?	Subtasks can be identified.	Divisible	Playing a football game, building a house, preparing a six-course meal
	No subtasks exist.	Unitary	Pulling on a rope, reading a book, solving a math problem
Which is more important, quantity produced or quality of performance?	Quantity	Maximizing	Generating many ideas, lifting the greatest weight, scoring the most runs
	Quality	Optimizing	Generating the best idea, getting the right answer, solving a math problem
How are individual inputs related to the group's product?	Individual inputs are added together.	Additive	Pulling a rope, stuffing envelopes, shoveling snow
	Group product is average of individual judgments.	Compensatory	Averaging individuals' estimate of the number of beans in a jar, weight of an object, room temperature
	Group selects the product from pool of individual members' judgments.	Disjunctive	Questions involving yes/no, either/or answers such as math problems, puzzles, and choices between options
	All group members must contribute to the product.	Conjunctive	Climbing a mountain, eating a meal, relay races, soldiers marching in file
	Group can decide how individual inputs relate to group product.	Discretionary	Deciding to shovel snow together, opting to vote on the best answer to a math problem, letting leader answer question

(Source: Steiner, 1972, 1976)

of the items then combine these rankings. The group must work together and agree on a complete solution. The task is optimizing because the group strives for a correct answer (determined by NASA experts). The task is discretionary because groups can decide how individuals will contribute to the final product. However, the task has elements of both disjunctive and compensatory tasks. Pieces of the exercise are disjunctive even though the complete solution isn't an either/or answer. For example, the first item on the list, a box of matches, is the lowest ranked item because matches don't burn without oxygen. If one member of the group recognizes this fact, the group will rank the matches low. Hypothesis 1 states that groups with a member who is an expert should have higher decision quality than groups without an expert. Because the experts are more likely to know the facts associated with the disjunctive parts of the exercise, the groups with experts should have higher-quality decisions. Other parts of the exercise are compensatory because groups tends to average individual judgments. For example, if group members individually ranked oxygen 1, 2, and 3, the group would probably give oxygen a rank of 2.

Groups perform better on disjunctive tasks because groups stand a better chance of having a member who knows the correct answer (Marquart, 1955). This conclusion assumes that "truth wins." In other words, the individual with the correct answer must convince the other members he or she is correct. Shaw (1981) concludes that groups perform better than individuals on compensatory tasks. The averaging process tends to remove extreme answers. Because the Lost on the Moon exercise is disjunctive and compensatory, groups are expected to score better than the average of the individual scores.

MATERIALS AND METHODS

This chapter describes the details of my experiment. I begin with a classification of my research based on goals, logic, and methodology. I then describe my plan for this research. This plan discusses the subjects, instruments, and procedures used in the experiment and the analysis of my data. Appendix F describes a pilot study I ran prior to this experiment.

TYPE OF RESEARCH

Classification Based on Goals

Research can be classified by goals (Ary, Jacobs, & Razavieh, 1972). The goal of *basic research* is to formulate, expand, or evaluate theory. The goal of *applied research* is to find a solution to a practical problem. I'm conducting basic research because my goal is to formulate and evaluate a theory of the effects of experts in consensus groups. Although this research may be useful for real world applications, I'm not seeking the solution to a specific, real-world problem as in applied research.

Classification Based on Logic

Deductive and inductive logic are two ways of seeking information about the unknown (Leedy, 1989). With *inductive logic*, you start with observations then generalize to explain them. With *deductive logic*, you start with a theory or an hypothesis and collect data to test its accuracy (Light, Singer, & Willett, 1990). I use deductive logic when testing hypotheses using data collected from controlled experiments (my first research question). I use inductive logic when I make recommendations based on my results and the literature (my second research question).

Classification Based on Methodology

Kerlinger (1986) describes four types of research. *Experiments* test hypotheses by manipulating conditions to demonstrate the relationship between variables. *Field experiments* are experiments performed in real-world settings. Field experiments have less control than laboratory experiments. *Field studies* record a phenomenon in the real world without attempting to manipulate conditions. *Survey research* uses surveys to determine the incidence, distribution, and interrelationships among variables. This study is experimental. My objective is to demonstrate the relationships between the presence of an expert and consensus and decision quality. I selected subjects randomly and used a control group to limit extraneous variance.

RESEARCH PLAN

Subjects

I placed 110 subjects in 22 groups of 5 people. Eleven groups had an expert (experimental condition); 11 groups had no expert (control condition). All subjects were college students. Experts were recruited from an astronomy club. (One expert was recruited from an astronomy course.) Non-experts were recruited from an introductory psychology course. Experts received $15 for their participation. Non-experts received class credit. I placed subjects randomly into single-gender groups. I used college students to control for age, intelligence, and experience. I used single-gender groups to control for the effects of gender. Experts were chosen based on their knowledge of the moon learned in one or more astronomy courses. As a manipulation check, I tested the experts on their knowledge of the moon. I also used the initial individual quality score on the Lost on the Moon exercise as a

manipulation check. The information I used to make up the subject test is included in Appendix G. This information was derived from NASA's rationale for the correct ranking of the fifteen items. I used this information to develop the 20-item test given to experts. The test is shown in Appendix H. Five of the questions on the test tap knowledge essential for successfully completing the Lost on the Moon exercise. Five other questions are useful for completing the exercise. The remaining ten questions were asked so the test wouldn't prompt responses on the exercise. To control for referent power, groups were set up so friends weren't in the same group. I accomplished this by assigning adjacent names on the sign-up sheet to different groups. Since friends generally sign-up together, this minimized the risk of putting friends in the same group. As a manipulation check, I measured the use of referent power in the groups. (See "Instruments" (below) for a description of how referent power was measured.)

Instruments

I used a 68-item questionnaire to measure consensus (six-item scale), perceptions of opportunity to express views (eight-item scale), perceptions of decision quality (four-item scale), use of expert power (three-item scale, repeated for each group member), use of referent power (three-item scale, repeated for each group member), and perceptions of leadership emergence (four-item scale, repeated for each group member). The consensus, perceptions of opportunity to express views, and perceptions of decision quality questions were generated by several employees of Management Systems Laboratories (MSL), including myself. These questions will be asked in other consensus research done by MSL. Some of these questions were based on questionnaires found in the literature (Bouchard, 1969; Hoffman, 1959;

Knutson & Holdridge, 1975; and Mahler, 1987). I used an earlier version of this questionnaire in my pilot study. (See Appendix I). The use of expert power, and referent power sections of the questionnaire are a subset of a 20-item questionnaire developed by Hinkin & Schriesheim (Hinkin, 1989). Their questionnaire measures French & Raven's (1959) five types of power and was designed to be given to subordinates to rate their superiors. I modified the questionnaire slightly to make the questions applicable to leaderless consensus groups. I measured leadership emergence with a subset of a five-item scale from Lord, Foti, and De Vader (1984). Because the expert power, referent power, and leadership emergence scales are ratings of group members by other group members, they were filled out by each subject for each member of his or her group. Subjects didn't rate themselves. Several open-ended questions were included at the end of the questionnaire to support MSL's research. The responses to these answers weren't analyzed for this thesis. Appendix C is a copy of the questionnaire. The stimulus material (Lost on the Moon, described in the next section) also served as an instrument to measure consensus. Because the stimulus material is a ranking exercise, I can generate two statistical measures of consensus. One measure is the sum of the absolute value of the differences between the group members' second (post-discussion) ranking and the group's ranking. The other measure is Kendall's coefficient of concordance computed for the five group members' second rankings. These measures will be discussed in greater detail in the Data Analysis section.

Procedure

Stimulus Material. I used the Lost on the Moon survival exercise as my stimulus material. Survival exercises have subjects assume they are stranded in a particular

area, in this case, the moon. They are asked to individually rank order fifteen items according to their importance for survival. After the first individual ranking step, groups are instructed to reach consensus on the ranking of the fifteen items. Appendix E shows the Lost on the Moon exercise as it was given to the subjects. NASA experts have determined the "correct" answer to this exercise. I chose the Lost on the Moon exercise as the stimulus material because it has both consensus and decision quality components.

Task Instructions. The task instructions, read to subjects, are from Hall's (1971) rules for gaining consensus (Appendix D). In essence, Hall defines consensus as discussing a problem among group members and trying to reach a group decision. Groups were instructed not to vote to resolve conflict, nor to average their individual solutions to reach a group solution, because voting and averaging would defeat the purpose of the exercise. Groups had considerable leeway in running the process.

Specific Procedure. The specific procedure used to conduct this research is described below. Figure 9 outlines the specific procedure in flow chart form. This procedure is outlined in greater detail in three appendices. Appendix J is the procedure and script to test and instruct the experts. Appendix K is the procedure and script I used to administer the first individual ranking. Appendix L is the procedure and script given to the proctors who led the groups through the group ranking, second individual ranking, questionnaire, and debriefing.

1. Experts arrived, signed a consent form, took the pretest, and received instructions from the experimenter.

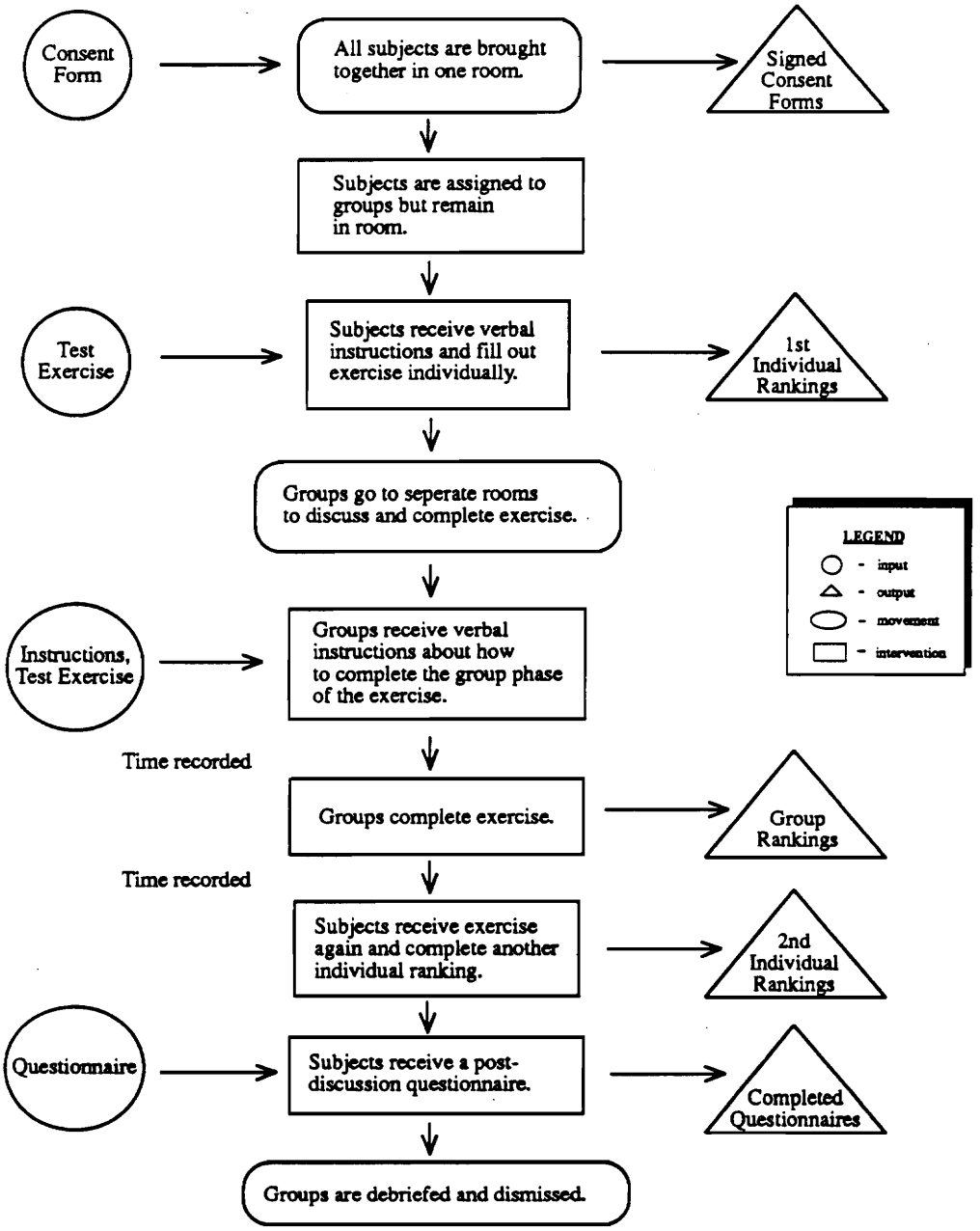


Figure 9: Specific Procedure Flow Chart

2. All subjects arrived one hour later, signed a consent form, and completed the Lost on the Moon first individual ranking step. Subjects were prevented from discussing the task or solutions prior to the group discussion. Subjects were placed into groups prior to the session. All subjects were given a confidential number. This number was placed on all tests, exercises and instruments. This number told them what group they were in. Subjects who had been assigned to a group but didn't show up for the experiment were replaced with subjects from a surplus subjects pool.

3. Each group was sent to its own room with a proctor.

4. Before completing the exercise as a group, group members introduced themselves by giving their name, major, and any classes they had taken they believed would help them solve the problem. This was intended to indicate to other members who had the expert knowledge without signaling out that person as a leader.

5. The proctors collected the individual ranks, explained the task to the group, and read the task instructions for the group ranking step. (See "Task Instructions" above.)

6. Groups interacted to come up with a group ranking. Each group member had a ranking sheet to record the group ranking. The group rankings were collected.

7. Individuals completed the second individual ranking.

8. Individuals filled out the questionnaire.

9. The proctors debriefed subjects. (See next section.)

Debriefing Session. During the debriefing session, the proctors gave the subjects:

1. the true purpose of the experiment,
2. the NASA solution to the exercise, and
3. instructions not to discuss the exercise with anyone.

Data Analysis

To analyze my data, I used descriptive statistics, correlations, and t-tests. Figure 10 is a flow chart describing the process I used to analyze my data. Tests of Hypotheses are noted in parentheses. The chart also describes manipulation and assumption checks.

Computation of Statistics. I calculated decision quality scores by summing the absolute difference between the group's (or individual's) ranking of each item and NASA's ranking. Hall (1971) used this measure to determine decision quality. I used the individual quality score to check if either condition (expert or non-expert) had an advantage from better individual quality scores. I used the group quality scores to see if the presence of an expert increased decision quality. I used three different measures of consensus in this study. The first measure (the difference measure) is similar to my measure for decision quality. I calculated this measure by summing the absolute differences between the individual's second ranking of each item and the group's ranking. Tjosvold and Field (1983) used this statistic to

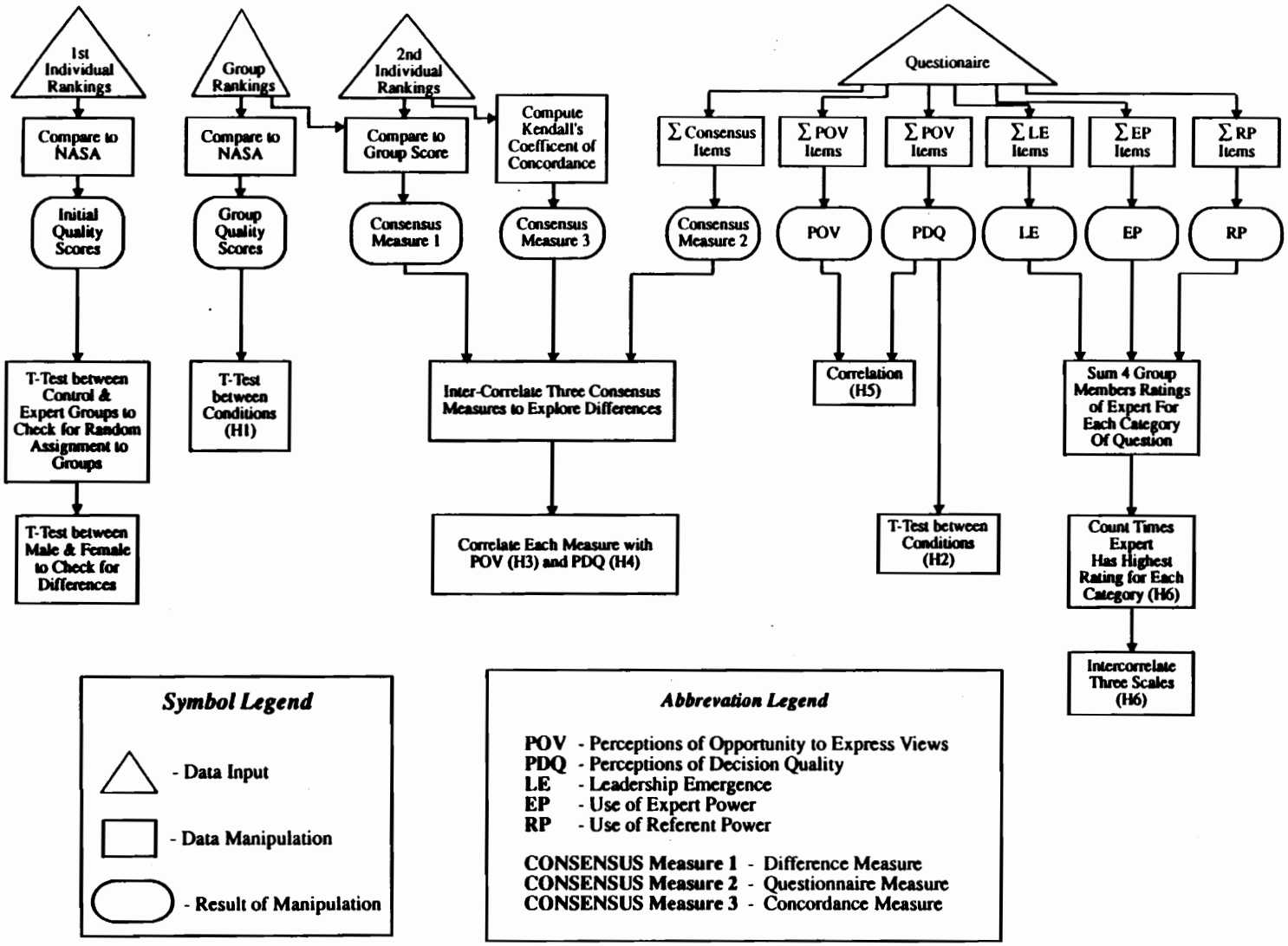


Figure 10: Data Analysis Flow Chart

measure individual commitment with a group decision. Since commitment is one aspect of consensus as I've defined it, this measure should be a reasonable measure of consensus. The second measure (the questionnaire measure) is a questionnaire addressing acceptance of, agreement with, and commitment to the group's decision. The third measure of consensus (the concordance measure) is Kendall's coefficient of concordance computed for the five second (post-discussion) rankings for each group. This statistic indicates the degree of association between rankings. Appendix M gives a more-detailed description of Kendall's coefficient of concordance.

Hypotheses Testing. To test my hypotheses, I used a group level of analysis. While this reduces the statistical power of my tests, I believe it gives a more accurate description of what happens in consensus groups. I'm interested in *group* consensus and decision quality, not *individual* consensus and decision quality. I also ran my analysis using the individual level of analysis to explore my data. I tested H1 with a t-test on the groups' quality scores. My sample size was the number of groups ($n = 21$). I tested H2 with a t-test on perceptions of decision quality (summed over all five group members). I tested H3 by computing Pearson's product-moment correlation coefficient (r) for perceptions of opportunity to express views and the three measures of strength of consensus. I tested H4 by computing Pearson's product-moment correlation coefficient for perceptions of decision quality and the three measures of strength of consensus. To test H5, I computed Pearson's product-moment correlation coefficient for perceptions of opportunity to express views and perceptions of decision quality. To test H6, I determined the number of groups where the expert received the highest leadership ratings. I also computed Pearson's product-moment correlations between the three ratings scales (use of expert power,

use of referent power, and leadership emergence) to test this hypothesis. A significant correlation between use of expert power and leadership emergence (with non-significant correlations for the other combinations) adds support for H6.

RESULTS

This chapter summarizes the results of my data analysis. I've included three sections. The first section shows the results of a reliability analysis on the six scales of my questionnaire. The second section shows the results of several manipulation and assumption checks. The final section shows the results of my hypotheses testing. Because I ran so many tests to check my manipulations, controls and assumptions and test my hypotheses, I've included interpretations and conclusions related to specific tests in this chapter. Broader conclusions are drawn in the "Conclusions" chapter.

RELIABILITY ANALYSIS

I assessed the reliability of the six scales I used on my questionnaire. I used the individual level of analysis to assess reliability because individuals responded to the questionnaire. The sample size for this analysis varied, depending on the scale. For the first three scales, perceptions of opportunity to express views (eight items), perceptions of decision quality (four items), and consensus (six items), the sample size was 110. For the last three scales (use of expert power, use of referent power, and leadership emergence), the sample size was 55. I only used expert groups to analyze these three scales because I only used the expert groups to test the hypothesis associated with these last three scales. I ran the analysis on these last three scales for each group member number. This is because the same question would be answered differently for different group members in the same group. For example, the ratings of the expert (group member number 1 in all groups) were

analyzed together. Therefore, I had five separate scales for each category (expert, referent, and leadership). I used Cronbach's alpha to assess internal consistency for each scale. Alphas above .70 are considered acceptable. This analysis also gives the alpha that would result if each item was deleted one at a time. This gives an indication of any questions that might not be consistent with the scale. All scales had acceptable reliability, (all but one alpha were over .75). In no case did deleting a question from a scale significantly increase the reliability of the scale so I kept all questions in my analysis. The consensus scale had the lowest reliability (alpha = .68) for any of the scales. This is probably due to the fact that the scale measures several components of consensus: acceptance, agreement, and commitment for the individual and the individual's perceptions of the group. Analyzing the reliability of sub-sets of the consensus scale might help explain the relatively low alpha level. For example, separating the scale into two sets of three measuring individual consensus and the individual's perceptions of others' consensus, might increase reliability. The alphas for each scale are presented in Appendix N.

MANIPULATION, CONTROL, AND ASSUMPTION CHECKS

I ran several analyses to check whether or not the study went as I expected. In this section, I discuss the purpose of each manipulation or control and the reason for each assumption. I then discuss the analysis I used to check the success of the manipulation, control, or assumption, the results of the analysis, and the implications for my study. Appendix O gives a summary of the descriptive statistics computed on the major variables of my study.

Manipulation

Each Experimental Group Should Have One Expert. I attempted to put one, and only one, expert in each experimental group. The purpose of this manipulation was to set up groups with experts and compare them to groups without experts on decision quality and consensus. To check this manipulation, I gave experts a test covering astronomy and general physics. (See subject test in Appendix H.) I also used the experts' scores on the first individual ranking on the Lost on the Moon exercise as a check. The test measured subject expertise; the first individual ranking measured task expertise. (See "Categorizing Experts" in the "Review of the Literature" chapter for a discussion of subject and task expertise.) I wanted experts to have both subject and task expertise. Five questions tested knowledge essential for successfully completing the Lost on the Moon exercise. Missing any one of these could hurt a subject's or group's quality score on the exercise. The experts should get all five of these questions correct. The experts should also have the best quality score in their group on the first individual ranking of the exercise. The manipulation was unsuccessful. Only seven of eleven experts correctly answered the five most important questions on the test. Of the seven, only three had the best first individual quality score on the exercise in their group. This manipulation failure is most likely responsible for my failure to support Hypothesis 1 (discussed in the "Hypotheses Testing" section below).

Controls

Group Members Would Recognize the Expert's Expertise. Before the group discussion, group members introduced themselves and gave their major and any classes they took that they believed might help them do well on the exercise. This was intended

to let other group members know one member of their group had some knowledge of the moon without labeling that person an expert. To check this control, I looked at the use of expert power scale. All subjects rated all other subjects on their use of expert power. Perceptions that a group member used expert power implied other group members believed that member had expertise. This control was successful. Nine of eleven experts received the highest rating on use of expert power. Even though many experts had low expertise, most were perceived as experts by their group members. This indicates that false experts can be dangerous if they have bad information but influence the group.

Group Members Should be Strangers. I placed subjects in groups so the groups would be made up of strangers. The purpose of this control was to ensure referent power wasn't a cause of leadership emergence. Subjects were assigned to groups so subjects who signed up together were put in different groups. Otherwise, assignment to groups was random. The assumption was that subjects who signed up together were friends. Since experts came from a separate pool, they most likely wouldn't know any of the other group members. To check this control, I had subjects rate the other group members on the use of referent power. I then checked the number of times the person rated highest on referent power was also rated highest on leadership emergence. The control was successful. In only two cases was the subject rated highest on leadership emergence also rated highest on referent power. In both cases, this person was the expert and was also rated highest on use of expert power. This means referent power was successfully controlled and wasn't an issue for my study.

Subjects Should Be Placed in Conditions Randomly. To ensure groups in both conditions had equal talent to begin with, I assigned non-expert subjects to conditions randomly. This control was designed to ensure expert groups didn't score better simply because they had better talent. To check this control, I ran a t-test by condition on the quality score for the first individual ranking. Appendix P shows the results of the t-tests run by condition. I ran this test on a group level (n = 21) by summing first individual quality scores for each group. The control was partially successful. When analyzed by groups, there was a significant difference between expert groups (M = 207.8) and non-expert groups (M = 227.5), $t(18.6) = 2.13$, $p < .05$. This difference wasn't due to the presence of experts since in many groups, the experts didn't have the best score. However, when analyzed by gender, the differences disappeared. If Hypothesis 1 had been supported (See "Hypotheses Testing."), this control check would make that finding suspect. As it is, this check makes it more surprising that expert groups didn't score better than control groups.

Assumptions

There Would Be No Differences Between Male Groups and Female Groups. I used single-gender groups to control for leadership emergence due to gender. If there were differences between genders, I needed to analyze the two genders separately. I performed t-tests by gender to explore for differences on several group-level variables (first individual score, group score, perceptions of opportunity to express views, perceptions of decision quality, and consensus). Appendix Q summarizes the t-tests I ran by gender. This assumption was incorrect. There were significant differences between genders for first individual quality score (M = 205.9 for males, 234.4 for females, $t(12.6) = 3.25, p < .01$) and the questionnaire measure of

consensus (M = 170.7 for males, 178.9 for females, $t(16.9) = 2.54, p < .05$). There were marginally significant differences between genders for group quality score (M = 24.8 for males, 30.9 for females;, $t(11.4) = 1.88, p = .09$; the difference measure of consensus (M = 64.3 for males, 50.7 for females, $t(18.8) = -1.95, p = .07$; and the concordance measure of consensus (M = .89 for males, .93 for females), $t(18.3) = 1.97, p = .06$. Because of these results, I analyzed some of the data by gender to see if my hypotheses were supported using males or females only. These gender-specific tests had lower statistical power than the non-gender-specific tests.

The Three Measures of Consensus Address the Same Construct. I used three measures of consensus. The first consensus measure was the sum of the absolute differences between the individual's second ranking and the group's ranking (the difference measure). The individual consensus measures were summed over the group to get a group consensus score. The second consensus measure was a six-item questionnaire measure (the questionnaire measure). The individuals' responses to these six questions were summed over the group to get a group consensus score. The third consensus measure was Kendall's coefficient of concordance measuring the closeness of the five group members' second individual rankings (the concordance measure). I used three different measures of consensus because multiple measures of a single variable increase the validity of findings. Also, using three measures let me explore the differences among the measures. I ran Pearson product-moment correlations between the three pairs of the three consensus measures. Appendix R is a correlation table for the major variables in my study, including the three measures of consensus. I used group measures summed from individual measures. There was no evidence to believe the assumption was incorrect. The difference measure was

significantly correlated with the questionnaire measure ($r = .56, p < .01$). The difference measure was also significantly correlated with the concordance measure ($r = .83, p < .001$). Finally, the questionnaire measure was marginally correlated with the concordance measure ($r = .43, p = .05$). These correlations indicate there's more than one way to measure strength of consensus. However, there's not complete overlap. Also, two of these measures depend on having a ranking task.

There Would Be No Difference between Conditions for Perceptions of Opportunity to Express Views. I believed there would be no difference between conditions on perceptions of opportunity to express views because both groups followed the same group decision-making guidelines. Also, I didn't believe any of my experts would dominate the discussion so much as to affect other group members' opportunity to express their views. To check this assumption I performed a t-test on perceptions of opportunity to express views by condition. There was no evidence to believe the assumption was incorrect. Expert groups had no significant difference in perceptions of opportunity to express views ($M = 237.0$) than non-expert groups ($M = 238.8$), $t(14.4) = 0.63, p > .05$. There were no significant differences when analyzed at the individual level or when the genders were analyzed separately.

Time to Decision Would Not be a Factor in this Study.

I allotted groups 45 minutes to complete the exercise. However, groups were free to finish early. I assumed expert groups and non-expert groups would not differ in their time to decision. To check this assumption, I ran a t-test between expert and non-expert groups on time to decision. There was no significant difference between expert groups ($M = 17.6$) and non-expert groups ($M = 17.7$) on time to decision,

$t(18.6) = 0.022, p = .98$). Variations in time to decision could affect several of my variables, most importantly, group decision quality. To see if time to decision affected any of my variables, I ran Pearson product-moment correlations between time to decision and the major variables in my study. Time to decision was significantly correlated with group quality score ($r = .60, p < .01$), and perceptions of opportunity to express views ($r = .49, p < .05$). These are not surprising results. The more time groups spend on their decisions the more chance they have to consider all relevant information, increasing decision quality. Also, spending more time solving the problem gives group members more opportunity to express their views. Since there was no significant difference between groups on time to decision, these significant correlations are not a problem for my research. Time was not significantly correlated with any of the measures of consensus. For the difference measure, ($r = .04, p > .05$). for the questionnaire measure, ($r = -.19, p > .05$). For the concordance measure, ($r = -.09, p > .05$). Time to decision was not significantly correlated with perceptions of decision quality ($r = -.01, p > .05$).

HYPOTHESES TESTING

This section describes the results of my hypotheses testing. For each hypothesis, I repeat the hypothesis and the associated statistical test. I then describe the results of the test and briefly discuss the results. I threw out one expert group because the expert missed four of the five most important questions on the test and had a poor individual quality score on the first individual ranking. My sample size for the tests was 21 (ten expert groups and eleven control groups) because I used group measures. Appendix O gives the descriptive statistics for the major variables of my

study. The results for H1 and H2 constitute output number 2, expressions of the relationships between characteristics of experts (in this case, the presence of an expert) on strength of consensus and decision quality. In the case of strength of consensus, the expression relates the presence of an expert to perceptions of decision quality. To express the relationship between the presence of an expert and strength of consensus, I'd have to combine H2 results with H4. The results for H3, H4, and H5 constitute output 4b, expressions of the relationships between characteristics of the small-group consensus process (in this case, perceptions of opportunity to express views and perceptions of decision quality) and strength of consensus.

Hypothesis 1: Groups with a member who is an expert will have better decision quality scores on the Lost on the Moon exercise than groups without experts.

To test this hypothesis, I performed a t-test by condition on group quality score. (See Appendix P.) The hypothesis wasn't supported. There was no significant difference between expert groups ($M = 26.3$) and non-expert groups ($M = 28.5$) on group quality score, $t(16.3) = 0.66, p = .52$. Because of possible gender differences, I ran the test using only males and only females. Both were also non-significant. The most probable cause for the failure to support this hypothesis was the failure of my expert manipulation. Only three of my eleven experts had perfect scores on the five most important test questions and had the best scores in their group. Another problem was low power.

Hypothesis 2: Members of groups with an expert will have higher perceptions of decision quality than members of groups with no expert.

To test this hypothesis, I performed a t-test by condition on perceptions of decision quality. (See Appendix P.) The hypothesis wasn't supported. There

was no significant difference between expert groups (M = 118.6) and non-expert groups (M = 119.2) on perceptions of decision quality, $t(17.6) = .23, p > .05$. I also ran tests using only males and only females. Both were non-significant. The most likely explanation for this result is the control groups didn't know they didn't have an expert in their group. In other words, members of control groups had no reference point to make them think their decision quality was any worse than any other group made up of psychology students. Also, since the experts weren't very expert, the expert group members may have realized their decision quality wasn't perfect. Another possible reason for the failure to support this hypothesis is that most groups had better decision quality scores than their best individual. Therefore, most subjects recognized the group decision was an improvement over their individual decision. Because there was an improvement, they tended to rate the group's decision quality high.

Hypothesis 3: The higher group members' perceptions of opportunity to express their views, the stronger the consensus.

To test this hypothesis, I computed a Pearson product-moment correlation between the perceptions of opportunity to express views scale and the three measures of consensus. (See Appendix R.) There was little support for this hypothesis. For the difference measure of consensus, the correlation was non-significant ($r = .27, p > .05$). For the questionnaire measure of consensus, the correlation was marginally significant ($r = .39, p = .08$). For the concordance measure of consensus, the correlation was non-significant ($r = .26, p > .05$). It's surprising this hypothesis wasn't better supported since the next two related hypotheses were supported. (See below.) One possible explanation is that the

data had low a variance and was skewed towards the high end of the scale. In other words, most subjects felt they had an opportunity to express their views. Another explanation is that student subjects had little stake in the problem. Therefore, they weren't concerned if they didn't express their views completely. As long as they believed the group came up with a good decision, they agreed with it. Also, the experimenter stressed that there was a correct answer to the solution. This may have made decision quality more salient than the opportunity to express views. As a population, college students may also be more concerned with decision quality.

Hypothesis 4: The higher the group members' perceptions of decision quality, the stronger the consensus.

To test this hypothesis, I computed a Pearson product-moment correlation between the perceptions of decision quality scale and the three measures of consensus. (See Appendix R.) The hypothesis was supported. For the difference measure of consensus, the correlation was significant ($r = .56$, $p < .01$). For the questionnaire measure of consensus, the correlation was significant ($r = .79, p < .001$). Finally, for the concordance measure of consensus, the correlation was marginally significant ($r = .43, p = .06$). Subjects seemed to be more concerned with their perceived decision quality than with how much they got to express their views. If this finding generalizes to real-world groups, it may mean it's more important to convince group members of the correctness of the decision than to make sure all group members can speak their mind. In groups solving problems without a correct decision, perceptions of opportunity to express views may be more important to consensus. One possible

reason for the high correlation between the questionnaire measure of consensus and perceptions of decision quality is that both variables were measured with the same questionnaire at the same time. Also, the questions for both variables were similar.

Hypothesis 5: The higher the group members' perceptions of the opportunity to express their views, the higher their perceptions of decision quality.

To test this hypothesis, I computed a Pearson product-moment correlation between perceptions of opportunity to express views and perceptions of decision quality. This hypothesis was supported. Perceptions of opportunity to express views and perceptions of decision quality were significantly correlated ($r = .52$, $p < .05$). I interpret this result to mean if subjects agree with the group's decision, they'll believe their views were considered even if they themselves didn't state them. On the other hand, if subjects believe their views were considered when making the decision, they'll believe the decision is high quality. If people believe their views are low in quality, they probably wouldn't express them to the group.

Hypothesis 6: Experts will be perceived as being leaders.

To test this hypothesis, I took a descriptive look at how many experts received the highest ratings from other group members on the leadership emergence scale. I also ran Pearson product-moment correlations between the three rating scales (use of expert power, use of referent power, and leadership emergence) for the expert groups. This hypotheses was partially supported. Of the nine experts who received the highest rating on use of expert power, five received the

highest rating on leadership emergence. Two other experts received the second highest rating. When run only for the experts, the expert power scale and the leadership emergence scale were significantly correlated ($r = .91, p < .001$). No other combination of variables was significantly correlated. Appendix S shows the correlation table for these three variables. The results of this analysis weren't as clean as I expected. Every combination of ratings for experts (on the expert power, referent power, and leadership emergence scales) existed. There were also false experts. For example, the expert I threw out because she scored poorly on the test and had the worst quality score on the exercise had the highest ratings on all three scales. One expert did well on both expert criteria yet was rated low on all three scales. This indicates that researchers need to control or measure the group process better to fully understand the link between expertise and leadership emergence.

DISCUSSION

This chapter takes the results discussed in the previous section and extends them in two directions. The first extension takes the results of this study, the review of the literature, and my own thought, and gives managers recommendations for dealing with experts in their consensus groups. Because my results were limited in what they could tell me about experts, some of the advice I give for dealing with experts is based on the literature and my own thought. The second extension looks at the research itself and gives researchers suggestions for related areas to explore.

RECOMMENDATIONS FOR MANAGING A GROUP WITH AN EXPERT

This section gives managers, convenors, and facilitators (referred to as managers) guidelines for running meetings involving an expert. These guidelines are based on the results of this study, results and theory from the literature, and my own thought. I've outlined steps managers can take before, during, and after the meeting to ensure the expert gives the group valuable information without undermining consensus.

Before the Meeting

Match the Expert to the Situation. The manager should make sure he or she has the right expert for the job. Expert authority is a triadic relationship between a person with a special competence, a person with a need that he or she can't meet individually, and a field of authority (Benne, 1944). In my study, the expert was the person with a special competence, the other group members were persons with a need, and the moon was the field of authority. The subject of the expertise is equal

in importance to the expert and the person who needs the expertise. "There is little evidence that a person highly skilled in one domain can transfer the skill to another" (Glaser & Chi, 1988, p. xvii). In the literature review section, I described four types of experts. These types were based on two criteria. The first criterion was whether the expert had task expertise or subject expertise. The second criterion was whether the expertise was global or specific. If a manager is choosing an expert for a decision-making group, he or she should choose an expert whose type matches the group's task. For example, a specific-subject expert may not be useful to a group performing a task only slightly associated with the expert's subject. In my study, I had several specific-subject experts (as judged by their score on the subject test) who scored poorly on the Lost on the Moon exercise. Their poor performance occurred because the exercise requires knowledge of other subjects (such as human survival priorities) to score well. For this exercise, a task expert would be more valuable. For example, someone who has done the Lost at Sea or Lost in the Wilderness survival exercise may have learned some of the tricks associated with these exercises. Therefore, this person may be a better expert than a subject-specific expert. Also, someone with expertise in leading small decision-making groups may be more useful than a subject-specific expert. If possible, the manager should fill the group with different types of experts. If the expert is already a member of the group, the manager should try to assess what type of expert the expert is and see how well it matches the task. The manager should then discuss with the expert and the group members the fit between the expert and the task. By understanding the fit, group members will rely on the expert's knowledge and opinions only when appropriate.

Decide if Decision Quality Is Important. If the decision is such that the need for consensus far outweighs the need for quality, the manager shouldn't bother putting an expert in the group. The expert may be seen as an outsider by the stakeholders, decreasing consensus if group members don't agree with the expert's advice. For problems where consensus is all-important, the manager should focus on making sure all people who have a stake in the decision are included in the decision-making process. If one of the stakeholders is an expert, the manager should take steps to ensure the expert doesn't dominate the group.

Decide if the Group Needs a Leader. In a leaderless group, someone is likely to emerge as a leader. In a group with an expert, the expert may emerge as a leader. If the manager wants to avoid this, he or she should appoint a leader or keep the expert in an advisory role.

Beware of False Experts. While this seems like obvious advice, the world is full of people who have been taken advantage of by false experts. Especially in a group of strangers, it's easy for a false expert to fool people. In my study, the worst expert (as judged by the subject test and the first individual quality score on the exercise), was rated the highest on use of expert power and leadership emergence. Not surprisingly, this expert's group decision was low in quality. Managers often rely on the symbols of expertise to select an expert. However, accepting the symbol is no guarantee of the expertness of the expert (Benne, 1944). One of my experts wore a NASA hat. The group members may have seen this hat as a symbol of expertise even if the expert didn't really know what he was talking about. Managers should seek true evidence of the expert's qualifications. The best evidence is past performance.

Counsel the Expert Before the Meeting. Before the meeting, the manager should talk to the expert and explain the situation. The following sections outline areas the manager should discuss with the expert.

1. *Explain the Expert's Role.* The manager should explain that the expert has been chosen to participate because of his or her expertise. Is the expert a full member of the group or simply an advisor? Should the expert show his or her bias or simply give the group information? Should the expert take charge of the group? Understanding his or her role will help the expert avoid role ambiguity.

2. *Explain Why a Group is Making the Decision.* Is the group making the decision because no one person knows the best answer or because the manager needs buy-in on the expert decision? In the first case, the manager should instruct the expert to present his or her expert knowledge and opinions but be open to others' suggestions. In the second case, the expert should focus on giving the group convincing arguments, and using his or her power to get the group to accept his or her expert decision. However, the expert must be careful not to dominate. (See the next section, "Tell the Expert not to Dominate.") Most real-world problems solved by groups are of the first case. In my study, only one group decision was worse than the decision made by the expert individually. In other words, forcing the expert's decision on the group would have lowered decision quality.

3. *Tell the Expert not to Dominate.* Explain that you don't want the expert to dominate the discussion or the decision. In their written comments, some of my subjects complained that the expert forced the group to accept his or her views.

Even if the expert could make the best decision, other members may not accept it if they don't have a chance to express their views. I found partial support for the relationship between opportunity to express views and consensus. Opportunity to express views will be especially important if group members have a high stake in the decision. When people have high stake, the best group decision may not be the best decision for the individuals. In this situation, group members may be less interested in the expert-influenced best decision than in a decision that incorporates their views.

4. *Instruct the Expert to Communicate Clearly and Concisely.* A common problem with experts is that they use jargon associated with their field. Extensive use of jargon may cause one of two undesirable outcomes. First, group members may refuse to accept the expert's advice because they don't understand it. Second, group members may simply go along with whatever the expert says because they don't want to admit they don't understand what the expert is saying. The first case results in consensus with low decision quality because the other group members haven't contributed to the decision. The second case results in a false consensus, group members openly agree, but they secretly disagree because they don't really understand the information the decision was based on. Even if experts don't use jargon, they may not communicate concisely. A few of my subjects commented that the expert's explanations were too detailed. Not communicating concisely wastes the group's time and may irritate group members to the point where they ignore expert information.

5. *Tell the Expert not to Ignore Maintenance Functions.* Very few of my experts received high ratings on their use of referent power. One explanation for this is that

it takes time to establish referent power. However, other group members received high ratings on referent power. Another explanation is that the experts may have focused on task functions. Most leadership theories recognize that leaders must pay attention to maintenance (or socioemotional) functions as well as task functions (Blake & Mouton, 1964; Bowers & Seashore, 1966; Hersey & Blanchard, 1977; House, 1971; Kerr, Schriesheim, Murphy, & Stogdill, 1974; Likert, 1967, Yukl, 1989). Because experts often emerge as leaders, they could be looked to by group members to perform maintenance functions. However, the expert is likely to focus on task functions because they know that's where they can contribute most. If the expert ignores the maintenance functions, the group members might come to resent the expert's focus on the task, affecting consensus adversely.

Counsel Group Members. Before the meeting, the manager should also talk to the group members and explain the situation. The following sections outline points the manager should make to the group members.

1. *Identify the Expert to the Group.* The manager should identify the expert to the group. Group members must recognize the expert's expertise. "Until recognition is available on the part of those with a potential need for his expertness, the authority relation remains incomplete--potential rather than actual" (Benne, 1944, p. 44). The manager should also point out the range of the expert's expertise. This will discourage the group from relying on advice from the expert on areas outside his or her expertise.

2. *Give the Group Members Some of the Same Explanation Given to the Expert.* The manager should explain the expert's role just as in "Explain the Expert's Role," above. If the group has been brought together because no one individual can make the best decision, the group should be told so. This will encourage all group members to participate. Some managers bring a group together merely to get buy-in on an expert decision. This is dangerous because group members naturally expect to have a say in their group's decision. If a manager uses a group this way, the group members may be discouraged from participating in groups where the manager truly wants group member input. A way to avoid the problem of getting group buy-in for an expert decision is to have the expert make the decision and give a presentation to convince stakeholders of the correctness of the decision. In addition to explaining the role of the expert, the manager should tell group members to let everyone participate and to communicate clearly and concisely. The manager should also remind group members of the importance of both task and maintenance functions.

3. *Instruct Group Members to Examine Assumptions.* This is good advice for any decision-making group. However, in a group with an expert, group members are more likely to accept the expert's knowledge or opinions as valid because it saves time and people don't like to question experts' authority. The manager should remind group members that nothing is true simply because an expert says it's true. "The truth or falsity of [the expert's] knowledge can only be decided by reference to the facts.... The authority of the expert is never the ground for the truth of what is believed on that authority" (Benne, 1944, p. 40). Failure to examine underlying assumptions is one cause of groupthink (Janis, 1972). Questioning underlying assumptions should also help expose a false expert. Suppose the expert in one of my

groups told the other group members they needed the compass because they needed a navigation tool for the trip to the mother ship. This advice is based on the assumption that a compass will work on the moon. If the group members examined this assumption, they would try to determine if the compass would work by looking at how compasses work. If someone in the group knew a compass depends on a magnetic field, they would then try to find out if the moon has a magnetic field. If no one in the group knew, they would be stuck. However, in real-world groups, the group can go outside the group to find out the information they need to check assumptions. Techniques such as devil's advocacy or dialectical inquiry help force groups to examine their underlying assumptions by purposefully attacking an idea or looking at both sides of an issue. A false expert shouldn't be thrown out of the group because such an action may discourage other group members from expressing their views. In most cases, a false expert isn't purposefully trying to mislead the group and should still have valuable input to give.

During the Meeting

Ensure the Group Process Gives Group Members a Chance to Express their Views. The manager can take active steps during the meeting to ensure all group members get a chance to express their views. For example, the manager (or facilitator) can ask each group member specifically for their opinion on each sub-topic. The manager should also discourage people from dominating the discussion. Reminding all group members to communicate concisely will increase the amount of time people have to speak. A technique for encouraging concise communication is to have each group member write down what they want to say before they say it. One drawback of this technique is that group members who are writing aren't listening to other group

members. Another way to increase participation is to ask the expert to withhold his or her opinion until everyone else has had a chance to express theirs. Janis (1972) reported that during the Cuban Missile Crisis, President Kennedy withheld his opinion so his advisors would have to come up with a recommendation on their own rather than simply supporting his. The manager should also stress the importance of group members having the opportunity to express views to achieving consensus. In my study, perceptions of opportunity to express views were somewhat important for consensus. Explaining this relationship to a consensus-seeking group should encourage group members to ensure each member gets to express his or her views.

Control the Expert's Dominance. Because the expert is likely to be concerned with decision quality and is aware of his or her expertise, the expert will be tempted to dominate the group process and decision. The manager should control the expert by asking him or her to keep his or her comments brief and by forcing the expert to back up his or her opinions with factual information. The manager can also control the expert by encouraging participation from other group members.

After the Meeting

Measure Perceptions. To make sure the expert didn't adversely affect the group process or its outcomes, the manager can measure group members' perceptions. This can be accomplished through informal interviews, structured interviews, or questionnaires. The variables measured in my study (perceptions of opportunity to express views, perceptions of decision quality, strength of consensus, and use of expert power) are possible perceptions to measure after a meeting. The instruments used in this study showed good reliability. More study is needed to test the validity of

these instruments. However, they appear to be useful instruments. One drawback of the instrument to measure the use of expert power is that it was originally designed to measure subordinates' perceptions of their superior's use of power.

Evaluate the Group Process and Decision. The manager should evaluate the group's process and resulting decision immediately after the meeting and after the decision has been implemented. Was the group process functional? Did the group reach consensus? If possible, an outside expert can evaluate the decision for quality. Did the group make a good decision? What happened in the group process to cause the decision to be good or bad? After the decision is implemented, the manager can see if the group process and resulting decision were successful and make changes to the group process the next time a group makes a decision.

FUTURE RESEARCH

This section describes future research efforts that would build and expand upon this research. I came up with the ideas for future efforts several ways. First, some efforts consist of testing ideas I failed to adequately test. Second, some efforts consist of ideas I wanted to explore but couldn't due to the limitations of a masters-level research project. Third, some efforts consist of further exploring the findings of this study. I've grouped these recommendations for future research under two broad categories: 1) Continuing the Study of Experts, and 2) Generalizing the Findings of this Study to Other Scenarios.

Continuing the Study of Experts

Test the Effects of Experts on the Small-Group Consensus Process. Because the expert manipulation failed, the central hypothesis of this study, that experts increase decision quality, remains untested. Therefore, the first recommendation for future research is that this hypothesis be better tested. To do this, I recommend giving expert candidates a more thorough screening. This screening should be used to determine the expert's type and qualifications. The researcher should screen experts beforehand and only use experts who meet pre-set criteria. To further ensure the expert manipulation is successful, the researcher should test non-experts against the same criteria. Then subjects who by chance have expertise can be removed or used as experts.

Test the Effects of Experts on the Small-Group Consensus Process Using Different Tasks. Some of the experts who scored well on the subject test scored poorly on the Lost on the Moon exercise. This is partly because they made some bad assumptions about some of the items. On a different exercise, the experts may not have had these problems and would have been more useful to the group. On the other hand, if the exercise had been even more ambiguous, the experts may not have been helpful to any group. To some extent, the Lost on the Moon exercise is an additive task (using Steiner's, 1972, task typology). This means most groups do better than the best individual. In all of the control groups and seven of the expert groups, this was the case. What effect would an expert have on a compensatory task where the group product is an average of the individual judgments? Most likely, the expert would improve the group's decision. By manipulating the task, the researcher can investigate the effects of different matches between type of expert and type of task.

Examine the Use of Expert Power. This study tested the effects of the *presence* of an expert on decision quality and consensus. However, my experts appear to have used the power associated with their expertise to varying degrees. What effect does a dominant expert have on a group compared to a non-dominant or passive expert? Do dominant experts affect group members' perceptions of their opportunity to express their views? The researcher can use a perceptual measure of use of expert power like the questionnaire used in this study, or a behavioral measure such as amount of time the expert spends talking compared to other group members. To ensure varying degrees of use of expert power, the researcher could use confederates as experts. Confederates can be instructed to dominate the group discussion or be passive.

Look at the Effects of an Expert on Other Dependent Variables. Experts also should affect other dependent variables associated with small-group decision making. What effect do experts have on the quantity and quality of information shared in the group by experts and non-experts? The information shared by experts may be of higher quality, but do non-experts share their information? Is group cohesion affected by experts? Do coalitions form against an expert? How is commitment to the group affected by an expert? I measured commitment to the decision as part of my measure of consensus. How does this commitment to the decision translate into commitment to the group? Do group members want to continue to work with a group containing an expert? Commitment to the group will likely be affected by how the expert treats other group members.

Study the Effects of False Experts on the Small-Group Consensus Process. Although this study failed to adequately test the effects of an expert on consensus, I believe experts can improve decision quality without hurting consensus. A false expert, if he or she isn't exposed as false, would most likely reduce decision quality, but also wouldn't hurt consensus. Further research should also look for ways to avoid the effects of a false expert.

Generalizing the Findings of this Study to Other Scenarios

Manipulate the Importance of Consensus and Decision Quality. In this study, subjects were instructed to seek consensus on a high-quality decision. Neither variable was given priority over the other. In the real world, one variable may be more important than the other. If consensus were given more weight, the expert may have less power. If decision quality were given more weight, the expert may have more power.

Focus More on the Group Process. In this study, I measured variables before and after, but not during group discussion. I tried to control the group discussion to some extent by having groups follow Hall's (1971) consensus guidelines. However, within these guidelines, group members had a lot of freedom to run the process as they saw fit. Measuring the group process through trained observers or videotape may have helped me determine why certain experts (real and false) helped (or failed to help) their group. Focusing on the group process also helps ensure nothing out of the ordinary goes on in the experimental groups. In my study, proctors watched the group process. However, they weren't trained to take specific observations on the group process. I had no formal mechanism for capturing the group process.

Use Real-World Groups. In my study, perceptions of decision quality were more important than perceptions of opportunity to express views. In the real world, groups consist of true stakeholders. True stakeholders are more likely to insist their views be heard. Also, decision quality to a stakeholder may not be the technically best solution, but the one most advantageous to the stakeholder

Perform the Same Study with Facilitation. Can trained facilitators eliminate any negative effects an expert may have on the group? Facilitators may be able to ensure all members have an opportunity to express their views. Facilitators may also be able to cause group members to examine all assumptions.

Explore the Differences Between Genders. In my study, there were significant differences between genders for several variables. Males had better first individual quality scores and group quality scores. On the other hand, females had stronger consensus when measured by absolute differences, questionnaire, and Kendall's *W*. Researchers should explore the reasons for these differences. Quality score differences may be a function of the task. More interesting are the gender differences associated with consensus. Females had stronger consensus than males. Is this difference because females are more concerned with group agreement than males? Is this difference real or perceived? Is the difference caused by differences in perceptions of opportunity to express views or perceptions of decision quality? My study doesn't support either of these last two explanations since t-tests were insignificant. The power of the tests I ran was too low to make definitive statements about gender differences.

CONCLUSIONS

This chapter begins by reflecting on the research hypotheses. I also draw broad conclusions based on my literature review and the results of my specific hypotheses. More-specific conclusions were discussed in the "Results" chapter.

CONCLUSIONS RELATED TO MY RESEARCH HYPOTHESES

My ability to address my research hypotheses is hindered by the failure of my expert manipulation. My first research hypothesis proposed the presence of an expert in a consensus group will only decrease the strength of consensus if that expert dominates the group process, preventing other members from having the opportunity to express their views. Demos (1926, p. 250) states that using an expert's advice "in no way impugns the dignity of the person who employs it." In other words, group members won't be offended if the expert's opinions play a large role in the decision. Therefore, consensus shouldn't be destroyed by group member reliance on expert advice. My experts didn't dominate their group processes. Most group members appeared to have the opportunity to express their views. This opportunity was marginally related to consensus. However, the group members' perceptions of decision quality was very important for consensus. It appears a key element for consensus is perceiving the decision to be high in quality. However, this relationship may not hold if group members can't speak their minds.

My second research hypothesis proposed the presence of an expert in a consensus group will increase decision quality unless that expert doesn't contribute information to the group process or dominates the group process. Again, I can't say if experts

increase decision quality because I didn't have true experts. However, based on this research, this hypothesis should be altered to say, ". . . unless that expert doesn't contribute information, *or contributes inaccurate information*, ..." In my study, some of my experts didn't have the information they needed to successfully solve the problem; therefore, their decision quality suffered.

BROAD CONCLUSIONS

In spite of my failure to test the effects of an expert on decision quality, I still believe experts can improve group decision quality. What my manipulation failure implies is managers must be sure they have real (not false) experts. Managers must also match the type of expert (knowledge versus task, and global versus specific) to their situation.

In spite of my failure to place true experts in my experimental groups, I believe experts won't affect consensus unless they affect other variables that lead to consensus. Managers who are worried an expert might decrease consensus should ensure the expert doesn't dominate the discussion, reducing other group members' opportunity to express their views. Also, managers should ensure experts use logical arguments based on fact, rather than simply appealing to their status as expert to persuade group members of the correctness of their advice. By relying on logical arguments, group members should have high perceptions of decision quality, thus increasing consensus.

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APPENDICES

APPENDIX A: DEFINITION OF TERMS

Convenor. A person who brings a group together for a purpose. In this thesis the purpose is to achieve consensus.

Stakeholder. Someone who is concerned with (or will be affected by) the decision being made.

Expert. A person with great knowledge, skill or experience in a specific subject (Webster's II New Riverside Dictionary, 1984). Expertise can only be judged relative to the other group members.

Expert Power. The ability to administer to another information, knowledge, or expertise (Hinkin, 1989).

Consensus. A state where a common judgment has been reached by most of those concerned. Consensus exists when a group makes and supports a decision. In this study, consensus is an aggregation of acceptance, agreement, and commitment. Within the state of consensus, there are degrees of consensus.

Strength of Consensus. A measure of the degree of consensus. Unanimity, or complete agreement is the strongest consensus.

Decision Quality. The degree to which a group's decision matches an accepted standard or "right" answer.

Leadership Emergence The perceptions of group members as to who was a leader in formerly leaderless groups.

Opportunity to Express Views. Perceptions by individual group members that their views and opinions were considered in the decision-making process.

APPENDIX B: SCENARIOS

Below is a list of scenarios related to my research. I describe each scenario and tell how (if at all) my research addresses it.

Scenario Addressed by My Research

1. One expert is in a group of people who have some knowledge of the problem. The expert is known as an expert by the other members before the meeting starts. The expert could have been placed in the group by the convenor or already be a part of the group. I didn't distinguish between these two cases because I used groups of strangers who were meeting for the first time. I assumed the other group members have some knowledge to help solve the problem otherwise, the convenor would just have the expert solve the problem. My research tested hypotheses related to this scenario and gave managers advice for managing this scenario effectively and efficiently.

Scenarios Not Addressed by My Research

2. A group of experts is brought together to solve a complex problem. Each group member is an expert on a different aspect of the problem. The Environmental Management Review Group (EMRG) fits this scenario. The EMRG is a group of environmental experts brought together by the Department of Energy to discuss environmental policy issues. Each member of the EMRG is an expert on different aspects of environmental policy. This is the scenario I had in mind when I began this research. However, because it would be too difficult to study a group of experts, I confined the situation to the above scenario. Although my research didn't specifically address this scenario, managers with groups of experts must first understand the effects of one expert on the small-group consensus process.

3. A group of stakeholders meets to solve a problem. One or more people naturally have greater knowledge on different aspects of the problem. A work group is an example of this scenario. This scenario is similar to scenario 2. The difference is that in this scenario, the group exists before the problem. In scenario 2, the problem exists, then group members are picked based on their expertise. My research could have addressed this scenario by calling the individual with the best initial score the expert, rather than trying to plant an expert based on education. Although my research didn't specifically address this scenario, managers with groups of stakeholders must try to identify group members with natural expertise and use them to their advantage.

4. An expert or group of experts advises a group on its problem (or specific aspects of the problem). In this scenario, the expert isn't a member of the group. The expert may simply give the group information during a one-shot presentation or interact with the group by answering questions throughout the group discussion. The expert isn't a "voting" member (one who must come to consensus). My research doesn't address this situation because my expert is a "voting" member.

However, the results of my research showed that in some situations, the expert should *not* be a member of the group, but rather an advisor.

APPENDIX C: QUESTIONNAIRE

Subject Number: _____

POST-SESSION QUESTIONNAIRE

Listed below are 18 statements. Following each statement is a scale ranging from 1 (strongly disagree) to 7 (strongly agree). *Please read each statement carefully and circle only one number corresponding to how you feel about the statement.* Please do not discuss this questionnaire until everyone is done.

1. My group's ranking is correct.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

2. My group members accepted what I had to say.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

3. I am willing to accept the group's solution as my own.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

4. I disagree with the group's decision.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

5. My group reached agreement on the topic we discussed.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

6. The final group ranking represents the preferences of everyone in my group.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

7. The final group ranking was the best decision we could make.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

8. My views were given full consideration by my group members.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

9. I had sufficient opportunity to make my views known.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

10. I am satisfied with the decision my group reached.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

11. The final ranking my group derived adequately reflects my concerns.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

12. My group members did not listen to what I had to say.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

13. I don't think my group arrived at a good decision.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

14. My group members understood my opinions.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

15. If asked to defend my group's solution, I would be willing to do so.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

16. If asked to defend the group's solution, I believe the other group members would do so.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

17. Group members influenced each other to reach a decision.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

18. I am satisfied with the way my group interacted to reach this decision.

1	2	3	4	5	6	7
strongly disagree	disagree	moderately disagree	neither agree nor disagree	moderately agree	agree	strongly agree

The following questions concern your feelings towards and evaluations of group member _1_.

Please circle the answer that best reflects your feelings.

19. To what extent did this member provide the group with needed knowledge?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

20. To what extent did this member make you feel personally accepted?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

21. To what extent did this member share his or her experience?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

22. To what extent did this member make you feel valued?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

23. To what extent did this member give good suggestions?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

24. To what extent did this member exhibit control over the group's activities?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

25. To what extent did this member make you feel important?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

26. To what extent did this member contribute to the effectiveness of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

27. To what extent did this member exert influence on the final outcome of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

28. If you had to choose a leader for a new task, to what extent would you be willing to vote for this member as a leader?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

The following questions concern your feelings towards and evaluations of group member **2**.

Please circle the answer that best reflects your feelings.

29. To what extent did this member provide the group with needed knowledge?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

30. To what extent did this member make you feel personally accepted?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

31. To what extent did this member share his or her experience?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

32. To what extent did this member make you feel valued?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

33. To what extent did this member give good suggestions?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

34. To what extent did this member exhibit control over the group's activities?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

35. To what extent did this member make you feel important?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

36. To what extent did this member contribute to the effectiveness of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

37. To what extent did this member exert influence on the final outcome of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

38. If you had to choose a leader for a new task, to what extent would you be willing to vote for this member as a leader?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

The following questions concern your feelings towards and evaluations of group member **3**.

Please circle the answer that best reflects your feelings.

39. To what extent did this member provide the group with needed knowledge?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

40. To what extent did this member make you feel personally accepted?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

41. To what extent did this member share his or her experience?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

42. To what extent did this member make you feel valued?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

43. To what extent did this member give good suggestions?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

44. To what extent did this member exhibit control over the group's activities?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

45. To what extent did this member make you feel important?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

46. To what extent did this member contribute to the effectiveness of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

47. To what extent did this member exert influence on the final outcome of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

48. If you had to choose a leader for a new task, to what extent would you be willing to vote for this member as a leader?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

The following questions concern your feelings towards and evaluations of group member **4**.

Please circle the answer that best reflects your feelings.

49. To what extent did this member provide the group with needed knowledge?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

50. To what extent did this member make you feel personally accepted?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

51. To what extent did this member share his or her experience?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

52. To what extent did this member make you feel valued?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

53. To what extent did this member give good suggestions?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

54. To what extent did this member exhibit control over the group's activities?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

55. To what extent did this member make you feel important?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

56. To what extent did this member contribute to the effectiveness of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

57. To what extent did this member exert influence on the final outcome of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

58. If you had to choose a leader for a new task, to what extent would you be willing to vote for this member as a leader?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

The following questions concern your feelings towards and evaluations of group member **5**.

Please circle the answer that best reflects your feelings.

59. To what extent did this member provide the group with needed knowledge?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

60. To what extent did this member make you feel personally accepted?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

61. To what extent did this member share his or her experience?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

62. To what extent did this member make you feel valued?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

63. To what extent did this member give good suggestions?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

64. To what extent did this member exhibit control over the group's activities?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

65. To what extent did this member make you feel important?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

66. To what extent did this member contribute to the effectiveness of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

67. To what extent did this member exert influence on the final outcome of the task?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

68. If you had to choose a leader for a new task, to what extent would you be willing to vote for this member as a leader?

1	2	3	4	5	6	7
not at all	very little		moderately		very much	to a great extent

69. What is your age? _____

70. What is your major? _____

71. What is your academic level? _____

OPEN-ENDED QUESTIONS

1. The advantages of coming to a group decision the way we did were:

2. The disadvantages of coming to a group decision the way we did were:

3. I suggest you make the following changes the next time you have people work together to complete this task.

4. Explain why the changes are necessary.

APPENDIX D: HALL'S CONSENSUS GUIDELINES

Consensus is a decision process for making full use of available resources and for resolving conflicts creatively. Consensus is difficult to reach, so not every ranking will meet with everyone's *complete* approval. Complete unanimity is not the goal--it is rarely achieved. But each individual should be able to accept the group rankings on the basis of logic and feasibility. When all group members feel this way, you have reached consensus as defined here, and the judgment may be entered as a group decision. This means, in effect, that a single person can block the group if he or she thinks it necessary; at the same time, he or she should use this option in the best sense of reciprocity. Here are some guidelines to use in achieving consensus:

1. Avoid arguing for your own rankings. Present your position as lucidly and logically as possible, but listen to the other members' reactions and consider them carefully before you press your point.

2. Do not assume that someone must win and someone must lose when discussion reaches a stalemate. Instead, look for the next-most acceptable alternative for all parties.

3. Do not change your mind simply to avoid conflict and to reach agreement and harmony. When agreement seems to come too quickly and easily, be suspicious. Explore the reasons and be sure everyone accepts the solution for basically similar or complementary reasons. Yield only to positions that have objective and logically sound foundations.

4. Avoid conflict-reducing techniques such as majority vote, averages, coin-flips and bargaining. When a dissenting member finally agrees, don't feel that he or she must be rewarded by having his or her own way on some later point.

5. Differences of opinion are natural and expected. Seek them out and try to involve everyone in the decision process. Disagreements can help the group's decision because with a wide range of information and opinions, there is a greater chance that the group will hit upon more adequate solutions.

APPENDIX E: THE LOST ON THE MOON EXERCISE

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

Your crew's survival depends on reaching the mother ship, so you must choose the most critical items available for the 200-mile trip. Your task is to rank the 15 items in terms of their importance for survival and their necessity to your crew in reaching the rendezvous point. Place the number 1 by the most crucial item, the number 2 by the second most crucial, and so on through number 15, the least important.

____ Box of matches

____ Food concentrate

____ Fifty feet 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 constellations)

____ Self-inflating life raft

____ Magnetic compass

____ Five gallons of water

____ Signal flares

____ First-aid kit, including injection needles

____ Solar-powered FM receiver transmitter

APPENDIX F: DESCRIPTION OF PILOT STUDY

In August 1990, I ran a pilot study and reported the results at the southeast region of The Institute of Management Science (Polk, Kurstedt, & Welch, 1990). This appendix describes this effort.

Introduction

Subjects and Group Composition. The subjects were 20 females, age 18 to 24, from Management Systems Laboratories (MSL). To minimize the effects of referent power, subjects were assigned so employees from the same department were in different groups. All groups consisted of five subjects. There were two experimental groups with one expert each and two control groups. One of the experts was a physics major, and the other was an aerospace engineering major. Both had recently taken an astronomy course. Because one of the experts scored poorly on a pretest, both were given general knowledge about the Moon and physics before entering the experiment. The experts had no other knowledge of the nature of the experiment.

Procedure. The experiment involved two phases. In the first phase, subjects individually completed the Lost on the Moon exercise. In the second phase, five-person groups came to consensus on the rankings using Hall's consensus guidelines. Before performing the group exercise, group members introduced themselves by giving their name, major, and any classes they have taken that would help the group solve the problem. After group discussion, I had subjects rank the objects individually. However, these data weren't used in the analysis. This third ranking has been used as a measure of consensus.

Measures.

1. *Base of expert power.* The potential for expert power was measured by the expert's quality score on the individual ranking step.

2. *Use of expert power* was measured using a subset of a 20-item scale developed by Hinkin and Schriesheim (Hinkin, 1989) to measure French and Raven's five bases of power. Only the expert and referent items were used because other bases of power were controlled for by design. Questions were modified so they would apply to group members rather than supervisors. Each group member rated all other group members on expert power. Measures of referent power were also given as a manipulation check.

3. *Consensus* was measured with two questions addressing two distinct aspects of consensus. One question measured how much group members accepted the decision (individual acceptance). Another measured how much members believed others accepted the decision (perceptions of group acceptance).

4. *Decision quality* was measured by the group's score on the Lost on the Moon exercise. Scores were computed by summing the absolute differences between a subject's ranking and the ranking given by NASA experts. Because there were only four groups in the pilot study, correlational statistics couldn't be computed on group measures. To get around this problem, an improvement score for individuals was used as a surrogate measure of decision quality. This score was calculated by subtracting the group score from the individual's initial quality score on the exercise.

5. *Perceptions of opportunity to express views* was measured with four questions addressing the extent subjects were able to express their views and have these views understood and reflected in the group ranking.

6. *Perceptions of decision quality* was measured with two questions addressing the extent subjects were confident in the ranking and believed it to be the best one.

7. *Leadership emergence* was measured with a five-item scale from Foti and Lord. This scale was filled out by each member for each other member. Items address the group member's contribution to effectiveness, degree of influence, leadership behaviors, and control over activities. Questions were modified slightly to match the format of the use of expert power and use of referent power questions.

The questionnaire used in the pilot study is shown in Appendix I. This questionnaire was modified slightly to conform to a set of questions used in other research efforts at MSL. The biggest change was the inclusion of four more consensus questions. Also, some questions were reverse coded in the final questionnaire. Finally, some open-ended questions were added to the end of the questionnaire.

Results and Discussion

Manipulation Checks. Both experts failed to score higher on the quality measure than other group members. In fact, one expert had the worst individual score in her group. The other expert scored above average, but one person in her group scored better. This was obviously an unexpected result since the experts were given information about the Moon prior to the exercise. However, the exercise also tested some general knowledge, not related to the Moon, that the experts lacked. The experts also misinterpreted parts of the scenario and even forgot some of the information they learned previously. In other words, even Moon experts may not be experts on the Lost on the Moon exercise. To check that neither condition had an advantage from higher individual scores, a t-test was run on individual quality scores. This test showed no significant difference ($p > .05$) between expert and no-expert groups on individual quality scores.

The Effect of an Expert on Decision Quality. There was mixed support for the hypothesis that experts increased decision quality. Group quality scores are given in Table 1. Combining group scores by condition, the expert groups had a slightly better average group score (lower scores indicate higher quality). Researcher observations help explain each group's score. In the first expert group, the expert was able to contribute the information she had learned. Even though she was unable to translate this information into the proper ranking on her own, the group was able to use the information and add to it to produce the best ranking. In the second expert group, the expert forgot several key pieces of information, leading the group astray on the rankings of some key items. In both non-expert groups, most or all members contributed to the groups' effectiveness. All groups scored considerably better than the average of their individual scores. This clearly demonstrates the concept of group synergy. The correlation between condition and individual improvement scores was insignificant ($p > .05$).

The Effect of an Expert on Consensus. The correlation between the presence of an expert and perceptions of opportunity to express views wasn't significant ($p > .05$). This supports the validity of my assumption that experts wouldn't overuse their power. There were significant correlations between perceptions of opportunity to express views and individual acceptance ($r = .50, p < .05$), between perceptions of opportunity to express views and perceptions of group consensus ($r = .45, p < .05$), between perceptions of decision quality and individual acceptance ($r = .58, p < .01$), and between perceptions of decision quality and perceptions of opportunity to express views ($r = .61, p < .01$). Individual acceptance and perceptions of group consensus weren't significantly correlated ($p > .05$), indicating that these are separate constructs. These correlations support my contention that consensus, acceptance, and agreement are closely related. Group members may accept a decision without thinking the rest of the group has reached consensus.

Table 1:
Group Scores[1]

Condition	Group	Mean Individual Score	Range of Individual Scores	Expert's Individual Score	Group Score
Expert	Group 1	44.4	38	40	8
	Group 2	46.8	18	60	22
No Expert	Group 3	46.4	24	N/A	22
	Group 4	50.8	30	N/A	18

[1]Lower scores indicate higher quality. Possible range: 0-112.

Leadership Emergence. In both expert groups, the expert had the highest average ratings on both the expert scale and the leadership emergence scale. In other words, even though the experts weren't true experts, they were perceived as being experts and leaders. This finding can be explained two ways. First, as subjects introduced themselves, it became clear to the other members that the expert had the best background for solving the problem. Group members had no way of knowing the expert's individual score. All other group members indicated they had practically no knowledge about the Moon, heightening the disparity. Second, even though the experts' scores were average to poor, both were able to give their groups useful information. The expert's emergence can't be attributed to their being the most-liked individuals because neither expert rated highest on referent power.

APPENDIX G: INFORMATION FOR GENERATING SUBJECT TEST

The information in this appendix was used to generate a test to give the experts to ensure they had an adequate level of expertise on the task subject. The first section lists the 15 items and the related facts one must know to rank the items correctly. These facts are coded as to whether they refer to astronomy (A), physics (P) or general knowledge (G). The second section distills these facts by the three categories. The subject test given to the experts (Appendix H) only taps astronomy and physics knowledge. The third section lists priorities for human survival. Although these facts are important for a high-quality decision, I didn't test my experts on them because they aren't related to astronomy or physics. The human survival priorities are a key area where other group members may have had better knowledge than my experts.

15 Items With Related Facts

Box of matches
A: No oxygen on Moon

Food concentrate
G: Need food (concentrate is more efficient than milk)

Fifty feet of nylon rope
A: Surface of Moon has many cliffs

Parachute silk
A: No atmosphere on Moon to protect people from the Sun's rays

Solar-powered portable heating unit
A; Lighted side isn't cold

Two .45-caliber pistols
P: Newton's equal and opposite reaction law (propulsion)

One case of dehydrated Pet milk
G: Milk is bulkier than concentrate

Two 100-pound tanks of oxygen
A: No oxygen on Moon

Stellar map (of the Moon's constellations)
G: Navigation

Self-inflating life raft
P: Newton's equal and opposite reaction law (CO bottle used for propulsion)

Magnetic compass
A: Magnetic field on Moon isn't polarized

Five gallons of water
A: Lighted side causes tremendous liquid loss through sweat

Signal flares
G: Distress signal for mother ship (designed for use in space--don't need oxygen)

First-aid kit, including injection needles
A: NASA space suits have aperture for needle injection (use to inject vitamins, medicine, etc.)

Solar-powered FM receiver transmitter
P: FM requires line-of sight transmission and short ranges

Distilled Facts

Astronomy
There is no oxygen on Moon.
The surface of Moon has many cliffs.
There is no atmosphere on Moon to protect people from the Sun's rays.
The lighted side of the Moon is hot.
The lighted side causes tremendous liquid loss through sweat.
NASA space suits have an aperture for needle injection. (This may not be known by astronomy majors.)

Physics
For every action there is an equal and opposite reaction (Newton's law of propulsion).
FM requires line-of sight transmission and short ranges. (This may be unrealistic for a physics major to know.)

General
PET milk is bulkier than concentrate.
The signal flare won't need oxygen because it was designed for astronauts.
The life raft includes a CO_2 cartridge.

Human Survival Priorities

1. Need oxygen
2. Need water
3. Need navigation tools
4. Need food
5. Need communication tools
6. Need transportation aids

APPENDIX H: SUBJECT TEST GIVEN TO EXPERTS

Directions: Answer the multiple choice questions below. This test is intended to test your basic knowledge of the Moon and some general physics concepts.

1. Objects are _____ on the Moon than on the Earth.

   a. lighter
   b. the same weight
   c. heavier

2. The Moon

   a. Rotates on its axis with the same period as its revolution about the Earth.
   b. Does not rotate.
   c. Always points the same face toward the Sun.

3. Which element is not found in the Moon's crust?

   a. Aluminum
   b. Iron
   c. Carbon
   d. Silicon

4. The Moon's diameter is approximately

   a. 500 kilometers.
   b. 1500 kilometers.
   c. 2500 kilometers.
   d. 3500 kilometers.

5. *Maria* are thought to have originated as

   a. Bodies of water which are now dried up.
   b. Lava flows.
   c. Highlands.

6. *Rilles* are

   a. smooth valleys.
   b. canyons.
   c. highlands.

7. The temperature on the lighted side of the Moon is approximately

   a. -150 degrees Celsius.
   b. -75 degrees Celsius.
   c. 0 degrees Celsius.
   d. 110 degrees Celsius.
   e. 230 degrees Celsius.

8. The temperature on the dark side of the Moon is approximately

   a. -150 degrees Celsius.
   b. -75 degrees Celsius.
   c. 0 degrees Celsius.
   d. 110 degrees Celsius.
   e. 230 degrees Celsius.

9. How does the Moon's magnetic field compare to the Earth's?

   a. The Moon's magnetic field has the same form as the Earth's.
   b. The Moon's magnetic field is stronger than the Earth's.
   c. The Moon has no magnetic field.

10. The Moon's gravity is ___ the Earth's gravity.

    a. $1/6^{th}$
    b. $1/2^{th}$
    c. the same as
    d. twice

11. Where is the Moon when full Moon occurs?

    a. Between the Earth and the Sun.
    b. Opposite the Sun from the Earth.
    c. At a 90^{o} angle from the Sun as seen from the Earth.

12. In comparison to Earth's surface, the Moon receives how much radiation (at all wavelengths)?

    a. More radiation.
    b. About the same amount of radiation.
    c. Less radiation.

13. The oxygen content of the Moon's atmosphere is

    a. approximately the same as the Earth's.
    b. greater than the Earth's.
    c. less than the Earth's.
    d. The Moon has no atmosphere.

14. The Moon's surface has more crater's than the Earth's surface because

    a. erosion has eliminated most of the Earth's craters.
    b. the Moon has no atmosphere to shield it from meteorites, dust, and solar radiation.
    c. Both a and b.

15. The mountainous areas of the Moon

    a. are rocky with steep cliffs and valleys.
    b. are more rounded than the Earth's largest mountains.
    c. There are no mountainous areas on the Moon.

16. What happens to an ice skater who throws a rock?

    a. The skater moves away from the direction the rock was thrown.
    b. Nothing.
    c. The skater moves towards the direction the rock was thrown.

17. Why couldn't you pick up K92 on the west coast, even if it had a large transmission signal?

    a. The west coast is below the horizon of the Earth as seen from Roanoke.
    b. The signal would be absorbed by the atmosphere.
    c. Other nearby stations on the same channel would swamp the signal.

18. Why can we pick up short wave radio transmissions from the west coast?

    a. They are transmitted along the power line grid.
    b. They reflect off the Earth's ionosphere.
    c. They are bent in the atmosphere.

19. If the Sun's gravity were to disappear suddenly, how would the Earth move?

    a. It would move directly away from where the Sun was.
    b. It would move in a straight line tangent to the point in the orbit where it was when the Sun's gravity stopped.
    c. It would continue to move in the same orbit around the place where the Sun was.

20. If you hit a ping pong ball and a golf ball with a small stick, which would move the fastest at first?

    a. The ping pong ball.
    b. The golf ball.
    c. Both would go the same speed.

What is your major? _____

What year are you in _____

What Astronomy courses have you taken?

Course	Semester Taken

APPENDIX I: PILOT STUDY QUESTIONNAIRE

Member Number: _____

Scale:
1. Not at all
2. Very little
3. Moderately
4. Very much
5. To a great extent

1. What is your sex (circle answer)? Male Female
2. What is your age? _____
3. What is your major? _____

4. To what extent do you feel you were able to express your views?
5. To what extent does the final group ranking reflect your concerns?
6. How confident are you in the correctness of your group's ranking?
7. To what extent do you accept the group's final ranking?
8. How listened to and understood did you feel?
9. To what extent do you think the final ranking represents the preferences of everyone in the group?
10. To what extent did the group take account of your inputs in the discussion?
11. To what extent do you believe the final group ranking was the best one?

The following questions concern your feelings towards and evaluations of group member _____. Please circle the answer that best reflects your feelings. (These questions were repeated for each group member.)

12. To what extent did this member make you feel valued?
13. To what extent did this member exhibit control over the group's activities?
14. To what extent did this member contribute to the effectiveness of the task?
15. To what extent did this member make you feel important?
16. To what extent did this member share his or her experience?
17. To what extent did this member exert influence on the final outcome of the task?
18. To what extent did this member give good suggestions?
19. To what extent did this member provide the group with needed knowledge?
20. If you had to choose a leader for a new task, to what extent would you be willing to vote for this member as a leader?
21. To what extent did this member make you feel personally accepted?

APPENDIX J: PROCEDURE AND SCRIPT FOR TESTING AND INSTRUCTING EXPERTS

Have experts fill out consent forms. "Read this, sign it, and pass it back."

Give Astronomy Test. "This short test will test your knowledge of the Moon and general physics principles."

"You have been chosen to participate based on your knowledge of the Moon."

"Some, but not all, of the information tested in the test will be useful in solving the exercise."

"The other members in your group will not have been tested on astronomy. They are in the introductory psychology class. Some will have little information to contribute to the exercise; others will have a lot to contribute. All group members should have some information to contribute to the decision."

"You are free to introduce any information you feel is relevant for solving the problem."

"Your goal is the same as all other subjects: to reach the highest quality decision that all group members can accept."

"After the other subjects arrive, you will be treated as any other subject."

"Follow all instructions given during the experiment and fill out all questionnaires when asked to. You will be asked to fill out another consent form and opscans for class credit. Fill these out, even though they don't apply to you. Put your correct ID number so I can remove your opscans. Don't tell other subjects you are being paid for your participation."

"Before the group discussion, subjects will state their name, major, and any classes they've had that may relate to the subject of the exercise. Tell the group your major and that you recently took (or are taking) an astronomy class."

"If anyone asks how you know a particular piece of information, tell them you learned it in one of your classes."

"Do not let anyone know you were tested on your knowledge of the Moon or were asked to participate because of this knowledge."

"Report back to Pamplin 30 after the experiment to get your $15. The other subjects are receiving class credit for their participation."

APPENDIX K: PROCEDURE AND SCRIPT FOR FIRST RANKING AND GROUP FORMATION

Introduce yourself and thank them for participating.

Hand out *consent forms*. "Read this, sign it, and pass it back. Don't discuss this experiment with anyone until after Wednesday."

Hand out orange *opscans* (2 per subject). "Write in your name and ID number. Then darken in your ID number." Collect opscans.

Hand out *first individual ranking sheets* and *subject number cards* by name. Make sure the Subject Number recorded on the exercise matches the number on the subject number card. Note those who are absent and replace them with people at end of list after all those present have received their individual ranking sheets. "Don't look at the exercise until you are told to."

"Turn over your exercise sheets and follow along as I read the instructions." Read instructions for **individual ranking step**. "**NASA experts have determined the best solution.** You should try to come up with this best solution. Don't discuss the task or your solution with other group members. You'll have 15 minutes to do this."

"Rip off your subject number card and pass in your exercise sheet. You'll need to keep your subject number card with you at all times."

Form groups one at a time. Send each group off with its proctor.

Pay experts when they return from group part of the experiment.

APPENDIX L: PROCEDURE AND SCRIPT USED BY PROCTORS

Proctor: _____ Time Exercise Began: _____
Room Number: _____ Time Exercise Ended: _____
Group Number: _____

(Please read through these instructions twice. The steps to follow are numbered. Important points are in bold. If something is in quotes, say it exactly as written to the group. If a subject has a question, tell them you can't answer it. **For every handout, make sure the subject number on the form matches the subject's number.**)

1. Introduce yourself and escort your group to the room written above.

2. Set up the room so subjects sit in a circle. If chairs are fixed in a row, ask them to sit on the floor. Collect individual ranking forms.

3. "Now you'll complete the same exercise as a group. Discuss the items among yourselves until you reach a group decision. Your goal is to reach the highest quality decision all members can accept. To help you reach this group decision, you'll follow these group decision-making guidelines." Read GROUP DECISION INSTRUCTIONS (attached). (Note: these instructions were attached for the proctors. They are shown in Appendix D.)

4. Before performing the task, **have group members introduce themselves.** "Before you begin, each person should introduce himself or herself by giving your name, major, and any classes you have taken that might be useful for completing the task." **(This step is important.)**

5. Hand out *group ranking* sheets. (Each member gets a sheet so they can see how the group's decision evolves.) "You'll have 45 minutes to complete the exercise. That should be plenty of time. Let me know when you're finished."

6. Record the starting time at the top of the page. If you don't have a watch, ask to borrow one from one of the subjects.

7. When the group is finished, ask one member of the group to read the group's ranking. Ask other members to make sure their rankings match what is read.

8. Collect the group ranking sheets. Record ending time.

9. Hand out the *second (post-discussion) individual ranking* sheets. "Now, do the same exercise one last time on your own. This ranking should be what *you* believe is the best answer, regardless of what the group decided. You'll have 10 minutes."

10. Ask members to display their subject number cards so other group members can see them. Fold them into a tent.

11. Hand out *questionnaire*. (An extra copy is attached. Make sure subject numbers match.) "Before you begin, let me read you the instructions." Read instructions on page 1. "On page 3, you will be rating the other group members. Be honest; all answers are anonymous. You won't rate yourself. The questions that apply to you should already be crossed out. Don't forget the last three questions on page 7." (Note: the page numbers mentioned above refer to the page numbers as they appeared on the post-task questionnaire given to subjects. These numbers are different than the page numbers as they appear in Appendix C.)

12. "Don't discuss the experiment with other students, because a similar experiment will be run Wednesday."

13. If subjects don't want to hear the NASA solution, they may leave.

14. After everyone has turned in their questionnaire, tell them "This study is investigating the effects of an expert on consensus and decision quality."

15. Read them the correct rankings developed by NASA (below).

16. Thank subjects for their participation. Dismiss subjects.

LOST ON THE MOON--ANSWER KEY

1. **Two 100-pound tanks of oxygen**. Most pressing survival need.

2. **Five gallons of water**. Replenishes loss by sweating.

3. **Stellar map**. Primary means of navigation.

4. **Food concentrate**. Efficient means of supplying energy requirements.

5. **Solar-powered FM receiver-transmitter**. For communication with mother ship, but FM requires line-of-sight transmission and short ranges.

6. **Fifty feet of nylon rope**. Useful in scaling cliffs, tying injured together.

7. **First-aid kit**. Needles for vitamins, medicines, etc., will fit special aperture in NASA space suits.

8. **Parachute silk**. Protection from sun's rays.

9. **Self-inflating life raft**. CO_2 bottle may be used for propulsion.

10. **Signal flares**. Distress signal when mother ship is sighted.

11. **Two .45-caliber pistols**. Possible means of self-propulsion.

12. **One case dehydrated Pet milk**. Bulkier duplication of food concentrate.

13. **Solar-powered portable heating unit**. Not needed unless on dark side.

14. **Magnetic compass**. Magnetic field on moon is not polarized, worthless for navigation.

15. **Box of matches**. No oxygen on moon to sustain flame.

APPENDIX M: DESCRIPTION OF KENDALL'S COEFFICIENT OF CONCORDANCE (*W*)

Assumptions

1. The data consist of m complete sets of observations or measurements on n objects or individuals.
2. The measurement scale is at least ordinal.
3. The observations as collected or recorded must consist of or be able to be converted into ranks.

Test statistic

$$W = 12 \frac{\sum_{j=1}^{n} R_j^2 - 3m^2n(n+1)^2}{m^2n(n^2-1)}$$

Where m is the number of sets of rankings, n is the number of objects that are ranked, and R_j is the sum of the ranks assigned to the jth object.

(Description adapted from Daniel, 1978.)

APPENDIX N: CRONBACH'S ALPHA FOR QUESTIONNAIRE SCALES

This appendix gives Cronbach's alpha for the six scales of my questionnaire. Cronbach's alpha gives an indication of the reliability of the scales.

Variable	alpha
Perceptions of Opportunity to Express Views	.81
Perceptions of Decision Quality	.79
Consensus	.68*
Use of Expert Power	> .90*
Use of Referent Power	> .90*
Leadership Emergence	> .90*

*For each group member number in the expert groups, alphas were above this number.

APPENDIX O: DESCRIPTIVE STATISTICS FOR MAJOR VARIABLES

This appendix gives the basic descriptive statistics (mean and standard deviation) for the major variables in my study. The statistics are given for expert and non-expert groups. I used these statistics (along with t-tests) to see which variables were affected by the presence of an expert.

EXPERT GROUPS

Variable	Mean	Standard Deviation
Quality Score 1	207.800	18.570
Quality Score 2	26.300	8.460
Quality Score 3	139.700	26.272
Consensus 1	62.900	16.987
Consensus 2	174.000	8.692
Consensus 3	0.887	0.060
POV	237.000	10.011
PDQ	118.600	6.381

NON-EXPERT GROUPS

Variable	Mean	Standard Deviation
Quality Score 1	227.545	23.763
Quality Score 2	28.455	6.154
Quality Score 3	154.182	27.914
Consensus 1	54.455	18.338
Consensus 2	174.364	8.250
Consensus 3	0.932	0.036
POV	238.818	7.935
PDQ	119.182	5.307

Key

Quality Score 1 - 1st Individual Ranking Scores Summed for Group
Quality Score 2 - Group Ranking Score
Quality Score 3 - 2nd Individual Ranking Score Summed for Group
Consensus 1 - Difference Measure Summed for Group
Consensus 2 - Questionnaire Measure Summed for Group
Consensus 3 - Concordance Measure
POV - Perceptions of Opportunity to Express Views Summed for Group
PDQ - Perceptions of Decision Quality Summed for Group

APPENDIX P: T-TESTS FOR EXPERT VS. NON-EXPERT CONDITION

This appendix gives t-tests between expert and non-expert groups for the major variables in my study. I used these statistics (along with the descriptive statistics) to see which variables were affected by the presence of an expert. These tests helped me check manipulations, controls, and assumptions, and test hypotheses.

Variable	T	DF	*p*
Quality Score 1	2.132	18.6	.047
Quality Score 2	0.662	16.3	.517
Quality Score 3	1.225	19.0	.236
Consensus 1	-1.096	19.0	.287
Consensus 2	0.098	18.6	.923
Consensus 3	2.055	14.4	.058
POV	0.458	17.2	.653
PDQ	0.226	17.6	.824

Key

Quality Score 1	-	1st Individual Ranking Scores Summed for Group
Quality Score 2	-	Group Ranking Score
Quality Score 3	-	2nd Individual Ranking Score Summed for Group
Consensus 1	-	Difference Measure Summed for Group
Consensus 2	-	Questionnaire Measure Summed for Group
Consensus 3	-	Concordance Measure
POV	-	Perceptions of Opportunity to Express Views Summed for Group
PDQ	-	Perceptions of Decision Quality Summed for Group

APPENDIX Q: T-TESTS BY GENDER

This appendix gives t-tests by gender for the major variables in my study. I used these statistics (along with descriptive statistics) to see if there were any differences on any of the variables between male and female groups. These tests let me check the assumption that there would be no differences between male and female groups.

Variable	T	DF	*p*
Quality Score 1	3.248	12.6	.007
Quality Score 2	1.879	11.4	.086
Quality Score 3	1.093	12.3	.295
Consensus 1	-1.952	18.8	.066
Consensus 2	2.536	16.9	.021
Consensus 3	1.970	18.3	.064
POV	0.636	14.4	.535
PDQ	0.591	16.6	.562

Key

Quality Score 1	-	1st Individual Ranking Scores Summed for Group
Quality Score 2	-	Group Ranking Score
Quality Score 3	-	2nd Individual Ranking Score Summed for Group
Consensus 1	-	Difference Measure Summed for Group
Consensus 2	-	Questionnaire Measure Summed for Group
Consensus 3	-	Concordance Measure
POV	-	Perceptions of Opportunity to Express Views Summed for Group
PDQ	-	Perceptions of Decision Quality Summed for Group

APPENDIX R: CORRELATION TABLE FOR MAJOR VARIABLES

This appendix gives correlations between the major variables in my study. I used these statistics to see which variables were related to which other variables. These tests helped me check manipulations, controls, and assumptions, and test hypotheses. Level of significance is noted with asterisks.

	Quality Score 2	Consensus 1	Consensus 2	Consensus 3	POV	PDQ
Quality Score 2	1.000					
Consensus 1	.019	1.000				
Consensus 2	-.045	.559 **	1.000			
Consensus 3	.084	.829 ***	.432	1.000		
POV	.253	.270	.388	.261	1.000	
PDQ	.153	.558 **	.792 ***	.420	.519 *	1.000

* $p < .05$
** $p < .01$
*** $p < .001$

Key

Quality Score 1 - 1st Individual Ranking Scores Summed for Group
Quality Score 2 - Group Ranking Score
Quality Score 3 - 2nd Individual Ranking Score Summed for Group
Consensus 1 - Difference Measure Summed for Group
Consensus 2 - Questionnaire Measure Summed for Group
Consensus 3 - Concordance Measure
POV - Perceptions of Opportunity to Express Views Summed for Group
PDQ - Perceptions of Decision Quality Summed for Group

APPENDIX S: CORRELATION TABLE FOR POWER AND EMERGENCE RATINGS

This appendix gives correlations between the three group member rating scales. I used these statistics to see if the use of expert power was related to leadership emergence. These tests helped me test H6. Level of significance is noted with asterisks.

	Use of Expert Power	Use of Referent Power	Leadership Emergence
Use of Expert Power	1.000		
Use of Referent Power	.022	1.000	
Leadership Emergence	.914 ***	.155	1.000

* $p < .05$
** $p < .01$
*** $p < .001$

VITA

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EDUCATION

Virginia Polytechnic Institute and State University (VPI&SU), Blacksburg, VA.

M.S., Industrial and Systems Engineering, Management Systems Engineering option, August 1991.

Major Professor:
Dr. Harold A. Kurstedt, Jr.

B.S., Industrial Engineering and Operations Research, May 1989.

Independent Studies:
A Management Plan for Recycling at VA Tech, Spring 1991.
Small-Group Problem-Solving Techniques, Fall 1988.

EXPERIENCE

Management Systems Laboratories, VPI&SU, Blacksburg, VA, Graduate Research Assistant, August 1989 - Present.

Assisted with research on a $10 million grant with the Department of Energy (DOE) to study consensus decision-making.
Observed and analyzed DOE-associated consensus groups.
Reviewed consensus decision-making literature.
Presented seminar on group dynamics.
Developed research models and instruments.

Military Sealift Command, Washington, DC Industrial Engineer, Information Systems Division, May 1989 - August 1989.

Designed a system for tracking computer repairs.
Designed and implemented a data base for tracking communication links.

EXPERIENCE

Bureau of Engraving and Printing (BEP), Washington, DC
Industrial Engineer (Co-op), Productivity Improvement Staff, January 1987 - August 1988.

Performed a gainsharing feasibility study.
In charge of automating the Office of Management Services. Selected hardware and software; trained staff members.
Assisted in the development of a Quality Circle Program. Trained and facilitated circle members; promoted and tracked the program.
Designed and implemented an automated productivity reporting system.

PUBLICATION

Polk, J. W., Jr., Kurstedt, H. A., Jr., & Welch, K. A. (1990). The effects of experts on the group consensus process. In K. E. Fitzpatrick, & J. R. Baker (Eds.), *Proceedings of the Twenty-Sixth Annual Meeting of the Southeastern Chapter of the Institute of Management Sciences, 20*, 115-118, Boone, NC: Appalachian State University.

SKILLS

Small-group facilitation.
Group problem-solving techniques.
Oral and written communication.

HONORS

Alpha Pi Mu, Industrial Engineering Honor Society.
Gamma Beta Phi, National Honor Society.
Special Act Performance Recognition, BEP, 1987, for automation project.
Special Act Performance Recognition, BEP, 1988, for automated productivity reporting system.
Marshall Hahn Engineering Merit Scholarship, 1984.