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A comparison of performance and satisfaction between two types of group decision support systems

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ABSTRACT

Group Decision Support Systems (GDSSs) and other electronic meeting technologies have been developed to support or replace traditional, verbal meetings. While extensive research has been conducted regarding the impact of these systems on the group decision making process, the vast majority of these studies have focused on groups meeting fact-to-face in one room. This paper focuses on how group members perform when distributed as non-proximate sub-groups (virtual legislative sessions) as compared to proximate, face-to-face groups (synchronous legislative sessions). Experiments involving 12 groups of 10 members each showed that there were few significant differences in productivity and satisfaction between the two types of meeting formats. These and other results indicate that groups may operate productively in a virtual meeting environment.

INTRODUCTION

Group Decision Support Systems (GDSSs) and other electronic meeting technologies have had a positive impact on group communication and decision making by providing participants with an anonymous electronic forum for the simultaneous exchange of ideas and preferences (Dennis, George, Jessup, Nunamaker, & Vogel, 1988). However, most meetings using these systems have been conducted in a face-to-face meeting environment. It is now technologically feasible to create facilities that will allow remote groups to interact as an intact virtual group in real time; that is, while sub-groups are face-to-face at a specific geographic location, the group as a whole may be comprised of distributed sub-groups (Nunamaker, Briggs, & Romano, 1993).

31

One project that seeks to create meeting facilities for virtual groups is currently underway at the University of Arizona. The Mirror Project is " . . . designed to combine different communication channels in an environment that integrates audio, visual, and textual media to provide synergistic, comprehensive, and robust support for effective and efficient group interaction" (Chappell, Vogel, & Roberts, 1992). In addition, the Computer-Aided Business Engineering (CABE) project at the University of Arizona will create meeting facilities that will allow geographically- and temporally-distributed sub-groups at Air Force sites to be linked through a GDSS and teleconferencing.

Very few studies have focused on distributed sub-group meetings, however. This research examines the differences between these distributed sub-group (or virtual legislative) meetings and traditional face-to-face (or synchronous legislative) meetings (DeSanctis & Gallupe, 1987). Results of the study show that very few significant differences between the two types of meetings exist. Therefore, groups may be able to meet efficiently and effectively in distributed, sub-group environments.

PRIOR RESEARCH

Previous GDSS research generally has concentrated on small and large groups meeting in a non-distributed or face-to-face environment, but some research has been undertaken to compare face-to-face meetings with nominal groups (groups in which members work individually at separate locations). In one such study (Valacich, George, Nunamaker, & Vogel, 1990), researchers found that the nominal groups were more productive than the face-to-face (FTF) groups (as measured by idea quantity and quality), and nominal group members were more productive per person. Members of four-person nominal groups were the most productive and eight-person FTF groups were the least. The researchers attempted to explain this difference by pointing out the fact that more verbal interruptions occurred in the FTF groups (laughing, talking about a written comment, etc.). There was no significant difference in satisfaction measures between the FTF and nominal groups, however.

In another study involving six- and 12-member nominal (non-communicating) and FTF (communicating) groups (Dennis & Valacich, 1993), researchers found that there were no differences in the six-member groups, but the 12-member FTF groups generated more ideas than did the 12-member nominal groups. These results were somewhat confirmed in a later study in which researchers found that FTF groups generated more ideas with higher quality than did groups of physically-separated individuals or sub-groups which pooled their comments after the meeting (Dennis & Valacich, 1994).

Another study (Valacich, George, Nunamaker, & Vogel, 1994) measured the idea generation performance of groups of four and eight members in both proximate and distributed conditions using the same synchronous computer-mediated communication systems. The distributed groups outperformed the face-to-face groups in terms of the total number of unique, quality, and high-quality ideas generated.

Another pilot study compared face-to-face groups with dispersed-synchronous and dispersed-asynchronous groups (Burke & Chidambaram, 1995). Face-to-face groups experienced more effective leadership and coordination competence as compared to the distributed groups. There was no difference between the members of any group type regarding task performance and perceptions of cohesiveness and equality of participation. These results led the authors to conclude that electronically-distributed work groups can become cohesive and perform effectively, provided that all the group members have adequate training and sufficient time for the meeting.

In perhaps the only prior study of synchronous legislative and virtual legislative groups (Aiken & Vanjani, 1996), virtual groups of eight people each wrote more quality comments, thought the comments were more anonymous, were more satisfied with the system, and believed participation among their group members was more uniform. However, there were no significant differences between the two types of groups in terms of idea satisfaction. Moreover, group members in both types of meetings did not think it was important to be able to see each other during the electronic discussion.

RESEARCH METHODOLOGY

To confirm the results of earlier research and investigate additional group process and outcome variables, this study was conducted using the synchronous or face-to-face (FTF) and virtual or non-face-to-face (NFTF) legislative session meeting formats.

Subjects

Six groups of 10 undergraduate business students each met in the FTF environment, and six groups of 10 met in the NFTF environment (each of these six groups split into two subgroups). The students received extra credit for their participation.

Procedures

Each subject was assigned to one of the two groups and was briefed regarding the meeting structure. Next, a 10-minute warm-up session allowed the subjects to acquaint themselves with the software and technology. The actual meeting took 10 minutes. A creative task for idea generation was used in the experiment. The subjects were asked to write as many comments about the solution of the parking problem on campus as they could.

Dependent Variables and Measurement

Following the meeting, subjects completed a self-assessment questionnaire which asked them to rate on five-point Likert scales their opinions of several facets of the meeting. In addition, the number of comments generated by each group was recorded. A quality comment was defined as a comment that pertained to the discussion topic. A unique, quality comment was defined as a comment related to the discussion and mentioned for the first time during the meeting. Two independent raters reviewed the transcripts to ascertain the number of quality and unique, quality comments.

33

EXPERIMENTAL RESULTS

Group Statistics

The comments generated during each of the meetings were reviewed by two raters, and inter-rater reliability tests indicated a high degree of agreement between them (Cronbach Alpha = 0.99). There were no significant differences between the FTF and NFTF groups in terms of the numbers of raw (F = 2.57, p = .14), quality (F = 0.64, p = .44), and unique, quality (F = .44, p = .52) comments.

Table 1. Questionnaire Summary for ALL Respondents (see the Appendix)

Group Type	ALL	(N = 120)
Variable:	**Mean**	**Std. Dev.**
Satisfaction with member proximity	3.03	1.31
Perception of group cohesiveness	3.04	1.21
Ease of communication	2.35**	1.26
Perceived anonymity	2.04**	0.95
Satisfaction with ideas generated	3.43**	1.07
Satisfaction with the system	4.21**	1.01
Preference to see all participants FTF	2.49**	1.30
Perception of production blocking	1.75**	1.00
Evaluation apprehension	3.91**	1.22
Perception of free riding	3.67**	1.31
Satisfaction with group membership	3.84**	1.08
Perception of group member participation	3.74	1.03
Time sufficiency for meeting	2.11**	1.40

** Significantly different from 3.00 at alpha = 0.05

Table 2. Questionnaire Summary for FTF Respondents (see the Appendix)

Group Type Variable:	FTF Mean	(N = 60) Std. Dev.
Satisfaction with member proximity	2.80	1.36
Perception of group cohesiveness	3.13	1.23
Ease of communication	2.27**	1.30
Perceived anonymity	2.15**	0.94
Satisfaction with ideas generated	3.42**	1.20
Satisfaction with the system	4.27**	1.02
Preference to see all participants FTF	2.52**	1.28
Perception of production blocking	1.63**	0.94
Evaluation apprehension	3.67**	1.35
Perception of free riding	3.47**	1.31
Satisfaction with group membership	3.87**	1.19
Perception of group member participation	3.77**	1.08
Time sufficiency for meeting	2.18**	1.44

** significantly different from 3.00 at alpha = 0.05

Table 3. Questionnaire Summary for NFTF Respondents (see the Appendix)

Group Type Variable:	NFTF Mean	(N = 60) Std. Dev.
Satisfaction with member proximity	3.27*	1.22
Perception of group cohesiveness	2.95	1.20
Ease of communication	2.43**	1.23
Perceived anonymity	1.93**	0.95
Satisfaction with ideas generated	3.45**	0.93
Satisfaction with the system	4.15**	1.01
Preference to see all participants FTF	2.47**	1.32
Perception of production blocking	1.87**	1.05
Evaluation apprehension	4.15**	1.04
Perception of free riding	3.87**	1.29
Satisfaction with group membership	3.82**	0.97
Perception of group member participation	3.72**	1.03
Time sufficiency for meeting	2.03**	1.23

** significantly different from 3.00 at alpha = 0.05
* significantly different from 3.00 at alpha = 0.1

35

Individual Statistics

Tables 1, 2, and 3 contain the means and standard deviations from the questionnaire responses. The tables also report significant differences in the overall response to each of the questions from the median value of 3 on the Likert scales.

Analyses of variance tests were also conducted on the evaluations. There was a statistically significant difference in the responses (at the $\alpha = .10$ level) between the FTF groups and the NFTF groups for only three variables: satisfaction with member proximity ($F = 3.91$, $p = .05$), evaluation apprehension ($F = 4.84$, $p = .03$), and perception of free riding ($F = 2.83$, $p = .09$). These and other results are discussed below.

Satisfaction with Member Proximity. The mean response for the FTF participants was not significantly different from 3 (2.80), and the mean response for all participants also was not significantly different from 3 (3.03). However, the mean response for NFTF participants was significantly higher than 3 (3.27). This implies that the NFTF participants did not consider group member proximity as being important for their satisfaction with the meeting process. About 67% of all participants (53% of FTF and 80% of NFTF participants) were either indifferent to or did not consider group member proximity important for their satisfaction. Thus, a lack of group member proximity may not be an inhibiting factor vis-a-vis satisfaction with the meeting.

Group Cohesiveness. There was no significant difference between the types of group members regarding perception of group cohesiveness. The mean response for the perception of group cohesiveness was 3.13 for FTF groups, 2.95 for NFTF groups, and 3.04 for all respondents. About 59% of all the participants (57% of FTF and 62% of NFTF participants) felt that group member proximity was not very important for feelings of group cohesiveness.

Communication Ease with Group Members. There was no significant difference in ease of communication perceptions among the two types of groups. The mean response for ease of communication was 2.27 for FTF group participants, 2.43 for NFTF group participants, and 2.35 overall for all participants. Most respondents felt that it was relatively easy to communicate with group members using the system. About 80.0% of all respondents (82% of FTF and 78% of NFTF participants) were either satisfied or indifferent regarding communication ease with respect to group members.

Anonymity. Although no names were attached to comments, anonymity may be reduced if group members are able to see each others' screens. However, there was no significant difference in anonymity perceptions between the two types of groups. The respective mean values for perception of anonymity were 2.15, 1.93, and 2.04 for FTF groups, NFTF groups, and all respondents. The frequency distribution shows that 90.8% of all respondents agreed that anonymity was reasonably protected. This percentage was 90.0% for the FTF group members and 91.7% for the distributed group members.

Idea Satisfaction. There was no significant difference between the two types of groups regarding satisfaction with the ideas generated. The mean response was 3.42 for the FTF groups, 3.45 for the NFTF groups, and 3.43 for all respondents taken together. The frequency dis-

36

tribution shows that while 78.3% of the FTF participants were neutral or satisfied with the ideas proposed by their group, the corresponding figure for the NFTF groups was 85.0%. About 82% of all participants were neutral or satisfied.

System Satisfaction. Most subjects were satisfied with the system with mean scores of 4.27 for FTF participants, 4.15 for NFTF participants, and 4.21 for all respondents. The frequency distribution is also fairly consistent as 91.7% of both FTF and NFTF (and consequently all participants) were neutral or satisfied with the system used.

Preference for Face-to-Face Meetings. Neither of the two groups considered it important to be able to see all group members during the meeting. The mean response was 2.52 for FTF participants, 2.47 for NFTF participants, and 2.49 for all participants. The frequency distribution shows that overall, 75% of all respondents were either indifferent to or considered being able to see all members of their group unimportant. The respective figures for FTF and NFTF groups were 73.3% and 76.7%.

Production Blocking. There was no significant difference between the two groups in regard to perceptions of communication ease. The mean response was 1.63 for FTF groups, 1.87 for NFTF groups, and 1.75 for all respondents. The frequency distribution also confirms this result as 90.8% of overall participants perceived low or no production blocking. The corresponding figure for the NFTF groups was slightly lower at 88.3%, and slightly higher for the FTF groups at 93.3%.

Evaluation Apprehension. There was a significant difference between both groups regarding feelings of evaluation apprehension: FTF groups were more apprehensive of peer opinion of their comments than the NFTF participants. The mean response for the NFTF group members was 4.84 while the mean response for FTF group members was 3.67. The overall mean response was 3.91. The frequency distribution shows that while 85.8& of all participants experienced low to no evaluation apprehension, the variation among groups was significant. In the case of the NFTF groups, the figure was as high as 91.7% compared to only 80.0% for the FTF groups.

Free Riding. The perception of free riding was significantly higher for the NFTF group participants. The mean responses were 3.87 for NFTF participants, 3.47 for FTF participants, and 3.67 for all respondents. The frequency distribution confirms this result as 81.7% of the NFTF respondents perceived some degree of free riding as opposed to 76.7% of the FTF respondents and 79.2% of all participants.

Group Membership Satisfaction. There was no significant difference regarding satisfaction with group membership between the two types of groups. The mean score was 3.87 for the FTF group members, 3.82 for NFTF group members, and 3.84 for all respondents. The frequency distribution shows that 88.3% of the FTF participants were neutral or satisfied with their group membership as were 93.3% of the NFTF participants and 90.8% of all subjects.

Participation. Most participants perceived that participation was fairly equal for their respective groups. The mean response was 3.77 for FTF group members, 3.72 for NFTF group members, and 3.74 for all respondents. The frequency distribution also had similarly close

37

results as 90.8% of all respondents, 91.7% of FTF respondents, and 90.0% of NFTF respondents perceived that all group members participated equally in the discussion.

Time Sufficiency. All meetings were allotted ten minutes and all groups discussed the same task using the same system. There was no significant difference between the two types of groups in perceptions of meeting time sufficiency. The mean score was 2.18 for FTF group members, 2.03 for NFTF group members, and 2.11 for all respondents. The frequency distribution shows that 78.0% of the FTF participants, 83.3% of the NFTF participants, and 80.8% of all participants felt that they had sufficient time for the meeting.

CONCLUSIONS

The objective of this study was to study differences between groups meeting face-to-face (FTF) and not-face-to-face (NFTF). Productivity, as measured by the total number of comments generated, number of quality comments generated, and number of unique, quality comments generated was not significantly different between the two types of groups, but these measures were slightly higher for NFTF groups. Further, a lack of member proximity did not have a negative impact on group members' meeting satisfaction or group cohesiveness. NFTF group members did not consider group member proximity important for them to feel like a part of a larger group.

All participants, FTF and NFTF, were satisfied with the ease of communication, and all meeting participants were generally satisfied with the ideas that their group members proposed. However, the percentage was higher for the NFTF group members. Neither the FTF participants nor the NFTF participants considered it important to be able to see everybody in their group.

Although all participants used the same system, and all communication and interaction was anonymous, the NFTF participants had significantly lower evaluation apprehension. This may be attributed to the lack of physical proximity. It would be interesting to study the impact of the addition of audio and video support in future distributed meetings using virtual groups.

Since most participants could not identify who was working, they did not perceive much free riding. However, the members of the NFTF groups indicated a slightly higher and statistically significant difference in perceived free riding. Generally, all groups will have some members who will not participate. However, a lower perception of free riding should have a positive impact on those who are participating.

All groups were equally satisfied with their group membership. However, although there was no statistically significant difference between the two meeting types, a higher number of NFTF group members were satisfied with being members of their group. This too is an important result for the future of virtual meetings. The implication is that if the system allows efficient communication, then the lack of physical proximity should not have a negative impact on group cohesiveness.

Almost all participants felt that their group members participated fairly equally. This should result in positive feelings about the meeting and group membership. However, it is interesting to note that there was very little opportunity for them to actually see which members of their group were participating. There was less opportunity for the NFTF group members, since they could not see the other half of their group. Even so, members of both groups reported equal participation.

These results imply that there is a good potential for success with virtual electronic meetings in the future.

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APPENDIX
Experimental Questionnaire

1. Sex: Male   Female

2. Classification: Freshman   Sophomore   Junior   Senior

3. Age

4. How important is group member proximity for your satisfaction with the meeting?

1	2	3	4	5
Very important				Not important

5. How important is it for all group members to be proximate for you to feel like a part of the group?

1	2	3	4	5
Very important				Not important

6. Was it easy to communicate with all members of your group?

1	2	3	4	5
Very easy				Not easy

7. Do you believe the comments were anonymous?

1	2	3	4	5
Very anonymous				Not anonymous

8. How do you feel about the ideas your group proposed?

1	2	3	4	5
Very dissatisfied				Very satisfied

9. How do you feel about the computer system used to discuss this problem?

1	2	3	4	5
Very dissatisfied				Very satisfied

10. How important is it to be able to see everybody in the group?

1	2	3	4	5
Very important				Not important

11. Was communicating easy using this system?

1	2	3	4	5
Very easy				Not easy

12. I was apprehensive of other members' opinions regarding my comments.

1	2	3	4	5
Very apprehensive				Not apprehensive

13. During the meeting, could you identify who in your group was working and who was not?

1	2	3	4	5
Yeas, easily				No, not at all

14. How did you feel about being a member of this group?

1	2	3	4	5
Very dissatisfied				Very satisfied

15. Rate the level of participation in your group.

1	2	3	4	5
Very unequal				Very equal

16. Did you have sufficient time for this meeting?

1	2	3	4	5
Sufficient				Insufficient