

INFORMATION EXCHANGE AND USE IN SMALL GROUP DECISION MAKING

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This study examines information exchange and decision-making processes in small groups that interacted verbally or with a group support system (GSS). Six-member GSS and non-GSS groups worked to solve a hidden profile task in which members had different information and needed to share their information to discover the optimal decision. Both GSS and non-GSS groups exchanged only a small portion of the available information. Both made poor decisions because they lacked sufficient information and failed to effectively use the shared information. GSS groups were less likely to use the shared information, possibly because anonymity reduced the information's credibility or the GSS impaired members' abilities to integrate the newly received information into their existing base of information.

Groups are formed for many reasons, such as sharing workloads, building social networks, gaining support among stakeholders, and training less experienced group members. Groups also are formed to improve decision quality. Individual managers seldom have access to all relevant information; group discussion enables members to share information so that the group as a whole can access a larger pool of information than any one member alone (Shaw, 1981). What little we know about information exchange in group decision making suggests that it is done poorly: Much unique information known to only certain group members is never shared with the group (Stasser, 1992). This unique information can be

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important, leading to poor decisions when it is not considered (Gigone & Hastie, 1993; Stasser & Stewart, 1992).

It is generally accepted that a group support system (GSS) that enables group members to exchange information by typing on a computer instead of, or in addition to, speaking verbally (see Jessup & Valacich, 1993) can fundamentally change the nature of information exchange in group discussion (DeSanctis & Gallupe, 1987; Nunamaker, Dennis, Valacich, Vogel, & George, 1991). Yet there is virtually no empirical evidence available on the nature of these changes. GSS use does result in more ideas during idea generation but often fails to help groups make better decisions (Jessup & Valacich, 1993). This study attempts to understand how GSS use can alter the information exchange patterns in small groups by studying what information group members choose to exchange and how they use it (or do not use it) in making decisions.

INFORMATION AND GROUP DECISION MAKING

INFORMATION DISTRIBUTION

In decision-making situations, group members typically know a host of information about possible alternatives. This information shapes members' prediscussion preferences and, as members communicate information during discussion, shapes the group's decision. The information that members have can be distributed in a variety of ways. It can be known to all members before group discussion ("common"), known to only one member before group discussion ("unique"), or known to some but not all members before group discussion ("partially shared").

Unique information can be distributed so that it is unbiased; that is, the group should reach the same decision with or without the unique information. However, information can be distributed so that the optimal alternative is hidden, called a "hidden-profile task" by Stasser (1992). If group discussion does not raise all available but unique information, the group may make a poor decision. In

this case, the value of unique information is high, but empirical studies have found that much of it is not exchanged (Stasser & Titus, 1985, 1987).

INFORMATION EXCHANGE AND USE

To reach a group decision, members engage in three activities simultaneously: information recall (either from memory or notes), information exchange (either giving or receiving information), and information processing (actually using the information: assessing the cognitive and social implications of the information and storing it in memory) (see Briggs, 1995). Humans have a limited amount of cognitive resources to spread across these three activities (Ball & Zuckerman, 1992). Most people can engage in only one activity at one time, so that engaging in any one activity limits the ability to engage in the other two. For example, actively listening to discussion blocks the processing of newly received information and the recall of related information (Lamm & Trommsdorff, 1973). I consider each activity in turn.

Information recall. Information recall of the group as a whole is biased toward common information, due to the laws of probability. Common information known by all members is more likely to be remembered by at least one individual than is unique information known only to one member (Stasser & Titus, 1987). Thus groups are more likely to focus discussions on common, not unique, information because common information is more likely to be recalled.

Information exchange. The exchange of information in verbal discussions is not perfect. Members must first decide to contribute the information and then have the opportunity to contribute it. Individuals are often motivated to defend or support their initial preference, so the information they choose to contribute often favors their preferences or challenges an alternative (Stasser & Titus, 1985). Information contradicting the preferences of the majority is also less likely to be exchanged (Hackman & Kaplan, 1974).

because members may fear a negative evaluation of their comments (Diehl & Stroebe, 1987; Lamm & Trommsdorff, 1973).

In verbal discussion, only one group member can speak at one time, so all other members are blocked from contributing. This "production blocking" significantly reduces the exchange of information because members who are prevented from contributing information as they choose often forget or suppress it because it seems less relevant or less important later in the discussion (Diehl & Stroebe, 1987; Lamm & Trommsdorff, 1973).

Information use. Once information is exchanged, members must actually process it before it can affect decisions. Petty and Cacioppo (1986) argue that there are two "routes" by which information is processed. The first is the *central route*, in which members actively assess the information and its quality and integrate it into their overall understanding of the situation and their preferences (also called persuasive arguments or information influence). This theory argues that unique information not previously known should be more persuasive than information already known and considered (Myers & Lamm, 1976; Vinokur, Trope, & Burnstein, 1975).

Empirical evidence, however, has found the opposite: Unique information is more likely to be ignored, but common information known to all members prior to discussion has a greater influence on the group's decision (Stasser, Taylor, & Hanna, 1989). There are at least two plausible reasons. First, during verbal discussions, members must constantly pay attention to other members or miss their contributions, and therefore the unique information first received during discussion is processed only superficially and not considered as fully as information studied before discussion. Second, information that supports prediscussion choices is more thoroughly processed and integrated into an individual's cognitive schema (Petty & Cacioppo, 1986), and information challenging initial decisions is discounted (Lord, Ross, & Lepper, 1979; Wood, 1982).

The second route by which information is processed is the *peripheral route*, in which members' preferences are shaped more by peripheral cues, such as the number of people arguing for a

position or their attractiveness, rather than the quality of the information itself (also called social comparison or normative influence). This theory argues that members are motivated to conform to the opinions of others to preserve a favorable self-perception and self-presentation (Myers & Lamm, 1976). After obtaining information about others' preferences, members may change their preference to more closely match others, either through choice or coercion (Hackman & Kaplan, 1974). In addition, publicly stating a preference may make that preference stronger; public commitment may make changing preferences more difficult without losing face (Salancik, 1977) and may cause stronger internalization to reduce cognitive dissonance (Myers & Lamm, 1976).

GSS EFFECTS ON INFORMATION EXCHANGE AND USE

GSS provides new opportunities for information exchange that may differ in important ways from non-GSS environments. One of these is electronic communication, which can augment or replace verbal communication. Electronic communication provides a package of many different components, each of which may introduce new dynamics into the information exchange process. Three components in particular should affect information exchange and use: parallelism, group memory, and anonymity (Nunamaker et al., 1991).

The first, parallelism, is the ability of all group members to enter information at the same time. All group members have computer workstations that enable them to contribute information and opinions by typing ideas that are immediately shared with all other members. Because all members can type at the same time, no participant need wait for others to finish before contributing information. This parallelism mitigates the blocking that inhibits the exchange of information in verbally interacting groups (Valacich, Dennis, & Connolly, 1994).

The second, group memory, means that all remarks typed into the computer are stored so that members can refer to them later in the discussion. One of the key problems in verbal discussion is that listening to group discussion blocks processing of new information,

and information processing blocks the receipt of new information from discussion. A group memory enables members to enter or read information at their discretion; they can more easily pause to process information without the risk of missing information.

The third component is anonymity; group members make contributions without attaching their names, which may motivate them to participate differently. Anonymity may reduce the reluctance to contribute information that contradicts the dominant group preference (Nunamaker et al., 1991). Members also are often motivated to defend or support their initial preference, so the information they choose to contribute favors their preferences or attacks an alternative (Stasser & Titus, 1985, 1987). To the extent that this motivation stems from the need to save face about a publicly advocated decision preference, anonymity, which can obscure both the initial public statement of preference and any subsequent arguments for or against it, may reduce the tendency to contribute information supporting one's initial preferences.

SUMMARY AND HYPOTHESES

Information exchange. An incomplete exchange of information in verbal discussions may lead to poor decisions. As argued earlier, the use of a GSS may increase the amount of information exchanged because it provides parallelism (which reduces blocking) and anonymity (which may reduce the reluctance to contribute information challenging one's own preference or that of the group majority). Therefore,

H1: Members of GSS groups will exchange more information than members of non-GSS groups.

Consistent evidence shows that a greater proportion of common rather than unique information is discussed. Information recall is biased to common information due to probability (more participants have common information). Although GSS may increase the amount of information exchanged, it is unlikely to have significant

effects on the factors encouraging common rather than unique information. Therefore,

H2: Participants are more likely to exchange common information than unique information, regardless of GSS use.

As argued earlier, information exchange often is biased to preference supporting information, because members are motivated to contribute information supporting their preferences due to a perceived need to defend their public positions. Anonymity may reduce this tendency. Therefore,

H3: Participants are more likely to contribute information that supports their prediscussion preferences than neutral or opposing information, although use of a GSS will reduce this.

Information use. As argued earlier, GSS should better enable group members to process information because it provides a group memory that enables members to review information at will. Previous GSS research also has found GSS use to increase a group's use of factual information rather than members' preferences—that is, to increase information influence rather than normative influence (Clapper, McLean, & Watson, 1991; Huang, Raman, & Wei, 1993).

H4: Members of GSS groups are more likely to use the information exchanged in making their decisions than are members of non-GSS groups.

In certain situations, such as hidden-profile tasks, greater use of unique information will enable groups to better identify the optimal alternative. Anonymity also may reduce the pressure to conform to others' preferences and reduce the loss of face in backing down from previous positions, making it easier for members to change their preferences. Therefore,

H5: When information distribution is biased, members of GSS groups will make better decisions than members of non-GSS groups.

METHOD

SUBJECTS

There were 126 junior and senior business students who participated as members of 21 six-person groups and were randomly assigned to one of two treatments (GSS or non-GSS). Subjects were drawn from a core business course that required students to work in three-person groups for three course projects. The experimental sessions were held between the first and third projects, and subjects were instructed to participate with their group members.

TASK

The task was similar to those used in prior hidden-profile tasks (e.g., Stasser, 1992; Stasser & Titus, 1987). It asked subjects to select one student from a set of three students for admission to the university. Four subjects received a subset of information favoring the same suboptimal alternative, and two received a subset of information favoring the optimal alternative. The complete information set included positive, negative, or neutral information on 18 criteria for each alternative for a total of 54 pieces of information. Five pieces of information for all three alternatives were "common"—that is, given to all subjects. The remaining information (13 pieces for each of the three alternatives) was "unique"—that is, distributed so each piece was known to only one subject. Subjects were informed that each individual member did not have all available information and would need to share information to make a good decision.

This task was designed with the assistance of the admissions office. I pilot tested four versions before settling on the final task. The common information presented for each alternative was verbal SAT, quantitative SAT, GPA, sex, and major. The unique information for each alternative was GPA on required courses, missing courses, high school quality, advanced-placement courses taken, extracurricular activities, job experience, military service, letters of

recommendation, state of residence, parents' education, parents' alumni status, parents' marital status, and parents' occupation. All this information is required on the admission form to the university. Some of this information is clearly irrelevant (e.g., parents' marital status), but other information may or may not be important (e.g., state of residence). No explicit statements about the relative importance of the information were given to the subjects, because pilot testing found this to make the task extremely simple. Subjects' beliefs about importance closely matched university policy (see Appendix A). No information was provided about minority status because I feared that this might dominate the discussion and that students' views might differ from official university policy.

The complete information version of the task was independently evaluated by three university admissions officers, all of whom identified the alternative designed as the optimal choice as the best decision. The complete information version of the task also was given to 32 subjects drawn from the same subject pool but who did not participate in the study. Eighteen (56%) correctly identified the optimal choice, 12 (38%) chose the second choice, and 2 (3%) chose the worst.

TREATMENTS

Subjects in the GSS treatment used two software tools from the GroupSystems Electronic Meeting System (Group Outliner and Quick Vote) (see Nunamaker et al., 1991). Subjects were instructed to use the software to exchange information as well as to talk verbally. Subjects in the non-GSS treatment were provided with blackboards to record information (four groups used it).

PROCEDURES

The procedures followed those of Stasser and Titus (1985). Subjects first read the task and made an individual decision. Then they worked together as a group (using either a GSS or no GSS) to arrive at a unanimous group decision or until 30 minutes had elapsed. Finally, subjects completed the postsession questionnaire.

MEASURES

Information exchange. The amount of information exchanged was measured by one rater who counted the pieces of correct information in the group discussions (audiotapes for non-GSS treatments, printed computer records and audiotapes for GSS treatments). A second rater reviewed the discussion from four randomly selected groups (two GSS, two non-GSS). The raters agreed on .96 of the ratings (measured as $1 - [\text{number of disagreements divided by information exchanged}]$), indicating adequate agreement. The extent to which members contributed information that supported, opposed, or was neutral to their prediscussion preferences was assessed by the proportion of unique information in each category that each member contributed.

Information use. Determining information processing and use was done in two ways. First, information use was considered by examining the information learned by each group member at the end of the group discussions; that is, information subjects recalled at the end of the experiment that they did not have in their initial task descriptions. This information must have been received and processed during discussions because information must be processed to be stored in memory (Cacioppo, Petty, & Morris, 1983; Stasser & Titus, 1987). Subjects were asked to list all information they remembered in a free-recall question on the postsession questionnaire. Only the information that the subject did not have at the beginning of group discussion was counted as information learned.

Second, each group's decision was compared to the decision indicated by the information present in the group's discussion (e.g., see Petty & Cacioppo, 1986). When the group decision matched the decision indicated by the information discussed, the group was deemed to have used the discussion information. The number of group decisions matching the information was then expressed as a proportion. The process for determining the decision based on the information in the group's discussion is described in Appendix A.

Outcome measures. Decision quality was measured by the proportion of groups making the optimal decision. Two additional

TABLE 1: Means and Standard Deviations

		<i>GSS</i>		<i>No GSS</i>		
n		M	SD	M	SD	F
Measures						
Information exchanged	21 groups	21.40	8.22	23.27	5.93	0.36
Information learned	125 subjects	1.32	1.75	3.92	3.15	31.10**
Decisions matching information	15 groups	.14	.38	.38	.52	0.96
Decision quality	21 groups	.30	.48	.28	.47	0.02
Subject perceptions (1 = low, 7 = high)						
Cohesiveness	125 subjects	4.81	1.40	5.52	.78	10.07**
Satisfaction	125 subjects	5.72	1.18	6.08	.69	3.44*

* $p < .10$; ** $p < .01$.

perceptual measures were included, with scales of 1 = low, 7 = high: satisfaction (3 items, $\alpha = .78$) and cohesiveness (3 items, $\alpha = .85$). See Appendix B.

RESULTS

Information exchange. H1 was not supported. GSS groups did not exchange more information than non-GSS groups ($F(1,20) = 0.36$, $p = \text{n.s.}$). See Table 1.

H2 was supported. Regardless of treatments, subjects exchanged a greater proportion of common information than unique information ($F(1,38) = 49.31$, $p < .001$). There were no main effects ($F(1,38) = 0.01$, $p = \text{n.s.}$) or interaction effects ($F(1,38) = 0.79$, $p = \text{n.s.}$) due to GSS. See Table 2.

H3 was partially supported. Participants, regardless of treatments, were more likely to exchange information that supported their prediscussion preferences than neutral information or information opposing their prediscussion choices ($F(2,286) = 33.36$, $p < .001$, post-hoc tests using Tukey at $\alpha = .05$). However, there was no interaction between information type and GSS use ($F(2,286) =$

TABLE 2: Proportions of Information Exchanged in Experiment 1

<i>Measures</i>	<i>GSS</i>		<i>No GSS</i>	
	M	SD	M	SD
Proportion of information exchanged				
Common information	.68	.20	.64	.15
Unique information	.30	.15	.35	.10
Proportion of unique information exchanged				
Preference supporting information	.45	.41	.64	.37
Preference neutral information	.12	.21	.19	.28
Preference opposing information	.27	.38	.50	.42

1.36, $p = \text{n.s.}$), but there was a significant GSS main effect: GSS groups exchanged a lower overall proportion of information ($F(1,286) = 14.93, p < .001$). (These tests were performed only on the unique information, not on both unique and common information as in H1.) See Table 2.

Information use. H4 was not supported. First, members of GSS groups reported learning less initially unknown information than members of non-GSS groups ($F(1,124) = 32.10, p < .001$). Second, using the judges ratings' of information importance, only 15 groups had sufficient information in their discussions to indicate one alternative over the others (7 GSS, 8 non-GSS). This information indicated the optimal decision for 6 GSS and 5 non-GSS groups. There were no significant differences in decisions: 1 GSS group (14%) and 2 non-GSS groups (38%) made the decision indicated by the information in the group discussion ($F(1,13) = .96, p = \text{n.s.}$). The same pattern is present using the students' ratings of information importance.

H5 was not supported. GSS groups did not make better decisions ($F(1,20) = 0.02, p = \text{n.s.}$).

Subject perceptions. Members of non-GSS groups reported more cohesiveness ($F(1,124) = 10.07, p < .001$) but no differences in satisfaction, although this measure approached significance ($F(1,112) = 3.44, p < .067$).

DISCUSSION

Contrary to our expectations, GSS use did not increase the amount of information exchanged. Both GSS and non-GSS groups exchanged only a small amount of the available information. Discussion focused on common rather than unique information, and members were more likely to contribute information supporting their prediscussion preferences than neutral information or information opposing their preferences. About half of the groups (six GSS and five non-GSS) exchanged sufficient information to identify the optimal choice.

Group members did not use the available information effectively. Both GSS and non-GSS groups made poor decisions. Only one GSS and two non-GSS groups actually made the decision indicated by the information present in their discussions. Members of non-GSS groups learned more information from the discussion, suggesting that they were more likely to have actually thought about and processed the information contributed by others.

Previous research has found that discussions in non-GSS groups tend to be ill-structured and focus on only a few pieces of common information (Stasser & Titus, 1985, 1987). This was observed for only two non-GSS groups in this study. The other nine non-GSS groups adopted rather similar semistructured processes. In these groups, one or two group members quickly became the discussion leaders. They polled the other members for their choices, and the group quickly discovered that some members had different preferences from that of the majority. Minority members were asked to provide reasons, at which point they contributed one or more pieces of unique information unknown to the rest of the group. This triggered an immediate reaction; the discussion leader noted the new information and suggested that members take turns contributing information that they each had to ensure that all important information was discussed. Each member was then polled for information. Once all members had contributed their information, the group discussed it (possibly arguing) until reaching a decision.

This polling of members resulted in the discussion of an average of 64% of the available common information (mean of 9.6 pieces

out of 15 available) and 35% of the available unique information (13.7 of 39). In contrast, Stasser et al. (1989) found six-member non-GSS groups to discuss 48% of available common information and 11% of available unique information. The greater exchange of information here may be due to the different task.

GSS groups did not adopt such structured processes but nonetheless discussed a similar amount of information. Although they were instructed that they could speak verbally as well as communicate electronically, only two GSS groups communicated verbally to any extent. All the other groups spent virtually the entire time typing comments without speaking. Here, no discussion leader emerged, and, as a result, the group did not adopt any polling strategy. Members typed information as they chose and discussed the information contributed by others, interspersed with argumentative comments. Minority members were again queried for their information, but there was considerable delay between the query and the response due to the electronic medium.

One key question was why GSS use did not encourage a greater exchange of information. Previous GSS research suggests that GSS use is best suited to more complex tasks undertaken by larger groups than those studied here (see Jessup & Valacich, 1993). It is possible that larger groups may benefit more than the smaller six-member groups used here (cf. Dennis, 1993).

Both types of groups failed to use the newly received, unique information in making their decisions. One possibility may lie in group members' abilities to integrate newly received information into their existing information base. Members must engage in three simultaneous activities (information recall, information exchange, and information use), and because people have a limited amount of cognitive resources, engaging in any one activity limits the other two. Factual information requires more cognitive processing than information about others' preferences (Petty & Cacioppo, 1986), so when group members receive information too quickly, they may process information about others' preferences more readily than factual information.

The evidence suggests that members of GSS groups were less likely to use and learn the exchanged information. A study by

Morley and Walker (1987) suggests that to cause a change in a previous decision, information must be important, novel (i.e., not previously processed), and plausible. In this case, the key information received in the discussion was both important and novel. But was it plausible? One of the more interesting debriefing comments was made by a subject who claimed not to believe *any* of the information in the GSS discussion because it was difficult to identify its source and verify its accuracy. Thus one potential reason for the lack of information processing in GSS groups may be that information received anonymously in electronic form lacks the credibility of listening to a specific person say it verbally.

A second interpretation may be that the reduced ability to challenge the information contributor in GSS groups reduced credibility. In all non-GSS groups, I observed at least one (usually several) occasions when unique information presented to the group was immediately challenged (e.g., "Really? I didn't get that."). The contributor would then confirm the validity of the information, and discussion would move on. Similar challenges were seen in GSS groups, but the response would come much later or not at all. It may be that the reduced ability to provide immediate, confirming feedback reduces credibility.

One key problem for both GSS and non-GSS groups was the difficulty in assessing and integrating newly received information that encouraged members to overlook it in favor of the information assessed and integrated prior to discussion. The implication is to structure meetings (both GSS and non-GSS) to provide time for members to assess and integrate new information before they must make decisions. One option is to separate information exchange from the decision making that uses it; groups could hold one meeting to discuss a problem or opportunity, break for several hours or days to evaluate and integrate the information, and hold a second meeting to make the actual decision. This structure is similar to the "incubation" period recommended for idea generation. Another alternative is to develop new group processes and tools to help members integrate information, but this will have to wait for more research.

APPENDIX A

DETERMINING INFORMATION-BASED DECISIONS

The decision indicated by the discussions was determined by calculating a score for each alternative based on only the information present in the discussion. This score was calculated by asking three judges to rate the importance of each type of information, using a scale of 1 = not important, 4 = neutral, and 7 = very important. Interjudge reliability was adequate ($\alpha = .84$). The six items receiving a mean score greater than 4 were deemed to be "important:" verbal SAT, math SAT, GPA on academic courses, advanced-placement courses, quality of high school, and courses missing from the state's prescribed university prep curriculum.

To assess the extent to which the student subject held similar opinions, a set of 204 students, drawn from the same population as the subjects, was asked to perform the same rating. Their ratings were similar to those of the judges (the correlation between the judges' means and the students' means was .72), but the students rated an additional four items with a mean score greater than 4: participation in extracurricular activities, unadjusted GPA (i.e., including nonacademic courses such as typing), letters of recommendation, and motivation to attend university.

The score for each alternative was calculated first by using the judges' ratings of information importance and then the students' ratings. Analyses were done on both the judges' and students' ratings. Discussions were considered to contain sufficient information to indicate a decision if the score for one alternative was 6 or more points higher than all other alternatives (i.e., superior to all others by one "highly important" criterion or two "moderately important" criteria). As an aside, I want to note that using this process on the complete information version of the task would lead to the choice of the optimal decision.

APPENDIX B

QUESTIONNAIRE MEASURES

SATISFACTION

How do you feel about the process by which your group made its decision?

Very Satisfied Neutral Very Dissatisfied

1	2	3	4	5	6	7
1	2	3	4	5	6	7

How do you feel about the group's discussions?

Very Satisfied Neutral Very Dissatisfied

1	2	3	4	5	6	7
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All in all, how do you feel?

Very Satisfied Neutral Very Dissatisfied

1	2	3	4	5	6	7
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COHESIVENESS

Considering the people with whom you worked in this experiment, to what extent are the people in this group helpful to you in getting the job done?

Very Helpful			Neutral			Not Helpful at All
1	2	3	4	5	6	7

Considering the people with whom you worked in this experiment, to what extent do you trust the members of this group?

A Great Deal of Trust			Neutral			No Trust at All
1	2	3	4	5	6	7

Considering the people with whom you worked in this experiment, to what extent do you look forward to being with this group?

Very Much			Neutral			Not at All
1	2	3	4	5	6	7

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