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## ABSTRACT

This research represents an attempt to determine the impact of a group decision support system (GDSS) on the ability of groups to influence the judgments of individual group members. The power of groups to influence individuals has been well documented in the social psychological literature. For organizations interested in promoting innovation and creative problem solving in group settings, this tendency can be quite troubling. In the past, researchers have looked at how certain types of GDSSs might lessen these types of group pressures in the generation of creative ideas. This research may be viewed as an extension of this work to the choice phase of decision making.

In an experimental setting, forty-eight subjects were combined on an individual basis with groups of confederates to test the normative influence of the groups on the choices made by the individuals. Three different communication modality configurations were employed to test the effect which this had on the influence of the group. Whereas negative group effects in the idea-generating phase may lead to good ideas not being considered, group effects in the choice stage can to lead poor decisions being adopted, perhaps with even more unfortunate results. Obviously, both of these effects represent serious threats to the effectiveness of decision-making groups; consequently, both represent areas for potential contribution of improved versions of GDSSs.

## 1. INTRODUCTION

In *Models of Man*, Simon (1957) made a distinction between two broad categories of behavioral models of decision makers: *Rational Man* and *Social Man*. The rational model was the model of choice for disciplines such as economics and management science, while the social model represented the types of models used by psychology and anthropology. Rather than viewing these as competing models, the position taken in this paper is that they represent two different, but complementary, aspects of all decision makers. Consequently, both contain valuable insights for the group decision support system (GDSS) researcher exploring how information technology can be used to enhance the performance of decision makers in a group setting.

One insight, perhaps self-evident, but nonetheless crucial, is that group decision making is not a purely rational exercise. Consequently, if the support that a GDSS provides is framed solely in the context of rational decision making, it is quite possible that social forces in the group processes will overwhelm any rational support that the system provides. This will likely result in frustrated users and eventually a system which becomes increasingly unpopular and, consequently, unused. On the other hand, there are clearly many situations where analytical models and quantitative techniques would be very valuable to a group of decision makers. It is important to note that both of these scenarios might occur within the same group, and even within the same session. The issue therefore is not superiority of rational versus social, but rather how to design a system which incorporates both into its group support toolbox.

The characteristics of the rational versus social models were detailed by Wolff (1966, p. 14) and are outlined in Table 1. The rational decision maker is influenced purely by information, while the social decision maker is influenced by the status and opinion of his peers. An examination of the GDSS design literature (Huber 1984; DeSanctis and Gallupe 1987; Dennis et al. 1988) suggests that there

is an orientation towards reinforcing the rational aspects of group decision making and dampening other influences. For example, SAMM is built around an agenda that is designed to lead a group systematically through a rational sequence of decision phases (DeSanctis, Sambamurthy and Watson 1987). The electronic brainstorming feature of GroupSystems uses anonymity to mask status differentials and lessen the fear of evaluation, which are non-rational influences that can affect the perception of an idea's worth and constrain a person's participation in the group (Dennis et al. 1988).

**Table 1. Characteristics of the Rational and Social Models**

| RATIONAL MODEL | SOCIAL MODEL |
|---|---|
| Influenced by information | Influenced by opinions, status, and number of others |
| Self-interested maximizer of subjective value | Influenced by the values and norms of the surrounding culture |
| An isolated center of consciousness to whom other persons present themselves as external objects | Immersed in a culture and closely linked to significant others |
| Psychologically autonomous | Personality develops through a process of internalization of social norms and values. Values human relationships. |
| Rational, calculating, egoistic seekers after pleasure | Emotional, altruistic, naturally social creatures |
| Competitive | Cooperative |

Current GDSS design principles generally attempt to enhance the rational decision maker and lessen the impact of the social dimensions of decision-making. However, it is quite possible to envision instances where rational support might negatively affect a group. One example of this would be a meeting whose sole purpose is consensus building. In this case, the dampening of social forces might impede the development of consensus and support for the decision. As this example suggests, GDSS designers often seek to enhance the rational side of decision makers when the actual goal of group decision making is an outcome that is acceptable to all group members – an outcome that appeals to the social side of decision makers. Indeed, the perception of a shared, commonly-owned outcome can be critical to rapid decision implementation. If GDSSs are to support aspects of both the rational and social characteristics of decision makers, then there is a need to understand the interplay of these characteristics in decision making. Ideally, the end-result of this understanding would be the ability to utilize GDSSs to support both rational and social aspects of decision making, as well as an ability to recognize the situations when one or the other might be most appropriate.

A group process model which provides a starting point for this understanding is shown in Figure 1. This model is adopted from the jury decision making literature in social psychology (Deutsch and Gerard 1955; Kaplan and Miller 1987; Kaplan and Rugs 1989; Kaplan 1988). The focus is on understanding the types of influences factors which determine how the initial positions of the jury members evolve into a unanimous group decision. Two broad categories of influence are suggested: *informational influence*, which represents the influential power of the ideas under discussion, and the factors which facilitate this influence; and *normative influence*, which represents the power of groups and group norms to influence members quite apart from the ideas being discussed. Figure 1 illustrates the adaptation of this theory for the GDSS area, with the goal of developing a group process model which can capture both the rational and social aspects of group decision making.

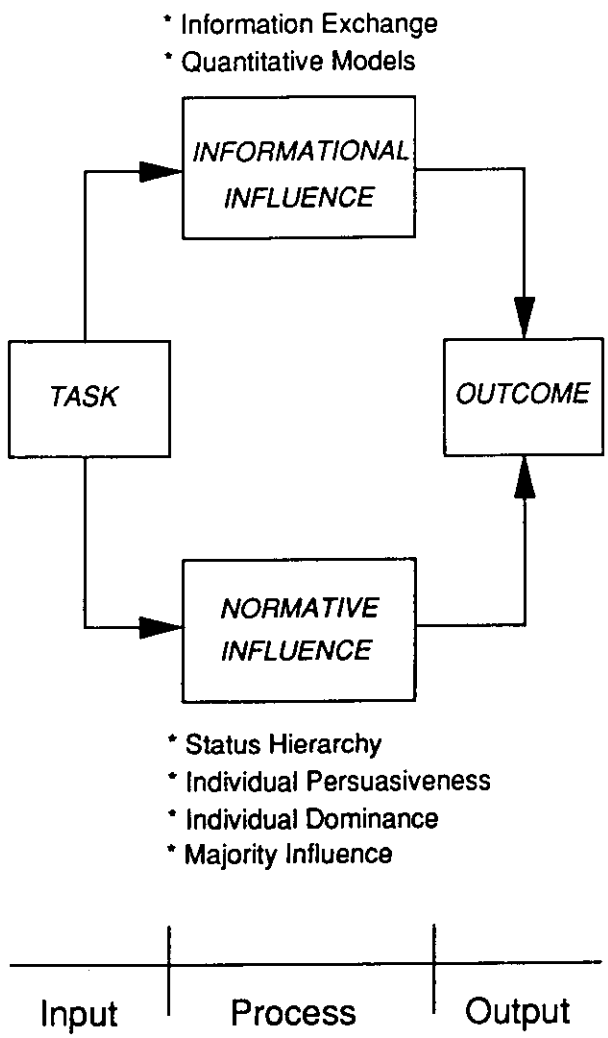


**Figure 1. Informational and Normative Influence**

For the purposes of this paper, informational influence can be seen as flowing from the rational model, and normative influence can be seen as flowing from the social model. It is assumed that both the informational and normative influence factors exist and mediate the group processes leading from a given group task to a final outcome. Thus, group process intervention would consist of manipulating the influence forces acting in the group to yield a desired outcome. What this model does not illustrate is the role of information technology as a mechanism for this process intervention. The model used for this is described in the next section.

### 1.1 Group Process Intervention and Information Technology

The conceptual model utilized in this paper is drawn from a model proposed by Clapper and McLean (1991), as shown in Figure 2. In this figure, the tasks and outcomes of the group processes are shown as depending on the informational and normative influence processes operating within the group; but, in addition, an important intervening variable called *communication configuration* operates on the influence processes in the group. The three dimensions of communication configuration, derived from McGrath (1984), are *communication networks*, *communication modalities*, and *communication strategies*. These three dimensions represent the mechanisms by which technology can be used to intervene into the influence processes of the group.

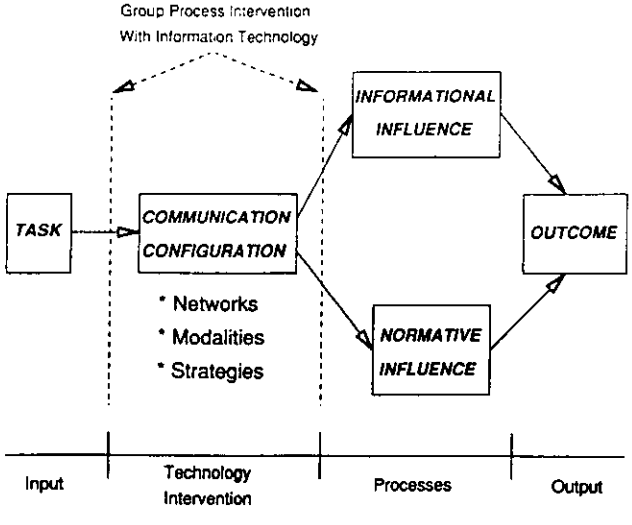


**Figure 2. Group Process Intervention Using Information Technology**

#### 1.1.1 Communication Networks

Communication networks represent fixed, specific patterns of communications among members of a group. If the group is allowed to communicate only by means of the GDSS, then the system can control, and thus manipulate, the structural pattern of communications within the group. Relevant research in this area includes Shaw (1974, 1964), Leavitt (1951), and Bavelas (1948).

#### 1.1.2 Communication Modalities

In addition to controlling the patterns of communication among group members, technology can also allow the manipulation of their mode of communication. Communication mode, as used by communication researchers, is a fairly broad term. Weeks and Chapanis (1976, p. 886) define a telecommunication mode as "the amalgam of methods and devices that may be used to convey information in a particular communication situation." Examples of different communication modalities are face-to-face, video only, audio-video, audio only, teletypewriting, and handwriting.

One means used to describe communication media is in terms of its being *rich* versus *lean* (Williams 1977; Daft and Lengel 1986). Media richness is related to both the number of communication channels which the media utilizes and the extent to which the media allows the feeling of closeness in the communication. The opposite of a rich media is a lean media. Williams (1977) summarized his review of the effects of rich versus lean media: "These rating results suggest that the 'richer' media, such as face to face, emphasize the affective content of the messages, as compared with the 'poorer' media, such as audio only or written notes" (p. 967). A substantial, and growing, research literature exists on the effects of communication media (Dubrovsky, Kiesler and Sethna in press; Morley and Stephenson 1969; Short, Williams and Christie 1976; Kiesler, Siegel and McGuire 1984; Siegel, et al. 1986; Sproull and Kiesler 1986).

#### 1.1.3 Communication Strategies

While communication networks and modalities are strongly tied to the hardware aspects of the system, communication strategies are most closely related to the software used by the GDSS, as well as the rules for using the system. In the context of non-technological group intervention, Eils and John (1980) define a communication strategy as "a set of verbal instructions to the group members about how to discuss and resolve differences optimally" (p. 271). For the GDSS context, this category will be more broadly interpreted as the explicit and implicit rules which comprise the strategies toward improving group performance that the system is designed to implement, for example, brainstorming, nominal group technique, and assumption surfacing. This would also include rules and procedures concerning the use of the system, such as the strategies governing the role of the facilitator (if any) in a group meeting.

### 1.1.4 Implications of the Conceptual Model

One important result of this conceptual model is that it partitions the broad area of GDSS into six more clearly defined areas of research possibilities. These broad areas, as well as representative research questions, are shown in Figure 3. The two columns represent the underlying influence processes operating in the group, and the three rows indicate the three dimensions of technological intervention which are open to the GDSS designer. The focus in the informational influence column is on the support the system can offer to a rational decision maker. Thus, it concerns such things as the cognitive limitations of the individuals and of the group as a whole, both in terms of information communication and analysis. Rather than focusing on the cognitive aspects of group problem solving, the normative influence column of Figure 3 deals with the impact of technology on the social dimensions of group problem solving.

| | Informational Influence | Normative Influence |
|---|---|---|
| Networks | How is information flow within the group affected by different networks?<br><br>How does the network impact the ability of the group to develop a shared understanding of the problem? | Do different networks impact the ability of a member to dominate the group?<br><br>Do different networks affect the development of cohesiveness in groups? |
| Modalities | Which modalities facilitate the most rapid communication of information?<br><br>Do some modalities encourage the group to focus on the task? | Do different modalities mediate the power of majority influence in the group?<br><br>How is the development of status hierarchies affected by different modalities? |
| Strategies | How can the system determine the optimal strategy for a given group task?<br><br>Is there an optimal ordering of strategies in relation to group phases? | What strategies can the system use to minimize influence due to status differences?<br><br>What role should the facilitator play when one member of the group appears to be dominating the group? |

**Figure 3. Research Areas Suggested by the Conceptual Model**

### 1.2 Modalities and Normative Influence

It is the impact of communication modalities on normative influence which will be the primary focus of this research - specifically, the impact of changing communication modalities of the GDSS on the ability of the group to influence an individual member. The study of group influence represents a very rich research stream in social psychology. Janis' (1973) Groupthink represents a well known example of the group rigidly enforcing the status quo, while suppressing any opposing ideas. Groupthink represents an extreme example of group influence, but the tendency of groups to move toward conformity has to be of concern to organizations interested in promoting creativity and innovation in group settings.

A number of GDSS researchers have explored the impact of a GDSS's ability to facilitate creativity in idea generating tasks such as brainstorming (Jessup, Connolly and Galegher 1990; Gallupe, Cooper and Bastianutti 1990; Nunamaker, Applegate and Konsynski 1987). The study described in this paper can be viewed as an extension of this type of research stream from the idea generation to the choice phase of group decision making.

In a classic experiment in small group research, Asch (1956, 1963) demonstrated the power of the group to influence the judgment of an individual member. In his experiment, Asch formed groups entirely of confederates except for one "naive" subject. The confederates were instructed to make unanimously incorrect judgments about the relative lengths of sets of lines. Asch found that the influence of the confederates resulted in a dramatic increase in the number of errors by the naive subjects. This can be viewed as normative influence because it is not new information, or reasoning, which induces the subjects to shift their judgment, but rather the pressure to conform to a unanimous group opinion.

As in Asch's experiments, the groups in our experiment are composed entirely of confederates except for one subject, and again the confederates vote for judgments which are similar to each others, but quite different from the initial vote of the subject. Having set up this high normative influence situation, however, our primary interest is in how the varying of the communication modality utilized by the group mediates the results of this group influence.

Three modalities are tested: a face-to-face group with only manual support, a face-to-face group supported by a GDSS, and a dispersed group supported by a GDSS. The manual, face-to-face GDSS, and dispersed GDSS conditions represent a rough continuum in terms of moving from the richest modality to the leanest. In the manual condition, the group has the rich communication channel of voice as well as the non-verbal information available from close physical proximity. In the face-to-face GDSS group, the leaner modality of keyboard to public screen is used, but the group still has the non-verbal information from being in a face-to-face setting. Finally, in the leanest modality condition, the dispersed GDSS groups have only the keyboard-to-public-screen channel of communication, with none of the non-verbal channels which are available in the face-to-face conditions.

In a sense, this experiment could be viewed as extending Asch's work into the age of electronic telecommunications. While Asch elegantly demonstrated the power of the group to influence individual members, this experiment explores how varying communication modalities might affect the power of this group influence, leading to the first hypothesis:

**Hypothesis H1: Different communication modalities will result in a significantly different number of rounds required for the subjects to move to the majority position of the confederates.**

Building on the work of communication modality researchers we hypothesize that communicating through leaner communication modalities will have the effect of dampening the influence power of the group. Thus in a situation in which the group is attempting to influence the individual to move toward the group position, we would expect that the subject will be more resistant to this influence in the leaner communication modalities condition, and hence take more rounds to agree to the majority position.

**Hypothesis H1a: Subjects in the leanest communication modality (Dispersed-GDSS) will take more rounds to move to the majority position than subjects in the richest modality (Manual).**

### 1.3 Task Type and Normative Influence

The theorized effects of task type is based on the research of Kaplan and Miller (1987). They proposed that the type of task – *intellective* tasks versus *judgment* tasks – will determine the nature of the predominant influence type utilized by small groups. Intellective tasks, which have a "correct" answer that can be determined by analysis and reasoning, will tend toward informational influence being the most significant influence mode. Judgment tasks, conversely, have no one correct answer, and instead are solved by the group arriving at a consensus. Kaplan and Miller contended that this type of task would lend itself more to normative influence pressures. Thus, an intellective task will tend to dampen, or at least not enhance, the normative influence in the group, while a judgment task will tend to enhance normative influence. Building from this work, we hypothesize that an intellective group task will not lend itself as readily to normative influence as will the less structured judgment task.

**Hypothesis H2: Subjects working on an intellective task will take a significantly greater number of rounds to move to the majority position than subjects working on judgment tasks.**

Finally, combining the effects of support and task type, the two most "extreme" of the six treatment conditions can be compared. Manual groups working on judgment tasks represent the condition most susceptible to normative influence. Dispersed-GDSS groups working on intellective tasks represent the condition least susceptible to normative influence.

**Hypothesis H3: Subjects working in manual groups on judgment tasks will take a significantly fewer number of rounds to move to the majority position than subjects in dispersed-GDSS groups working on intellective tasks.**

## 2. METHOD

### 2.1 Design

The overall experimental design used in this research is a two-factor (3 x 2) completely random design. The dependent measure is the *number of rounds required to achieve consensus*. The two independent variables are *type of group support* and *task type*. As indicated above, the three levels of support are dispersed GDSS, face-to-face GDSS, and manual. Across these three types of group support, the network and strategies dimensions will be controlled, while the modality dimension will be manipulated. Thus, the theoretical difference among the three types is the modalities of communication used in each treatment level. A diagram of these three types is shown in Figure 4. The second independent variable is task type, which has two levels: intellective and judgment.

The communication network is a wheel topology, as described by Leavitt (1951). That is, all communication flows from the subjects and confederates to a central public display – which is a public screen in the two GDSS conditions and a whiteboard in the manual condition. The subjects and confederates do not speak to one another directly, and are clearly instructed that all communication among group members must be via the public display.

The key aspect of communication strategies which is controlled in the experiment is the manner in which group members communicate. Communication is sequential, with each group member taking their "turn" in a series of rounds. Thus, even in the manual treatment condition, although the groups are face-to-face, they are not freely interacting because they do not speak to each other except in this very restricted manner. Although this is somewhat artificially restrictive, it is necessary to insure the experimental control over the interaction between the confederates and the subject in each group.

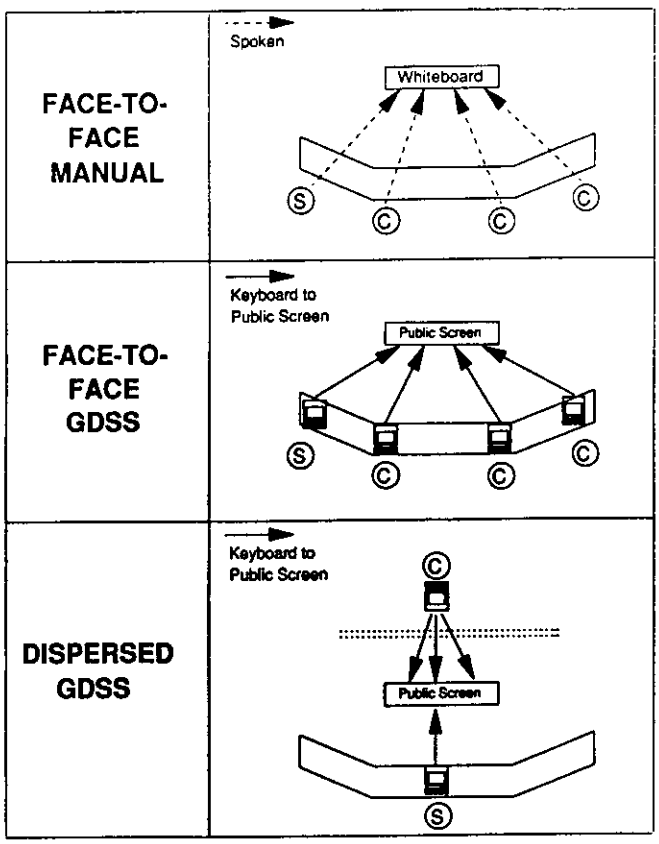


**Figure 4. Physical Layout of the Experiment (S-Subject, C-Confederate)**

Normative influence is controlled in the experiment so as to be at a relatively high level by using confederates who attempt to influence the subject away from the initial position taken. The level of the information influence in the group is controlled at a relatively low level. This is accomplished by carefully controlling the statements made by the confederates. This control is obtained by having each confederate follow a script which dictates their response for every round of the session. Given the configuration of the room, these scripts were not visible to the subjects.

### 2.2 Subjects

A total of forty-eight subjects (twenty-eight males and twenty females) participated as volunteers from introductory MIS courses at the University of Georgia in Athens. Each group consisted of three confederates and one subject. The confederates were undergraduate psychology students who received course credit for participating in this research. Although the subjects and confederates did not know each other, this did not arouse the suspicions of the subjects because the subjects were drawn from very large course sections and typically knew few other members of their class. A group size of four was chosen because Asch (1963) found strong group influence effects with this group size, and it was parsimonious in terms of the number of confederates needed. Treatments were randomly assigned to subjects, with a resulting eight subjects for each of the six treatments.

### 2.3 Setting

The study was conducted in the Decision Lab of the University of Georgia. The software used for the GDSS conditions was the *GroupSystems* system developed at the University of Arizona (Ventana 1990). The only module utilized was the *Topic Commenter* module, which allowed each subject to be presented with a screen with their name at the top. The subjects were then instructed to type their vote and arguments on the screen and send them to the public screen by pressing the F10 function key. This uncomplicated experimental procedure greatly reduced the amount of time needed for subject training. The hardware for the GDSS conditions consisted of four IBM microcomputers networked with Novell Netware 286 software on an IBM Token Ring Network.

### 2.4 Task

The two task types, intellective and judgment, are the two levels of this independent variable. These are slight modifications of the tasks developed and used in a mock jury experiment by Kaplan and Miller (1987). Both tasks can be characterized as complex, requiring the subjects to decide on the relative strengths of the defendant's arguments versus the plaintiff's arguments, and arrive at an overall damage award. The subject's initial reading of the case and decision on an initial award typically took fifteen to twenty minutes.

For the intellective task, the group is given relatively clearcut rules to follow in determining the correct amount of the award. The intellective case is described by Kaplan and Miller (p. 308) as: "group members have some ability to recognize and accept correct solutions... and members with the solution have the opportunity, ability, and motivation to demonstrate the solution to others." The judgmental task, on the other hand, is described as "less demonstrable...and more concerned with the question of what is ethical, proper, or preferred." For both tasks a decision must be made by the group, but for the intellective task, the "correctness" of that decision is relatively easy to prove, while correctness and proof have much less meaning with respect to the judgment task. Ultimately, the correct answer to the judgment task is simply the one which the consensus of the group dictates.

### 2.5 Procedures

Four-member groups (three confederates and one subject) were given the evidence based on an actual civil court case and asked to decide on either compensatory (intellective task) or exemplary (judgment task) damages for the plaintiff. The groups were told that the purpose of the

experiment was to explore the effects of technology on decision making groups and that their goal was to attempt to arrive at a consensus decision for an award for the plaintiff that was satisfactory to all group members. It was explained that the deliberations of the group would take place in a series of voting rounds. On the very first round, each person presented the amount that they felt was a fair award. In successive rounds, they presented their award amounts, but also a rationale for why they felt that this amount was correct, or arguments why other group members should change their position. Seating was controlled by the facilitator so that the subject was always the first to present an award amount. Once the subject presented an initial position, the confederates calculated and presented their initial position based on the subject's initial vote.

Hidden within the case that they were given, each confederate had a script which told them the award amount (in relation to the subject's initial position), as well as the exact text for the rationale, for every round of the session. The scripts were developed through several phases of pretesting, involving giving the cases both to individuals and groups. The subjects were instructed that they had 45 minutes to attempt to achieve a consensus. The general strategy for the change in the confederates' votes over the course of the session was as follows. Initially, one confederate was the most extreme in terms of the subject's initial position, and the other two confederates were more moderate. As the rounds progressed the two more moderate confederates moved away from the subject's initial position until all the confederates arrived at a consensus around the initial extreme position. This strategy was thought to generate less suspicion than if all the confederates agree on the extreme position at the very first round. It also simulated, in some sense, the process of group polarization, which has been found to be a very robust phenomena in decision making groups (Lamm and Myers 1978). These rounds continued until the subject changed his or her award amount to agree with the group, or until the maximum number of rounds (ten rounds) was reached. At the end of the session the subject was thoroughly debriefed as to the real purpose of the experiment.

## 3. RESULTS

### 3.1 Modalities Effects

The effect of the support type on the number of rounds required to reach consensus was significant at the 5% level [$F(2,44) = 4.54$, $p = .02$]. Therefore, hypothesis H1 was supported. The mean number of rounds required for the dispersed GDSS, face-to-face GDSS, and the manual conditions are 6.81, 6.31 and 5.0, respectively. These means are illustrated in Figure 5.

Hypothesis H1a asserted that the number of rounds required for the subject to move to the group position will be significantly greater for the leanest modality treatment, as compared to the richest modality treatment. This was tested statistically using Tukey's multiple comparison approach (Neter, Wasserman and Kutner 1985). This showed that the dispersed GDSS groups did in fact take a significantly greater number of rounds than manual groups; therefore, hypothesis H1a was supported. The *effect size* (Cohen 1988) was calculated as 1.06, which Cohen would classify as a large effect.

It is interesting to note that all of the subjects in the manual condition groups eventually moved to the group position. That is, none resisted the group majority long enough to reach the maximum number of ten rounds. In each of the face-to-face GDSS and dispersed GDSS conditions, however, two subjects refused to acquiesce to the majority.

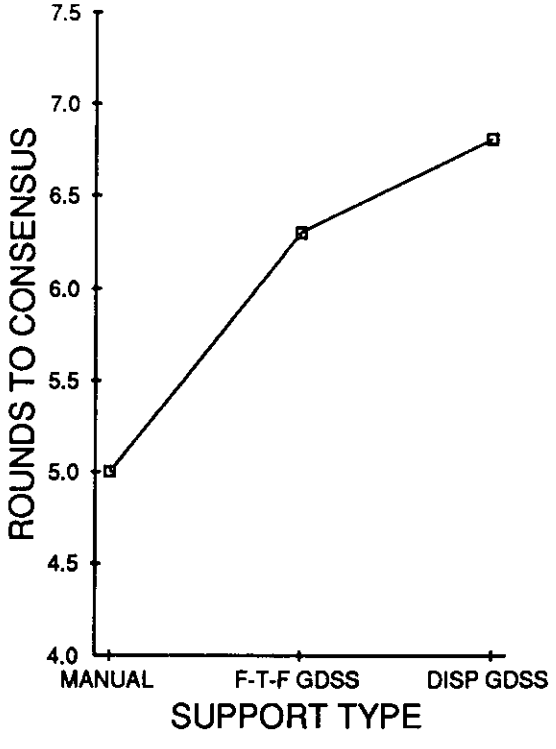


**Figure 5. Mean Number of Rounds for the Three Levels of Support**

### 3.2 Task Type Effects

The effect of the task type was not significant at the 5% level of significance [$F(1,44) = 3.27$, $p = .078$]. Therefore, hypothesis H2 was not supported. The mean profiles by task type are shown in Figure 6. These look as they would be expected to look if hypothesis H2 were correct; however, the distance between the two profiles is not enough, in relation to error variance, to be statistically significant at the 5% level. Using Cohen's approach, the effect size

was calculated to be 0.44. Cohen categorizes this as a small effect, although it is relatively close to the 0.50 value of a medium effect.

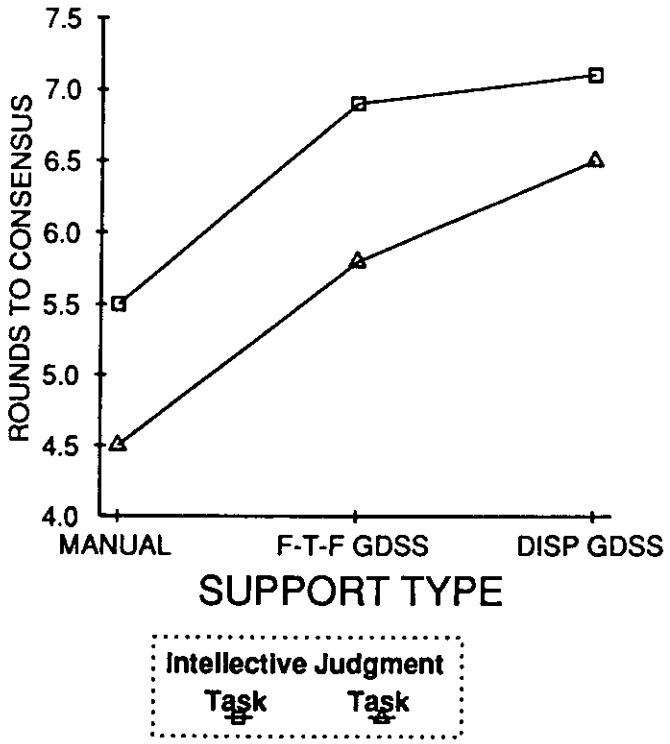


**Figure 6. Mean Profiles by Task Type**

While the task type effect was not significant, the difference between the two most extreme treatments, both in terms of support type and task type, is significant. A simple t-test indicates that the manual groups working on judgment tasks took significantly fewer rounds than the dispersed-GDSS groups working on intellective tasks ($t = 3.33$, $p = .0025$). Therefore, hypothesis H3 is supported. The effect size is 1.42, which Cohen classifies as a large effect.

## 4. CONCLUSION

The conceptual foundations of this study and the experiment described in this paper represent several potential contributions to GDSS research. First, it opens up the broad issue of what are the rational and social aspects of group decision making that should be encouraged or discouraged by GDSS technology. A review of recent research suggests that the GDSS field is strongly oriented towards reinforcing the rational aspects of decision making. The conceptual model utilized in the research reported here explicitly attempts to capture both the rational and social dimensions of human decision makers, thus helping to understand how these two dimensions can often be at cross-purposes.

Second, this research emphasizes the need to explore the exact role of technology as a means of intervening into group processes. Three fundamental design dimensions of technological intervention were described: communication networks, communication modalities, and communication strategies. This represents a micro-level extension of current GDSS theory.

Third, this research demonstrates an effect which has a great deal of relevance to any meeting which is enhanced by GDSS or telecommunication technology. That is, the modality of communication which the group uses has an impact on a fundamental aspect of small group behavior: the tendency of a group to drive individual members towards conformity to the majority position. This research demonstrated that communicating through a leaner communication modality – as would be typical in a telecommunications setting – significantly lessens the power of the group to influence an individual group member.

Finally, this research is framed in the social psychological point of view in terms of trying to understand why and how some specific phenomena happen. In contrast, much of the GDSS research has been characterized by an investigation into the building of systems and has thus been more concerned with demonstrating that an information technology product actually works. While recent GDSS research has concentrated more on the how and why aspects, it is useful to see how another discipline attacks this problem.

One concern which could be raised with regard to this study is the question of its external validity – the extent to which the results generalize to a "real-world" environment. Given that the research was carried out in a laboratory setting, that undergraduate students were used as subjects, and that the procedures were much more restrictive than would be typical of business meetings, this is clearly a valid concern. However, in experimental research there is often a tradeoff between external validity and internal validity – the degree of confidence with which assertions of causality can be made. The same factors which tend to weaken the external validity – factors such as a laboratory setting, student subjects, and restrictive procedures – can result in higher internal validity because they greatly increase the experimenter's ability to control and rule-out alternative explanations for an observed experimental effect.

In this study, the decision was made to attempt to achieve a high level of internal validity. Thus, it was felt that a lab setting with student subjects was appropriate. However, the results of this study should be viewed as an initial step. A richer understanding of the effects of the modality dimension of GDSS on group influence will require research to be done in a field setting as a final test of the effects initially demonstrated in the laboratory.

## 5. ACKNOWLEDGEMENTS

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