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ABSTRACT

The application of heuristic devices has been proposed as one approach to improving consensus decision making. The heuristics are intended to provide problem structuring and, more broadly, to improve the process of interpersonal collaboration in work settings. This study drew from research on group decision making (e.g., Shaw 1971; Poole 1983), problem structuring (e.g., Abualsamh, Carlin and McDaniel in press; Cats-Baril and Huber 1987), computer-mediated communication (e.g., Kiesler, Siegel and McGuire 1987), and technology adoption (e.g., Poole and DeSanctis 1989) to compare alternative approaches to delivery of decision heuristics for a task requiring resolution of competing values and preferences. Based on the arguments of adaptive structuration theory and social judgment theory, we hypothesized that the addition of a general heuristic to a specific, computer-based heuristic would improve group consensus; that is, the greater the comprehensiveness of the heuristic, the greater the gain in consensus. We further anticipated that combining general and specific heuristics in an integrated, interactive form would bring additional gains in group consensus. Greater restrictiveness in how the groups could execute the heuristic devices was also expected to improve group consensus, especially in cases where the specific heuristic was not coupled with the general heuristic. The results supported some of these predictions. By comparing heuristics in terms of their comprehensiveness and restrictiveness, we developed some understanding of how decision heuristics might be implemented within a computer-supported meeting environment.

1. INTRODUCTION

Consensus decisions are judgments for which there are no "correct" solutions but only more or less acceptable outcomes (McGrath 1984). For these types of decisions, objective measures rarely exist, leaving organizations to recognize only relatively good or relatively bad decisions, with little refinement in knowledge of quality (Van de Ven and Delbecq 1974). Examples include selection among a list of candidates for a job, prioritization of organizational goals, or allocation of surplus resources. These are judgment tasks that frequently involve resolution of value differences among individuals or organizational units.

The application of heuristic devices has been proposed as one approach to improving consensus decision making. Development and evaluation of group decision heuristics has yielded a rich research literature (e.g., Cosier 1982; Hall and Watson 1970; Herbert and Yost 1979; Rodrigues 1984; Rohrbaugh 1981; Van Gundy 1981). This literature offers several types of heuristics: low or high comprehensive; restrictive and nonrestrictive; divergent and convergent. The current study varied the first two dimensions in a computerized meeting environment to address two questions: (1) does the effectiveness of a more comprehensive (specific) heuristic improve when it is coupled with a less comprehensive (general) heuristic, yielding a highly comprehensive heuristic? (2) does greater restrictiveness in the implementation of heuristics improve their impact on consensus? and (3) does the effect of restrictiveness vary as a function of comprehensiveness? Based on the arguments of adaptive structuration theory (Poole and DeSanctis 1989) and social judgment theory (Stewart and Gelberd 1976), we hypothesized that coupling a general heuristic with a specific heuristic, to yield a highly comprehensive heuristic, would improve group consensus. We further anticipated that presenting general and specific heuristics in an integrated, interactive form would bring additional gains in group consensus, and that greater restrictiveness in how the groups could execute the heuristic devices would improve group consensus. By comparing heuristics along these dimensions, we hoped to determine how consensus tasks might be structured and, more generally, to develop some understanding of how decision heuristics might be implemented within a computer-supported meeting environment.

2. HEURISTICS AND CONSENSUS DECISION MAKING

According to behavioral decision theorists, people apply "rules of thumb" -- intuitively or socially acquired heuristics -- to guide their choices and actions. Unfortunately, people often apply ineffective rules of thumb to decision situations, thus failing to meet their desires of rationality (Frank 1987). In the group setting, the application of ineffective heuristics has been well documented (Janis 1972; Van de Ven and Delbecq 1974). In the case of consensus decision tasks, decision theorists propose that groups can solve complex problems more effectively if their discussion includes high member participation and a decision-making structure (Becker and Baloff 1969; Holloman and Hendrick 1972; Shaw 1971). They propose that groups be give supplemental heuristics that structure information generation and handling during the decision process (Holloman and Hendrick 1972). Thorough evaluation and critiques of inferences and assumptions are considered essential to an effective group process (Janis 1972; Stewart and Gelberd 1976).

A variety of heuristics, or decision techniques, have been proposed for use in group consensus tasks (see Van Gundy 1981). Although these could be described in terms of the specific advice that they provide to groups, they are more meaningfully distinguished in terms of two fundamental dimensions: comprehensiveness and restrictiveness.

Comprehensiveness refers to how general or specific is the structure provided by the heuristic. The heuristic represents a resource, in the form of a structure for group process, and this resource may vary in the degree of specific support activities that it provides to the group. Adaptive structuration theory, a theory of technology adoption, defines these aspects as the heuristic's "spirit," or general ends and attitudes the heuristic aims to promote, and its "structural features," which are the particular set of activities or capabilities that the heuristic provides (Poole 1983; Poole and DeSanctis 1989). A general heuristic emphasizes a philosophy of decision-making and is limited in the particular advice it gives to decision makers (Abualsamh, Carlin and McDaniel in press; Cats-Baril and Huber 1987). A specific heuristic emphasizes the particular structural features and instructs the decision makers to apply a specific set of activities during the decision process. A given heuristic may contain both general and specific elements, but the heuristic tends to stress one aspect over the other.

The Consensus Approach as outlined by Hall and Watson (1970) exemplifies a general, or less comprehensive, heuristic for consensus decision making. It emphasizes a spirit of participation and tolerance, encouraging divergence in group thinking. Group members are advised to openly state their viewpoints and be tolerant of one another, but the heuristic gives no specific instructions on the process for group discussion or the structure of argumentation; that is, the heuristic provides few explicit structural features.

Well known specific heuristics that are high in comprehensiveness and emphasize the group's use of specific structural features, include Rational Reflection (Dewey 1910; McBurney and Hance 1939; Barnlund and Haiman 1960), the Nominal Group Technique (Van de Ven and Delbecq 1974), the Delphi Method (Dalkey 1972), the Noninteractional method (Rodrigues 1984), Strategic Assumptions Surfacing and Testing (Mason and Mitroff 1981), and Social Judgment Analysis (Rohrbaugh 1981). In recent years, comprehensive heuristics such as these have begun to be embedded in computer software systems intended for use by groups during decision making (e.g., DeSanctis, Sambamurthy and Watson 1987; Nunamaker, Applegate and Konsynski 1988).

In addition to their comprehensiveness, heuristics can also be distinguished in terms of their *restrictiveness*. A group decision heuristic is restrictive to the extent that it limits, or channels, the group's use of the resources inherent in the heuristic (Silver 1988).[1] The heuristic is highly restrictive if the structural features are sequenced and instruction is given on their execution; the heuristic actively excludes the use of other (and presumably less effective) approaches to managing the decision process. When heuristics are restrictive, group members are less likely to bring old ways of behaving or rules of thumb to bear when applying the heuristic. Alternatively, if the heuristic is less restrictive, then it is implemented in an open-ended fashion; structural features are made available to the group, but the members are left to their own devices to determine exactly how the features are to be implemented during group discussion. The degree of restrictiveness is not so much a characteristic of the heuristic itself as its implementation. That is, the Consensus Approach, the Nominal Group Technique, and Social Judgment Analysis may be more or less restrictive depending on the degree to which group members can opt to execute the features in a particular sequence or fashion or to ignore them altogether.

There is ample evidence that groups can benefit from the structure provided by heuristics. Indeed it appears that even a modest addition of structure to the decision process helps to overcome some of the difficulties associated with natural, "free interacting" groups (Smith 1973). However, there is less conclusive evidence on the relative effectiveness of available heuristics or on the importance of the dimensions of comprehensiveness and restrictiveness. As group decision heuristics become embedded into computer systems, questions arise about what heuristics should be included in these systems and how they should be presented to users. Given that group members are faced with a consensus decision, should they employ a general or a specific heuristic, or both? a more restrictive heuristic or a less restrictive heuristic? In other words, how do comprehensiveness and restrictiveness in heuristics affect group consensus? Our study aimed to examine this problem.

3. HYPOTHESIZED EFFECTS OF HEURISTICS

3.1 Effects of Comprehensiveness

There is reason to expect that certain *general heuristics, such as the Consensus Approach, will be sufficient to promote consensus (agreement) in a group.* Consensus is the degree to which individual group members will make the same decision as the group following discussion. Studies by Hall and Watson (1970), Nemiroff and King (1975), and Nemiroff, Passmore and Ford (1976) demonstrate that the Consensus Approach leads to higher levels of group consensus than an unsupported, free interacting approach to decision making. This result is consistent with the reasoning of the theories of social comparison (Festinger 1954) and persuasive arguments (Vinokur and Burnstein 1974). Put in terms of adaptive structuration theory, the spirit of the heuristic is sufficiently powerful to promote participation and information sharing in the group; a rich set of structural features is not required. The Consensus Approach, which encourages the group to state and explain their positions but gives few specific instructions on the steps for group discussion or the structure of argumentation, is a general heuristic that should be adequate for promoting group consensus.

General heuristics can be simply stated -- usually in a page or two of text -- and do not require computerization or other elaborate means of presentation to decision makers. How should more specific, comprehensive heuristics be presented to users? For these heuristics to successfully influence consensus, they must be used, and used properly, by the group during discussion. Yet, when left to their own devices, decision makers are known to resist or fail to fully use heuristics effectively for a variety of reasons, including unfamiliarity with the decision method (novelty of the new procedure and cognitive load associated with applying it) and a preference for including nonrational, emotive elements in choice and judgment (DosSantos and Bariff 1988; Zigurs, DeSanctis and Billingsley 1989; Howard 1988). Indeed, the richer the heuristic in comprehensiveness, that is, the more structural features or philosophical elements it contains, the more difficult the adoption process may be. Given the difficulty of implementing comprehensive heuristics, what can be done to encourage their successful use?

One proposed approach for facilitating adoption of comprehensive heuristics has been the use of computer programs during group discussion (DeSanctis and Gallupe 1987; Huber 1984). The hope is that interactive computing may ease application of the heuristics, obviating the need for a group facilitator or special training in the heuristic (Dickson et al. 1989). Computing can take over some of the computational burdens associated with specific structural features (such as recursive voting or calculation of group judgment scores) and provide groups with rapid feedback on the ideas of individuals and where individuals stand with respect to the group's judgments. Despite these potential advantages, the research to date is disappointing with respect to the actual benefits realized with computer delivery of heuristics. Several studies have found no advantage of computers over paper and pencil as a delivery method for specific heuristics (Cats-Baril and Huber 1987; Easton, Vogel and Nunamaker 1989; Watson, DeSanctis and Poole 1988). One difficulty may be that when comprehensive heuristics are implemented in computer systems, they are typically not coupled with general heuristics. That is, the group is provided with a set of structural features but given little or no general information on the spirit of the heuristic. To improve effective use of computerized heuristics, it may be important to enrich the specific heuristic by adding a general heuristic. This may be particularly important when the heuristic is made available for the group to use on their own, without extensive training or use of a facilitator. From an adaptive structuration theory viewpoint, an explicit statement of the spirit of the heuristic should encourage successful adoption of the structural features made available to the group. We can hypothesize that *coupling a specific heuristic with an appropriate general heuristic to a specific heuristic will improve group consensus over use of the specific heuristic alone.*

Presuming that both general and specific heuristics are provided, how should they be presented to users? Cats-Baril and Huber (1987, p. 351) have observed that "For decision aids designed to address ill-structured problems, it is not clear that *computer delivery* is useful. We could find no evidence from the marketplace or from research literature suggesting that this is the case." It may be that merely presenting heuristics on a computer screen will not provide any added value over listing the heuristics on a sheet of paper; but if a system is devised to interactively facilitate use of the highly comprehensive heuristic throughout the meeting, then it may serve to ease the cognitive load of the group as they adopt new decision methods to replace old, preferred decision patterns (Cats-Baril and Huber 1987; Howard 1988). There is some preliminary evidence that this may indeed be the case (Cats-Baril and Huber 1987). In short, the combination of specific and general heuristics and interactive delivery should provide the most effective support for group decision making. So we hypothesize that *if multiple heuristics are supplied to the group, such as a combination of general and specific heuristics, then presenting* *them in an integrated, interactive fashion should improve their effectiveness over presenting them without such integration.*

3.2 Effects of Restrictiveness

In addition to coupling a general heuristic with a specific heuristic and presenting the heuristics in interactive form, successful adoption may also be affected by the degree of restrictiveness in the implementation of the heuristic. Supplemental heuristics represent external resources, or structures, that groups struggle to incorporate into already learned approaches to decision making (Poole and DeSanctis 1989). Adaptive structuration theory would predict that the way in which groups adjust to these novel structures is highly variable, depending on the group's cognitive interpretations of the structures, early experiences with the structures, prevailing practices with related structures, and so forth (Poole, Seibold and McPhee 1985). Since the combination of these forces is unique in every group, adaptation to structures is idiosyncratic to the group. Consequently, heuristics cannot be implemented in a way that guarantees their effectiveness. Decision analysts can, however, more or less channel group response to structures by increasing their degree of restrictiveness (Silver 1988).

To the extent that increased restrictiveness in the heuristic encourages its full use (rather than partial use or abandonment) and channels effective learning of the heuristic (Silver 1988), restrictiveness should reduce variance in group adaptation and improve the probability of successful adoption. On the other hand, we also know that many groups are capable of reaching good decisions without following a strict sequence of decision steps or proceeding with a highly organized approach (Hirokawa 1985; Payne and Bettman 1987); restrictiveness will not guarantee an improvement in decision consensus -- even if the restriction is objectively rational and logically sound. The importance of restricting execution of heuristics may be dependent upon the degree of comprehensiveness in the heuristic. *If a set of structural features are provided to the group (i.e., a specific heuristic) without a general statement of philosophy (i.e., an appropriate general heuristic), then restriction may enhance the probability of successful adoption of the heuristic. But adding an appropriate statement of philosophy (i.e., a general heuristic) may reduce the need for restrictiveness* during implementation, since the group will be less likely to bring in learned, ineffective rules of deciding when this component is added to the heuristic; the general heuristic cues them on how to use the structural features of the specific heuristic without *constraining* the way in which they employ these resources. That is, if the heuristic is adequate in communicating its spirit and structural features to the group, excessive restrictiveness may be stifling to the group, prohibiting active, constructive adaptation to the technology; in adaptive structuration terms, excessive restrictiveness may cause groups to lose their sense of ownership and control over the technology that is there to support them -- thus reducing group consensus rather than enhancing it. But, regardless of level of comprehensiveness, *restriction should help the group move smoothly through the structural features in the specific heuristic, discouraging group members from "getting off the point" during discussion, and thus reducing the time required to reach a decision.*

4. OVERVIEW OF THE STUDY

In order to test the hypothesized effects of comprehensiveness and restriction in heuristics on consensus and decision time, a laboratory experiment was conducted comparing consensus-seeking groups on three levels of comprehensiveness and two levels of restrictiveness, resulting in a 3 X 2 factorial design. One additional treatment, constituting a control group, was conducted subsequent to the study and will be described later.

Comprehensiveness was varied by providing groups with either (a) a specific heuristic alone (referred to as the "specific alone" treatment), (b) both a specific and a general heuristic -- presented together but not in an integrated form (the "coupled" treatment), or (c) an integrated package containing both the specific and general heuristics -- so that the two heuristics would appear as one highly comprehensive heuristic (the "integrated" treatment). The specific heuristic consisted of a social judgment policy approach to decision making (Rohrbaugh 1981) that cued groups to define and discuss the problem; identify and weight criteria for evaluating alternative solutions to the problem; consider alternative solutions to the problem; and evaluate the alternatives using recursive rating, ranking, and/or voting procedures, with intermittent discussion of aggregated information. The features within the heuristic were ordered to encourage divergent thinking (expansion of the range of ideas to be considered) followed by convergent thinking (reduction to a viable set of alternatives) (Abualsamh, Carlin and McDaniel in press), consistent with the ordering of structural features within Social Judgment Analysis (Rohrbaugh 1981), Rational Reflection (Barnlund and Haiman 1960; Dewey 1910; McBurney and Hance 1939), the Nominal Group Technique (Van de Ven and Delbecq 1974), and the Noninteractional method (Rodrigues 1984). Jointly these structural features promote vigilant decision making (Janis and Mann 1977). The specific heuristic was made available through a computer system.

The Consensus Approach (Hall and Watson 1970) served as the general heuristic. It consists of a general statement of philosophy on the meaning of consensus and six general guidelines for achieving consensus. In the coupled treatment, groups were provided with the specific heuristic *and* the Consensus Approach. They were instructed to use both heuristics in their decision process. In the integrated treatment, the heuristics were woven together to provide an integrated package for the group.

Restrictiveness was varied by instructing groups to either (a) use all of the available structural features and apply them in a sequential fashion until a decision was reached (higher restrictiveness), or (b) select the features that seemed most useful and apply them in any meaningful order (lower restrictiveness).

4.1 Subjects

Experimental participants were 239 students enrolled in upper division courses within a college of business at a large midwestern university. On average the students were 25 years old, with 2.5 years of full-time work experience. Many of the students were employed full-time in business settings when the study was conducted, and most were working at least part-time. The students were organized into 56 groups of three, four, or five members who were working as business teams for various class projects. The teams were "live" groups in that they were actively working together on class assignments at the time the study was conducted. The teams had met an average of seven times prior to participating in the study, for an average of 1.57 hours per meeting. The teams participated in the study voluntarily, and they received a modest number of course points for their participation. Although the use of live groups prohibited random assignment of subjects to groups, prior research on group decision making indicated that whenever possible groups with a meaningful history and future should be used for experimental research; in this way the initial socialization that occurs early in group formation can be avoided during the data collection (Bormann 1970). Groups were randomly assigned to experimental treatments.

4.2 The Consensus Task

"The Foundation Task," developed by Watson, DeSanctis and Poole (1988), served as the consensus task. This task requires group members to allocate a sum of money among six competing projects that have requested funds from a philanthropic foundation. Value conflict arises because the team members have varying preference structures that result in different allocation patterns. The six projects that subjects can fund are based upon the six personality components described by Spranger (1928): theoretical, economic, aesthetic, social, political, and religious. The task was validated against the Study of Values instrument (Allport, Vernon and Lindzey 1970). It is considered to be a difficult task because of its low analyzability and because cause-effect relationships are not clear (Ito and Peterson 1986; Van de Ven and Delbecq 1974). Validation data show that there is no solution that will be equally acceptable to all interest groups involved and that the task evokes very strong subject involvement (see Watson, DeSanctis and Poole 1988).

4.3 The Computer System

All treatments accessed the specific heuristic through a computer system developed at the University of Minnesota for support of group decision making (DeSanctis, Sambamurthy and Watson 1987). The system has been used in prior studies of group judgment and choice (Dickson et al. 1989; Watson, DeSanctis and Poole 1988; Zigurs, Poole and DeSanctis 1988). For the current study, the computer system incorporated the features described in the Overview above. To access the system, group members were seated at a horseshoe-shaped table, with a terminal and display screen for each group member and a large "public" viewing screen in front of the group. Individuals could enter problem definitions, alternative definitions, weights, ranks, and votes from their private terminals. The system then performed the functions of recording, storing, and displaying group ideas, comments, and aggregated (average and ranges) voting information. The system is easy to use and menu-driven and does not require a facilitator or technician for operation.

4.4 Procedure

The experimental procedure was as follows:

1. Individuals listened to a standard introductory script read by the experimenter, then read a background statement for the Foundation Task.

2. Individuals completed a consent form, a background questionnaire, and then allocated funds to a series of five sets of six projects each that had requested support from the philanthropic foundation. One of these sets of six projects was used to calculate pre-meeting consensus for the group and served as the task for the group decision in the next step of the procedure. The other five sets were given to provide practice in the task and to help stabilize reasoning processes.

3. Groups were given training in the heuristic associated with their treatment. This involved going through a packet of paper materials describing the features of the heuristic and learning how to use the computer system. Training time lasted approximately 40 minutes in the specific treatment, 46 minutes in the coupled treatment, and 48 minutes in the integrated treatment. All groups were shown how to use each structural feature of the heuristic in a sequential manner. High restrictive treatments were instructed that they must follow the same sequence during their group discussion and use every structural feature, whereas low restrictive treatments were told that they could use the features in any order, and that they did not have to use every structural feature in the course of their group meeting.

4. Groups allocated funds to the six projects requesting support from the philanthropic trust.

5. To determine post-meeting consensus, individuals once again individually allocated funds to the six projects requesting support from the philanthropic trust.

5. RESULTS

To test for the hypothesized effects of comprehensiveness, restrictiveness, and their interaction on group consensus, a full-factorial analysis of covariance was conducted. Pre-meeting consensus and group size were included as covariates. Levels of pre-meeting consensus were controlled in accordance with findings of Castore and Murnighan (1978) and Watson, DeSanctis and Poole (1988) that suggested an interaction between pre-consensus and decision procedures in predicting decision outcomes. Similarly, group size has been found in some studies to be related to outcomes (e.g. Hackman and Vidmar 1970; Holloman and Hendrick 1971; Thomas and Fink 1963). A probability value of less than .05 was applied to all tests of statistical significance.

Pre-meeting and post-meeting consensus were calculated using the method developed by Spillman, Spillman and Bezdek (1980). This method produces a scale in the range of 0 to 1 where 1 implies complete agreement in the group. Tables 1 and 2 provide descriptive statistics for each experimental treatment on measures of pre-meeting and post-meeting consensus. Analysis of covariance (Table 3) indicates a significant regression model, with significant effects associated with the comprehensiveness treatment and the group size covariate. A posteriori t tests indicate that post consensus was significantly higher in the coupled treatment than in either the high alone (p=.04) or integrated treatments (p=.001). The larger the group, the lower the group's postconsensus (r=-.42, p=.003).

Table 1. Mean Scores (and Standard Deviation and Cell Size) on Pre-meeting Consensus for Six Experimental Conditions

	Comprehensiveness			
Restrictiveness	Specific Alone	Specific + General Coupled	Specific + General Integrated	Overall
Higher	.260 (.09) (N=10)	.236 (.08) (N=9)	.256 (.04) (N=9)	.250 (.07) (N=28)
Lower	.277 (.12) (N=9)	.262 (.09) (N=10)	.254 (.08) (N=9)	.264 (.10) (N=28)
Overall	.268 (.11) (N=19)	.249 (.08) (N=19)	.255 (.06) (N=18)	.257 (.08) (N=56)

Table 2. Mean Scores (and Standard Deviation and Cell Size) on Post-meeting Consensus for Six Experimental Conditions

	Comprehensiveness			
Restrictiveness	Specific Alone	Specific + General Coupled	Specific + General Integrated	Overall
Higher	.417 (.16) (N=10)	.608 (.15) (N=9)	.538 (.21) (N=9)	.521 (.17) (N=28)
Lower	.446 (.13) (N=9)	.647 (.23) (N=10)	.457 (.13) (N=9)	.517 (.16) (N=28)
Overall	.431 (.14) (N=19)	.628 (.19) (N=19)	.498 (.17) (N=18)	.519 (.17) (N=56)

Table 3. Analysis of Covariance for Effects of Comprehensiveness and Restrictiveness on Post-Meeting Consensus

	SS	df	MS	F	p
Within Cells	1223571	48	25491		
Regression	327783	2	163891	6.43	.003*
Comprehensiveness	387486	2	193742	7.6	.001*
Restrictiveness	1559	1	1559	.06	.806
Compr X Restr	25745	2	12872.50	.607	
			Beta	t	p
Preconsensus			.183	1.3	.197
Groupsize			-78.38	-3.6	.001*

* p < .05

These results suggest that the addition of the general heuristic to the specific heuristic improved group consensus, as hypothesized. However, consensus was not higher in the integrated treatment than in the coupled treatment. One potential explanation is that the groups in the coupled treatment relied on the general heuristic rather than the specific heuristic to make their decision (i.e., because the two heuristics were not integrated, they ignored the specific heuristic during their discussion). To check this, we did several things. First, we analyzed computer system logs to test for differences across treatments in their use of the specific heuristic's structural features. Analysis of variance revealed no significant differences in total feature use across treatments (F=.82, df=48,2, p=.445). Next we searched for differences in the types of features used by each treatment and discovered that the integrated treatment used the criteria weighting feature significantly more than either of the other two treatments (p=.03 for the coupled treatment; p=.003 for the high alone treatment). This suggests that groups in the integrated treatment engaged in more policy capturing activity than the other two treatments -- a process that is more typically associated with decision quality than consensus (Rohrbaugh 1981). The effort devoted to discussion of judgment policies in the integrated treatment may explain lower consensus in this group than in the coupled treatment, but it still leaves the possibility that the specific heuristic was somehow preventing groups from achieving consensus. Did the specific heuristic get in the way of groups achieving consensus? Although there was no theoretical reason to expect this to be the case, we were concerned that there might have been some problem in our implementation of the specific heuristic in our computer system. We distributed the Foundation Task with the general heuristic alone to 12 additional groups. We then tested the null hypothesis of no difference between these control groups and the other experimental treatments. Post consensus was higher in the control groups than in the high alone or integrated treatments; however, analysis of variance revealed no difference between the control groups and the coupled treatment (F=.12, df= 19.1, p=.74). It seems that, although the general heuristic enhanced decision consensus, the specific heuristic did not detract from the groups' ability to achieve consensus.

The hypothesized effects of restrictiveness on consensus were not observed. We had anticipated that greater restrictiveness would enhance consensus in the high alone treatment more than in the other two treatments. In fact, the only gain due to restrictiveness occurred in the integrated treatment; here groups who used the heuristics with more restriction experienced substantially more change in consensus than those who were less restricted. It may be that the highly comprehensive nature of the integrated treatment was so overwhelming to groups that it was here that restrictiveness could lead to meaningful advantage. In the other two treatments, groups were able to manage quite effectively (at least in terms of our consensus measure) without restriction in their use of the heuristics. Higher restrictiveness did not improve effective use of the heuristics.

Higher restrictiveness did not bring consistent efficiency gains to the groups. There was less variance in the higher restrictiveness groups than in the other treatment, but overall discussion time was actually higher in these groups than in the less restrictive treatment (though not significantly so). When the heuristics included more than the specific heuristic alone, restrictiveness did reduce decision time. The greatest efficiency gain due to restrictiveness was in the coupled treatment where higher restrictiveness led to significantly lower decision time (see Table 4).

Table 4. Mean Scores (and Standard Deviation and Cell Size) on Decision Time for Six Experimental Conditions

	Comprehensiveness			
Restrictiveness	Specific Alone	Specific + General Coupled	Specific + General Integrated	Overall
Higher	78.0 (03) (N=10)	79.8 (22) (N=9)	93.11 (10) (N=9)	83.6 (11.7) (N=28)
Lower	50.8 (31) (N=9)	92.0 (8.7) (N=10)	99.3 (27) (N=9)	80.7 (22.2) (N=28)
Overall	64.4 (17) (N=19)	85.9 (15.3) (N=19)	96.2 (18.5) (N=18)	82.15 (16.9) (N=56)

6. CONCLUSION

Consistent with social comparison theory and the theory of persuasive arguments, this study showed that the addition of an appropriate general heuristic to a computer delivery of specific heuristics can bring dramatic improvements in group consensus over the use of specific heuristics alone. Within the adaptive structuration perspective, this means that it is important for computer systems to emphasize the spirit, or general ends and attitudes the technology aims to promote in the group, as well as the specific structural features. Use of an integrated heuristic did not bring the anticipated additional gain in group consensus. It may be that our treatment created a heuristic that was so highly comprehensive to groups that they found it to be overwhelming. The fact that these groups took longer on average to complete the decision task is evidence that this may be the case. The data on decision time also indicated that groups in the integrated treatment benefited from higher restrictiveness, again suggesting that the integrated treatment may have been too detailed for groups to comfortably handle.

Overall the results of this study suggest that the dimensions of comprehensiveness and restrictiveness are useful constructs in explaining the effects of decision aids on group problem solving. Since computerization is generally associated with the delivery of specific heuristics rather than general ones, the findings of this study suggest that the benefits of these heuristics are likely to be enhanced if appropriate general heuristics are added during implementation. Designers also might consider adding general heuristics to automated specific heuristics to make the decision aids more palatable and cognitively understandable to users. Finally, the tradeoffs associated with greater restrictiveness in delivery of heuristics to decision-making groups pose interesting issues for further research on the design of computer systems for group decision making.

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8. REFERENCES

Abualsamh, R. A.; Carlin, B.; and McDaniel, R. R., Jr. "Problem Structuring Heuristics in Strategic Decision Making." *Organizational Behavior and Human Decision Processes*, in press.

Allport, G. W.; Vernon, P. E.; and Lindzey, G. *The Study of Values*, Third Edition, Chicago: Riverside, 1970.

Barnlund, D. C., and Haiman, F. S. *The Dynamics of Discussion*, Boston: Houghton Mifflin, 1960.

Becker, S. W., and Baloff, N. "Organization Structure and Complex Problem Solving." *Administrative Science Quarterly*, Volume 14, 1969, pp. 260-271.

Bormann, E. G. "The Paradox and Promise of Small Group Research." *Speech Monographs*, Volume 37, 1979, pp. 211-217.

Castore, C. M., and Murninghan, J. K. "Determinants of Support for Group Decisions." *Organizational Behavior and Human Performance*, Volume 22, 1978, pp. 75-92.

Cats-Baril, W. L., and Huber, G. P. "Decision Support Systems for Ill-Structured Problems: An Empirical Study." *Decision Sciences*, Volume 18, Number 3, 1987, pp. 350-372.

Cosier, R. A. "Methods for Improving the Strategic Decision: Dialectic Versus the Devil's Advocate." *Strategic Management Journal*, Volume 3, 1982, pp. 373-374.

Dalkey, N. C. *Studies in the Quality of Life: Delphi and Decision Making*, Lexington, Massachusetts: Lexington Books, 1972.

DeSanctis, G., and Gallupe, R. B. "A Foundation for the Study of Group Decision Support Systems." *Management Science*, Volume 33, Number 5, 1987, pp. 589-609.

DeSanctis, G.; Sambamurthy, V.; and Watson, R. T. "Computer-Supported Meetings: Building a Research Environment." *Large Scale Systems in Information and Decision Technologies*, Volume 13, Number 1, 1987, pp. 43-59.

Dewey, J. *How We Think*, Boston: Heath, 1910.

Dickson, G. W.; Robinson, L.; Heath, R.; and Lee, J. "Observations on GDSS Interaction: Chauffeured, Facilitated, and User-Driven systems." *Proceedings of the Twenty-Second Annual Hawaii International Conference on System Sciences*, Volume III, 1989, pp. 337-343.

DosSantos, B. L., and Bariff, M. L. "A Study of User Interface Aids for Model-Oriented Decision Support Systems." *Management Science*, Volume 34, Number 4, 1988, pp. 461-468.

Easton, A. C.; Vogel, D. R.; and Nunamaker, J. F., Jr. "Stakeholder Identification and Assumption Surfacing in Small Groups: An Experimental Study." *Proceedings of the Twenty-Second Annual Hawaii International Conference on System Sciences*, Volume 3, 1989, pp. 344-352.

Festinger, L. "A Theory of Social Comparison Processes." *Human Relations*, Volume 7, 1954, pp. 117-140.

Frank, R. G. "Shrewdly Irrational." *Sociological Forum*, Volume 2, 1987, pp. 21-41.

Hackman, J. R., and Vidmar, H. "Effects of Size and Task Type on Group Performance and Member Reactions." *Sociometry*, Volume 33, Number 1, 1970, pp. 37-54.

Hall, J., and Watson, W. H. "The Effects of a Normative Intervention on Group Decision-Making Performance." *Human Relations*, Volume 23, Number 4, 1970, pp. 299-317.

Herbert, T. T. and Yost, E. B. "A Comparison of Decision Quality Under Nominal and Consensus Group Formats: The Case of the Structured Problem." *Decision Sciences*, Volume 10, Number 3, 1979, pp. 358-370.

Hirokawa, R. Y. "Discussion Procedures and Decision-Making Performance." *Human Communication Research*, Volume 12, 1985, pp. 203-224.

Holloman, C. R., and Hendrich, H. W. "Problem Solving in Different-Sized Groups." *Personnel Psychology*, Volume 24, 1971, pp. 489-500.

Holloman, C. R., and Hendrick, H. W. "Adequacy of Group Decisions as a Function of the Decision-Making Process." *Academy of Management Journal*, Volume 15, 1972, pp. 175-184.

Howard, R. A. "Decision Analysis: Practice and Promise." *Management Science*, Volume 34, Number 6, 1988, pp. 679-695.

Huber, G. P. "Issues in the Design of Group Decision Support Systems." *MIS Quarterly*, Volume 8, Number 3, 1984, pp. 195-204.

Ito, J. K., and Peterson, R. B. "Effects of Task Difficulty and Interunit Interdependence on Information Processing Systems." *Academy of Management Journal*, Volume 29, Number 1, 1986, pp. 139-148.

Janis, I. L. *Victims of Groupthink: Psychological Studies of Foreign Policy Decisions and Fiascoes*, Boston: Houghton-Mifflin, 1972.

Janis, I., and Mann, L. *Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment*, New York: Free Press, 1972.

Kiesler, S.; Siegel, J.; and McGuire, T. "Social Psychological Aspects of Computer-Mediated Communication." *American Psychologist*, Volume 39, pp. 1123-1134.

Mason, R. O., and Mitroff, I. I. *Challenging Strategic Planning Assumptions*, New York: Wiley-Interscience, 1981.

McBurney, J. H., and Hance, K. G. *Discussion in Human Affairs*, New York: Harper and Brothers, 1939.

McGrath, J. E. *Groups: Interaction and Performance*, Englewood Cliffs, New Jersey: Prentice-Hall, 1984.

Nemiroff, P. M., and King, D. C. "Group Decision-Making Performance as Influenced by Consensus and Self-Orientation." *Human Relations*, Volume 28, 1975, pp. 1-21.

Nemiroff, P. M.; Pasmore, W. A.; and Ford, D. L. "The Effects of Two Normative Structural Interventions on Established and Adhoc Groups: Implications for Improving Decision Making Effectiveness." *Decision Sciences*, Volume 7, October 1976.

Nunamaker, J. F.; Applegate, L. M.; and Konsynski, B. R. "Computer-Aided Deliberation: Model Management and Group Decision Support." *Operations Research*, Special Issue on Decision Support Systems, Volume 36, Number 6, 1988, pp. 826-848.

Payne, J. W., and Bettman, J. R. "Adaptive Strategy Selection in Decision Making." *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 1988.

Poole, M. S. "Decision Development in Small Groups: II. A Study of Multiple Sequences in Decision Making." *Communication Monographs*, Volume 50, Number 3, 1983, pp. 206-232.

Poole, M. S., and DeSanctis, G. "Understanding the Use of Group Decision Support Systems: The Theory of Adaptive Structuration." In C. Steinfield and J. Fulk, Editors, *Perspectives on Organizations and New Information Technology*, Beverly Hills, California: Sage, 1989.

Poole, M. S.; Seibold, D. R.; and McPhee, R. D. "Group Decision-Making as a Structurational Process." *Quarterly Journal of Speech*, Volume 71, 1985, pp. 74-102.

Rodrigues, C. A. "Group Decision Making: A Noninteractional Approach. *Strategy and Executive Action*, Volume 1, Summer 1984, pp. 24-27.

Rohrbaugh, J. "Improving the Quality of Group Judgment: Social Judgment Analysis and the Nominal Group Technique." *Organizational Behavior and Human Performance*, Volume 28, 1981, pp. 272-288.

Shaw, M. *Group Dynamics*, New York: McGraw-Hill, 1971.

Silver, M. S. "On the Restrictiveness of Decision Support Systems." In R. M. Lee, A. M. McCosh, and P. Migliarese, Editors, *Organizational Decision Support Systems*, North-Holland, Elsevier Science, 1988, pp. 259-270.

Smith, P. "Social Facilitation." In P. Smith, Editor, *Groups Within Organizations*, New York: Harper and Row, 1973.

Spillman, B.; Spillman, R.; and Bezdek, J. "A Fuzzy Analysis of Consensus in Small Groups." In P. P. Wang and S. K. Chang, Editors, *Fuzzy Sets: Theory and Application to Policy Analysis and Information Systems*, New York: Plenum, 1980, pp. 291-308.

Spranger, E. *Types of Men*, P. W. J. Pigors, Translator, Fifth German Edition, Max Niemeyer Verlag, Halle, 1928.

Stewart, T., and Gelberd, L. "Analysis of Judgment Policy: A New Approach to Citizen Participation in Planning." *Journal of the American Institute of Planners*, Volume 42, 1976, pp. 33-41.

Thomas, E. J., and Fink, C. F. "Effects of Group Size." *Psychological Bulletin*, Volume 60, Number 4, 1963, pp. 371-384.

Van de Ven, A. H., and Delbecq, A. L. "The Effectiveness of Nominal, Delphi, and Interacting Group Decision Making Processes." *Academy of Management Journal*, Volume 17, 1974, pp. 605-621.

Van Gundy, A. B. *Techniques of Structured Problem-Solving*, New York: Van Nostrand Reinhold Co, 1981.

Vinokur, A., and Burnstein, F. "Effects of Partially Shared Persuasive Arguments on Group-Induced Shifts: A Group Problem Solving Approach." *Journal of Personality and Social Psychology*, Volume 29, 1974, pp. 305-315.

Watson, R. T.; DeSanctis, G.; and Poole, M. S. "Using GDSS to Facilitate Group consensus: Some Intended and Unintended Consequences." *MIS Quarterly*, Volume 12, Number 3, 1988.

Zigurs, I.; DeSanctis, G.; and Billingsley, J. "Exploring Attitudinal Development in Computer-Supported Groups." *Proceedings of the Twenty-Second Annual Hawaii International Conference on System Sciences*, Volume III, 1989, pp. 353-358.

Zigurs, I.; Poole, M. S.; DeSanctis, G. "Computer Support of Group Decision Making: A Communication-Based Investigation." *MIS Quarterly*, Volume 12, Number 4, 1988, pp. 625-644.

9. ENDNOTES

1. Note that Silver defines restrictiveness along several dimensions. For purposes of this study, restrictiveness is confined to refer to the manner of resource use, given that a set of resources are available to the decision maker.