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Publicly expressed confidence ratings in computer-mediated-communication

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Rice University, 1993
RICE UNIVERSITY

PUBLICLY EXPRESSED CONFIDENCE RATINGS IN
COMPUTER-MEDIATED-COMMUNICATION

by

TAMMY NEUMANN LOWRY

A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE
MASTER OF ARTS

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May, 1993
ABSTRACT

Publicly Expressed Confidence Ratings
in Computer-Mediated-Communication

by

Tammy Neumann Lowry

It has been hypothesized that social influence processes are altered in computer-mediated-communication (CMC) due to the lack of non-verbal information available across a computer. In these three studies, confidence ratings were used in an attempt to replace some of the non-verbal cues lost in CMC. Subjects participated in group decision making tasks in which the distribution of preferences and confidences were simulated. The results of these three experiments suggest that confidence ratings do not have an effect on an individual's preference decision but may be used to assess one's probability of persuading the other members of the group. The confidence ratings did not increase the probability of a group reaching a consensus decision. In addition, the results suggest that communication patterns in CMC are altered and, together with the lack of non-verbal cues, may result in changes in the social influence process.
Acknowledgements

First, I would like to thank my advisor, David Lane, and the rest of my committee, Bob Dipboye, Randi Martin, and Al Napier, for all of their advice, support, and direction. The area of group technology provides the challenge of crossing several fields, and thus, the varying perspectives of the members of my committee were invaluable. I truly appreciate the time and effort each of them gave in helping me with this thesis.

Second, I would like to thank Dave Hoffman of Texaco, Inc. He gave me useful information concerning the practical applications of computer-mediated-technologies within industry, and the lessons we learned as we worked with group technologies gave me a new perspective.

Finally, I must thank my husband, Kevin. Without his loving support and encouragement, this thesis may not have been completed. This is our accomplishment.
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INTRODUCTION

Many trends are affecting communications in large organizations. For example, many organizations are becoming increasingly team oriented (Johansen, 1988). Business teams are becoming the focus of work and responsibility, and group decision-making is employed rather than individual decision-making. (DeSanctis G., Dickson, G., Jackson, B., Poole, M., 1991). There is also an increase in the geographic spread of organizations (Johansen, 1988); an increasing number of organizations have offices in varying locations within a country or in several countries. In addition, rapid technological changes are affecting the way organizations work and communicate (Kiesler, Siegel, & McGuire, 1984; Smilowitz, Compton, & Flint, 1988).

One result of these trends is an increasing number of dispersed meetings relying on computer technology to support communication. In dispersed meetings, group members depend on computer-mediated communication (CMC) to accomplish their tasks, and therefore, this technology is being adopted by organizations at a rapid rate (Smilowitz et al., 1988). It has become a key component of the emerging technology termed groupware.

Groupware is a "generic term for specialized computer aids that are designed for the use of collaborative work groups" (Johansen, R., 1988, p. 1). Specifically, many of these systems are designed to increase productivity in the decision-making process and can be used for distributed meetings, where the group members are in dispersed geographic locations.
CMC is an appealing area for social scientific investigation because as technology changes the way people interact, there may be some fundamental differences in the group process. For example, CMC seems to be less friendly and less socially oriented than face-to-face (FTF) communications (Chapanis, 1975; Danowski, 1982; Hiltz, Johnson, & Turoff, 1987), there may be a decrease in "group think" and "tunnel vision" when CMC is employed (Kiesler, Siegel, & McGuire, 1984), CMC affords more equal participation by all members of a group (Hiltz et al. 1986; Kiesler et al., 1984; ; Siegel, Dubrovsky, Kiesler, & McGuire, 1986), and there is less communication in groups using CMC (Hiltz et al., 1986; Siegel et al., 1986). In addition, research has shown that groups prefer a conventional meeting style, face-to-face communication, to CMC, and feel more effective and efficient using a conventional style (Adrianson and Hjelmquist, 1991; Valacich et al., 1991).

Another fundamental difference between groups communicating across a computer versus FTF is that social influence is weakened. Empirical research has shown that when computer-mediated groups were compared to conventional groups completing the classic Asch conformity tasks (Asch, 1956), fewer subjects committed judgment errors, and individuals with deviate opinions were more likely to hold out (Smilowitz, Compton, & Flint, 1988). Also, possibly due to the decrease in social influence, groups using CMC take longer to reach a consensus decision than those communicating FTF (Adrianson & Hjelmquist, 1990; Hiltz et. al, 1987; Kiesler et. al, 1984; Siegel et. al, 1986).
Several researchers have put forth suggestions concerning the decrease of social influence in CMC. One hypothesis is that by removing the physical presence of others, there is a lack of non-verbal information and social context cues. This absence results in a reduction of the normative influence process and enables group members to hold on to their position and ignore social pressure (Kiesler et al., 1984; Siegel et al., 1986; Smilowitz et al., 1988).

A second hypothesis deals with the decrease in socially oriented communications in CMC. Hiltz et al. (1986) have suggested that the lesser amount of socio-emotional communication does not provide the feelings of group cohesion necessary for members to wish to reach agreement.

Finally, the absence of non-verbal information may result in the absence of information feedback between group members in CMC. Therefore, it may be difficult for them to coordinate communication and control discussions. Group members do not know if their argument is being understood or agreed upon. Therefore, it is difficult to present an argument that is convincing enough to cause other members of the group to change their opinion, leading to a lack of consensus within the group (Adrianson & Hjelmquist, 1990; Kiesler et al., 1984).

Taken together, these hypothesis suggest that the lack of non-verbal information available in CMC plays a fundamental role in the social influence process within group decision-making. It seems that group members use social context and nonverbal communication cues to regulate their own behavior and determine the response to arguments that they are presenting. When these cues are lacking, group members exhibit more uninhibited behavior, have difficulties presenting convincing arguments,
and ignore social pressure. Furthermore, it appears that social interaction may be related to feelings of group cohesion. Therefore, if non-verbal information could be presented in CMC, social influence processes may occur and groups may be better able to reach agreement.

One type of information which may be communicated non-verbally in FTF interactions is certainty. In forming the Social Interaction Sequence Model (SIS) for group process, Stasser and Davis (1981) suggest that at any given time, a member of the decision-making group will be either in favor of or against a particular decision choice (being in either the majority or minority within the group), and may be either certain or uncertain of his or her position. The preference positions are stated publicly, whereas changes in certainty are usually communicated non-verbally. They also suggest that uncertain members will adopt the opinions of the more certain members (Stasser and Davis, 1981). Spitzer and Davis (1978) found a similar effect in studying triads. They found that subjects previously trained to have more confidence in their solution strategies were more influential in the group than subjects trained to have lower confidence (Spitzer and Davis, 1978).

Following these findings, it may be that in groups using FTF communication, members continuously monitor changes in certainty levels of the other members through non-verbal communication cues. By monitoring these changes, group members are able to assess the effectiveness of their arguments, and thus, present more convincing arguments, eventually leading to a consensus decision within the group. Or, if the majority of the groups appears confident in their decision, the
deviate will succumb to social pressure, again leading to a consensus decision.

Since nonverbal communication cues are lacking in groups relying on CMC, group members are unable to monitor certainty levels, and the group is unable to reach agreement. Therefore, by introducing a method through which the members are able to monitor these changes, the group may be better able to reach a consensus decision. In these three experiments, confidence information, which is communicated nonverbally in FTF groups, was presented to groups communicating through a computer. It was hypothesized that social influence may occur in groups using CMC when confidence information is available.

Experiment 1

In this experiment, a computer system was used that allowed the group members to state publicly both their opinion and confidence. Hypothetically, this allowed the group members to monitor the changes in each of the other members' positions and certainty levels, thus enabling the group to reach a consensus decision. Groups completing decision tasks using a system with and without this feature were compared.

Specifically, this study investigated the effects of this tool on members of a minority of two; the subject always had a confederate supporting his or her opinion. If the subject was a minority of one, she would be likely to change her opinion regardless of the confidence level of the group. However, since it has been found that deviates with social support are less likely to change their opinion to that of the majority (Kerr & MacCoun, 1985; Asch, 1957; Latané, 1981; Latané and Wolf,
1981), it may be that this tool will have had the greatest effect on group members in this situation.

In groups using the confidence tool, the distribution of confidence ratings was also manipulated. High confidence was defined as a rating of eight or greater on a 10-point scale (1 = not confident at all to 10 = very confident), and low confidence was defined as a rating of three or less on the same scale. These definitions are consistent with those given by Stasser and Davis (1981). The present study compared subject behavior when the confidence level of the majority was high and the confederate was low to subject behavior when the majority was low and the confederate was high. It was expected that the subject would be more likely to change his or her opinion when the majority of the group had high confidence in their opinions. Therefore, this group configuration would be more likely to reach a consensus decision.

Methods

Subjects

The subjects were 12 undergraduate students at Rice University. They participated in the study to complete a course requirement. Six of the subjects rated themselves beginner computer users, and six rated themselves intermediate computer users. In determining the subjects' previous meeting experience, five said they rarely attended meetings, four attended meetings frequently, and three constantly attended meetings. Furthermore, six of the subjects had some experience in leading meetings.
The Communication System

The system was programmed using Hypercard. The experimental session was conducted on a Macintosh LC personal computer which was networked, using HyperTalk, to one other Macintosh LC.

The system had three components, the first of which was a voting tool. In this component, the system displayed all of the information available to the subjects about three candidates applying for a job and required the subjects to enter their preference of candidates. Depending on the experimental condition, the system may have also required the subjects to enter their confidence concerning their choice of candidates. The confidence rating was on a ten point scale with one meaning "not confident at all" and ten meaning "very confident".

The second component in the system was a display component. This screen displayed the preferences for all members of the group and the confidence ratings given by each member. This information was displayed in two tables, one table contained information concerning the preferences and the other, confidences. The tables were aligned so that each member's preference and confidence were on the same line.

The final component of the system was the discussion component. The subjects were able to communicate with the other members of the decision-making group by sending and receiving typed messages. While in this component, the computer would require the subject to return to the voting component at timed intervals.

Design and Procedure

The experimental sessions were conducted one subject at a time. Each subject was told that he or she was a member of a six member
group, and that the other members of the group were in various locations around the campus. The subject was told that the group was networked through the computer. In reality, there were no other members of the group. All group interactions were simulated by the experimenter.

The experimental design was a 3 level within-subjects design. Each subject was involved in five decision-making processes, two of which were filler tasks. The first experimental task was the control condition; the subjects were not asked to indicate their confidence rating for their choice and did not have access to information about the other members' confidence ratings. The second condition included the confidence feature. In this condition, the majority had high confidence ratings (8-9) while the subject's confederate had a low confidence rating (2-3). In the third condition, the majority had low confidence ratings, and the subject's confederate had a high confidence rating. See table 1 for the experimental conditions.

<table>
<thead>
<tr>
<th></th>
<th>Majority High</th>
<th>Majority Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Majority (4)</td>
<td>Confidence ratings of 8 or 9</td>
<td>Confidence ratings of 2 or 3</td>
</tr>
<tr>
<td>Confederate</td>
<td>Confidence ratings of 2 or 3</td>
<td>Confidence ratings or 8 or 9</td>
</tr>
</tbody>
</table>

*Table 1:* Simulated confidence ratings in the three experimental conditions.

At the start of each experimental session, the subjects completed a questionnaire assessing their computer experience, comfort with computers, and previous meeting experience. The subjects then
participated in a brief tutorial session on the use of the communication system.

The subjects were then given the task instructions in which they were asked to imagine that they worked for a large retail corporation in the personnel department with five other people. The group's task was to evaluate several candidates and determine which should be hired to fill an entry-level business administration position within their company. The subjects were told that the candidates would enter a training program, and that they could not be sure what job the candidate would eventually fill. Therefore, it was important for the group to decide upon the best "overall" candidate. The subject was told that it was important to come to a unanimous decision, but that it was more important to choose the best candidate for the position. The group had a 20 minute time limit for each decision. See Appendix A for the task instructions.

There was not a distinct "best" candidate among the three in each task. In a pilot test, it was determined that the candidates did not differ overall, but did differ along several dimensions, such as experience, grade point average, and personality. See Appendix B for the candidate résumés.

At the onset of each task, unless in the control condition, the subject was prompted to give his or her initial candidate preference and confidence level. Simulated preferences and confidence levels of the other members of the group were based on this initial vote by the subject. The subject was a member of a minority of two, with the majority consisting of four members. After the initial vote, the subject participated in a "discussion" with the rest of the group. All discussion
was simulated by the experimenter. The comments simulated by the experimenter were based on the arguments presented by the subject. The content and number of arguments were consistent among subjects presenting the same argument.

The system prompted the subject to enter a new vote and confidence at five minute intervals. If the subject changed his or her opinion, the confederate was simulated to change his or her opinion on the next vote. Therefore, if the subject changed his or her opinion, the group reached a "consensus" decision. The subject went through a cycle of discussion and voting until the subject changed his or her opinion or 20 minutes had elapsed. If the subject did not change his or her opinion within 20 minutes of the onset of the task, the discussion was stopped. At the end of each task, the subject's confidence regarding the group's final decision was assessed. If the subject did not change his or her opinion (the group did not reach a consensus decision), the group decision was assumed to be the candidate who had received the majority of the votes. After the fifth task, the subject was given a questionnaire, probed for suspicion, and debriefed. See Appendix C for the final questionnaire.

Results

In debriefing and probing the subjects for suspicion, all of the participants seemed to believe that they were actually participating with other students around the campus. In fact, several subjects mentioned that they would like to get together with the group and finish some of their discussions. Others made comments about the group members to the experimenter. Therefore, the research paradigm appeared to be valid.
Social Influence

In the three experimental conditions, the subject changed his or her opinion a total of 22 out of 36 possible times (61%). As shown in table 2, the same number of subjects changed their opinion in the control condition as the majority high condition, and only one additional subject changed his or her opinion in the majority low condition.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Subjects changing opinion</th>
<th>Subjects not changing opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Majority low confidence</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Majority high confidence</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

*Table 2.* Number of opinion changes in the three experimental conditions: Experiment #1

A total change score was obtained for each subject. This score determined how many confidence units the subjects moved towards the majority opinion. For example, if a subject had an initial confidence rating of ten for the minority opinion and on the last vote indicated a confidence rating of seven for the majority opinion, he received a change score of 17 (10 + 7). Therefore, the highest possible change score for each subject on a particular task was 20. However, if a subject became more confident in the minority opinion, he received a negative change score. For example, if a subject indicated an initial confidence of seven in the minority opinion and on the last vote indicated a confidence rating of
ten for the minority opinion, he received a change score of -3 (7-10). Therefore, this score is a more sensitive measure of the effect of the confidence manipulation. This score could not be calculated for the control condition since a confidence rating was not obtained.

In the majority high condition, the mean change score was 8.42, and in the majority low condition, the mean change score was 5.50. The difference in change scores is not significant with $F(1,11) = 2.801$, $p = .1224$.

It is possible that if the subjects did not believe the other members of the group were giving accurate indications of confidence, they would not pay attention to the ratings. On the final questionnaire, the subjects were asked to rate on a seven-point Likert scale if they felt that the other members of their group were giving accurate indications of their confidence. The mean rating on this question was 3.75, with one meaning that they strongly disagreed that accurate indications were given, and seven meaning that they strongly agreed with this statement.

In order to determine if there was a relationship between subjects believing the confidence ratings of the other members and the effect of the confidence scores, a Pearson-Product correlation was obtained. For each subject, the difference between the change score in majority high condition and the change score in majority low condition was correlated with the subject's rating on the questionnaire. This relationship was not significant ($r = .274$, $p = .390$).

**Confidence in group decisions**

In assessing the subject confidence in the final group decision, there was not a significant difference between the three conditions ($F(2,33) =$
.283, p = .756). However, as was expected, the overall confidence in the group's decision was related to whether or not the subject changed his or her opinion. As shown in Figure 1, the mean final confidence scores was higher in all three conditions when the subject changed his or her opinion. In the control condition, the mean overall confidence rating was significantly lower when the subjects did not change their opinion (F(1,10)=5.788, p = .037). In the majority high condition, the same pattern of results was obtained (F(1,10)=28.005, p = .0001). In the majority low condition, the mean was still lower when the subjects did not change their opinion, but this difference was not significant (F(10)=1.476, p = .252).

![Graph showing confidence ratings by condition](image)

*Figure 1.* Overall confidence ratings in each condition: Experiment #1.
Social Interaction Sequence Model

The results of this experiment supported the assumption stated by Stasser and Davis (1981) that the subjects would be more likely to change their opinion if they were less certain about their choice (Stasser and Davis, 1981). See Table 3.

Because of the experimental manipulation, all subjects were in the minority at the onset of each task (vote x). This is represented by the top half of Table 3. For example, by summing the first row, it can be seen that 14 subjects had high confidence in the minority opinion at vote x. The first row also indicates that on the next vote, vote x+1, 12 of these

<table>
<thead>
<tr>
<th>Initial Opinion at vote x and confidence</th>
<th>Minority Confidence</th>
<th>Majority Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIGH</td>
<td>MED</td>
</tr>
<tr>
<td>Minority High confidence</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Minority Medium confidence</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Minority Low confidence</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority High confidence</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority Medium confidence</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority Low confidence</td>
<td>0</td>
<td>0</td>
</tr>
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</table>

Table 3. Subject position movement with respect to preference and confidence from vote x to vote x+1: Experiment #1.
subjects remained in the minority, and two subjects changed their opinions to that of the majority. On the next round of voting, these two subjects were now in the majority, and thus are represented on the bottom half of the table. For example, the subject who changed to the majority and had low confidence is now represented on the last row of Table 3. It can be seen that this subject remained in the minority on the next vote and increased his or her confidence to medium (4-7).

As can be seen in the first row of Table 3, most subjects who indicated high confidence in their opinion at vote x did not change their opinion to the majority at vote x+1, and most maintained high confidence. However, as can be seen in the second row, most subjects who indicated medium confidence in their opinion at vote x either maintained a medium confidence or changed their opinion to the majority at vote x+1. Row 3 of Table 3 shows that all subjects who indicated low confidence in their initial opinion changed their preference. The lower left quadrant of Table 3 indicates that no subject who changed their opinion to that of the majority changed their opinion back to the minority, and all but one of these subjects indicated increasing confidence in the majority opinion (lower right quadrant).

The mean confidence rating at vote 1 across all subjects changing their opinion at vote 2 was calculated for each condition. This value was also calculated for all subjects who did not change their opinion at vote 2. In the majority high condition, the mean confidence rating on vote 1 was 5.4 across subjects who changed. For subjects who did not change, the mean confidence rating on vote 1 was 7.0. This difference is significant with $E(1,10) = 6.667, p = .027$. In the majority low condition, the mean
confidence rating at vote 1 for those subjects changing their opinion at vote 2 was 5.2. The mean rating for subjects not changing their opinion was 6.7. This difference is approaches significance with $F(10) = 3.667, p = .084$.

**Subjective Ratings**

Finally, in analyzing the results of the questionnaire containing 7-point Likert scales (1 = strongly disagree to 7 = strongly agree) given at the end of the session, the subjects agreed that they felt comfortable using the computer ($M = 5.083$), and enjoyed using the computer ($M = 4.833$). However, the subjects indicated that they did not agree that the computer was more enjoyable than a FTF meeting ($M = 2.917$), nor was the computer more efficient than a FTF meeting ($M = 2.833$).

In answering questions about the confidence ratings, the subjects were neutral as to whether the ratings helped them convince the other members of their position ($M = 4.333$), and they somewhat disagreed that the ratings shaped their arguments ($M = 3.833$). They did agree that it was easy to indicate their confidence rating ($M = 5.417$). The subjects also indicated that they felt more effective when they knew the other members' confidence ratings ($M = 5.0$), and they preferred knowing the others' ratings ($M = 5.417$).

**Discussion**

**Social Influence**

The results of this study suggest that a confidence feature may not be contributing to a distributed group's ability to reach agreement. Specifically, the results imply that the majority's confidence level does not
affect whether or not a subject in the minority will change his or her opinion. The mean change score was not significantly different in the two conditions. This finding is counter-intuitive; one would expect a subject to change his or her opinion more often when the majority has high confidence than when they have low confidence.

It is possible that the subjects in this study ignored the confidence ratings of the other members of the group because they did not believe they were accurate indications. If this explanation was true, then the subjects who believed the confidence ratings would have changed their opinion more in the majority high condition and less in the majority low condition. This pattern would not be evident for the subjects who did not believe the confidence ratings. However, this suggestion does not seem to be viable because there was not a relationship between whether or not the subjects believed the confidence ratings were accurate and how much they changed their opinion in the two conditions.

Another possible explanation for these results is that the subjects did not remember the confidence ratings during the discussion component of the task, or when they were prompted to re-vote. Upon entering the discussion component of the task, the subjects were unable to return to the display component. It is possible that the subjects could not remember which member held which position, or how confident that member felt regarding their position, and thus, these ratings had no effect. The confidence ratings may have had more effect if the subjects had the ability to access the confidence ratings at any point in the discussion or vote components.
Confidence in group decisions

This study was designed so that in order for the group to reach a consensus decision, the subject must change his or her opinion to that of the majority. The final group decision was defined as the candidate receiving the majority of the votes at the end of the time allotted for each task. Therefore, if the subject did not change his or her opinion, the final group decision was to hire a different candidate than the subject's choice. If the final group decision is not in favor of the candidate that the subject believes should be hired, then the subject's confidence in the group's decision would be lower. The results of this study were consistent with this expectation.

However, it also seems that the subject's confidence in the final group decision would be higher when the other group members felt very confident in their individual choices than when they did not feel confident. The results did not show this pattern; there were no significant differences in the final confidence ratings for the three conditions. As was discussed previously, this may be because the subjects did not remember the confidence ratings.

Social Interaction Sequence Model

In the SIS model by Stasser and Davis (1981), it is assumed that if group members are currently certain of their opinion, they will not change it. However, if group members are currently uncertain, they may change their opinion and be uncertain of this new position. In this model, certainty is defined as seven or above on a 10-point certainty scale, uncertainty is defined as three or below, and the middle position is not accounted for (Stasser and Davis, 1981).
The results of this study support these assumptions. In general, subjects who changed their opinion had lower confidence ratings than those subjects who did not. However, a middle certainty position was defined in this study as being from four to seven on a 10-point scale. Of the 26 subjects who fell into this category, twelve did not change their opinion and fourteen did. The results suggest that when subjects are neither extremely certain of their opinion nor extremely uncertain, they may either remain in their current state, or change their opinion. When they do change their opinion, they are most likely to fall into the middle certainty position in respect to their new opinion.

Subjective Ratings

Many of the problems that have been observed previously in groups using CMC were also evident in this experiment. The results indicate that the subjects felt frustrated and hindered by the computer, even when the confidence feature was available. However, subjects seemed to prefer knowing confidence ratings and felt more effective when they did. These findings suggest that while other features may need to be added to increase user satisfaction with using CMC in comparison to FTF communication, including a confidence feature may increase user satisfaction.

Experiment 2

The purpose of this experiment was to investigate the possibility that the results from Experiment 1 were due to the subjects' inability to remember the confidence ratings of the other members of the group. As was discussed previously, in Experiment 1 the subjects were not able to
access information regarding the confidence levels of the other members of the group during either the discussion or vote components of the communication system. Therefore, the confidence ratings may not have had an effect because the subjects did not remember them. In this study, the system was modified to allow the subjects continuous access to the preference and confidence information.

Method

Subjects

Twelve undergraduate students at Rice University participated in the study to complete a course requirement. Three of the subjects rated themselves beginner computer users, and nine rated themselves intermediate computer users. In determining the subjects' previous meeting experience, three said they rarely attended meetings, six attended meetings frequently, and three constantly attended meetings. Furthermore, ten of the subjects had some experience in leading meetings.

Design and Procedure

The same system used in Experiment 1 was used in this experiment. However, the system was modified so that the tables containing the preferences and confidences of the group members were displayed throughout the discussion and vote components of the tool.

The procedure and design in this experiment were identical to that of Experiment 1. Again, each subject was involved in five decision-making processes, two of which were filler tasks. The three conditions were the same as in Experiment 1; a control condition, majority high condition, and majority low condition (see Table 1).
Again, the subjects were asked to evaluate several candidates and determine which should be hired to fill an entry-level business administration position. There was not a distinct "best" candidate among the three in each task.

At the onset of each task, unless in the control condition, the subject was prompted to give his or her initial candidate preference and confidence level. Simulated preferences and confidence levels of the other members of the group were based on this initial vote by the subject. The subject was a member of a minority of two, with the majority consisting of four members. After the initial vote, the subject participated in a "discussion" with the rest of the group. All discussion was simulated by the experimenter. The comments simulated by the experimenter were based on the arguments presented by the subject. The content and number of arguments were consistent among subjects presenting the same argument.

The system prompted the subject to enter a new vote and confidence at five minute intervals. If the subject changed his or her opinion, the confederate was simulated to change his or her opinion on the next vote. Therefore, if the subject changed his or her opinion, the group reached a "consensus" decision. The subject went through a cycle of discussion and voting until the subject changed his or her opinion or 20 minutes had elapsed. If the subject did not change his or her opinion within 20 minutes of the onset of the task, the discussion was stopped. At the end of each task, the subject's confidence regarding the group's final decision was assessed. If the subject did not change his or her opinion (the group did not reach a consensus decision), the group decision was
assumed to be the candidate who had received the majority of the votes. After the fifth task, the subject was given a questionnaire, probed for suspicion, and debriefed.

Results

In debriefing and probing the subjects for suspicion, all of the participants seemed to believe that they were actually participating with other students around the campus. Therefore, the research paradigm appeared to be valid.

Social Influence

In the three experimental conditions, the subjects changed their opinion a total of 19 out of 36 possible times (53%). As shown in table 4, seven subjects changed their opinion in the control condition, eight changed their opinion in the majority high condition, and four changed their opinion in the majority low condition. This difference is not significant with $F(2,22) = 1.375, p = .2738$.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Subjects changing opinion</th>
<th>Subjects not changing opinion</th>
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<tbody>
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<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Majority low confidence</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Majority high confidence</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

*Table 4.* Number of opinion changes in the three experimental conditions: Experiment #2.
Again, a total change score was obtained for each subject by calculating the difference between the subject's initial confidence rating and final confidence rating in each task. In the majority high condition, the mean change score was 6.727, and in the majority low condition, the mean change score was 3.818. This difference is not significant with \( F(1,10) = 1.246, p = .2904 \).

The subjects were neutral as to whether they felt the other members of the group were giving accurate indications of their confidence. On a seven-point Likert scale with one meaning they strongly disagreed that accurate indications were given, and seven meaning that they strongly agreed with this statement, the average rating was 4.41.

In order to determine if there was a relationship between subjects believing the confidence ratings of the other members and the effect of the confidence scores, a Pearson-Product correlation was obtained. For each subject, the difference between the change score in majority high condition and the change score in majority low condition was correlated with the subject's rating on the questionnaire. This relationship was significant (\( r = -.688, p = .019 \)). However, the negative correlation indicates that subjects who did not believe the confidence ratings were accurate were more affected by the confidence manipulation. This is exactly the opposite of what one would expect if the subjects were not paying attention to the confidence ratings.

**Confidence in group decisions**

In assessing the subject confidence in the final group decision, there was not a significant difference between the three conditions (\( F(2,22) = \))
.476, p = .6275). However, as was expected, the overall confidence in the group's decision was related to whether or not the subjects changed their opinion.

![Graph](image)

*Figure 2. Overall confidence ratings in each condition: Experiment #2.*

As shown in Figure 2, the mean final confidence score was higher in all three conditions when the subject changed his or her opinion. In the control condition, the mean overall confidence rating was significantly lower when the subjects did not change their opinion ($F(1,10)=14.440$, p = .0035). In the majority high condition, the mean was lower when the subjects did not change their opinion, however this difference was not significant ($F(1,10)=1.910$, p = .1970). In the majority low condition, the
mean overall confidence rating was significantly lower when the subjects did not change their opinion ($F(10)=4.727, p = .0548$).

**Social Interaction Sequence Model**

The results of this experiment again supported the assumption stated by Stasser and Davis (1981) that the subjects would be more likely to change their opinion if they were less certain about their choice (Stasser and Davis, 1981). See Table 5.

As can be seen in Table 5, the results from Experiment 2 were similar to Experiment 1. As shown in the first row of Table 5, most subjects that indicated high confidence in their opinion at vote $x$ did not change their opinion to the majority at vote $x+1$, and most maintained high confidence. However, as can be seen in the second row, most

<table>
<thead>
<tr>
<th>Initial Opinion at vote $x$ and confidence</th>
<th>Minority Confidence</th>
<th>Majority Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIGH</td>
<td>MED</td>
</tr>
<tr>
<td>Minority High confidence</td>
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<td>1</td>
</tr>
<tr>
<td>Minority Med confidence</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Minority Low confidence</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority High confidence</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority Med confidence</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority Low confidence</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

*Table 5.* Subject position movement with respect to preference and confidence from vote $x$ to vote $x+1$: Experiment #2.
subjects that indicated medium confidence in their opinion at vote x either maintained a medium confidence or changed their opinion to the majority at vote x+1. Row 3 of Table 5 shows that all subjects who indicated low confidence in their initial opinion changed their preference. Slightly different from Experiment 1, the lower left quadrant of Table 5 indicates that one subject that changed their opinion to that of the majority changed their opinion back to the minority. However, this one subject had low confidence in the majority opinion, so this result is still consistent with Stasser and Davis' predictions. Again, once subjects changed their opinions to the majority, they showed increasing confidence in the majority opinion (lower right quadrant).

The mean confidence rating at vote 1 across all subjects changing their opinion at vote 2 was calculated for each condition. This value was also calculated for all subjects who did not change their opinion at vote 2. In the majority high condition, the mean confidence rating at vote 1 was 4.5 across subjects who changed. For subjects who did not change, the mean confidence rating at vote 1 was 6.125. This difference approaches significance with \( F(1,10) = 2.949, p = .1167 \). In the majority low condition, the mean confidence rating at vote 1 for those subjects changing their opinion at vote 2 was 5.0. The mean rating for subjects not changing their opinion was 6.0. This difference is not significant with \( F(1,10) = .952, p = .3521 \).

**Subjective Ratings**

Finally, in analyzing the results of the questionnaire containing 7-point Likert scales (1 = strongly disagree to 7 = strongly agree) given at the end of the session, the subjects somewhat agreed that they felt
comfortable using the computer ($M = 4.833$), and enjoyed using the computer ($M = 4.75$). However, the subjects indicated that they did not agree that the computer was more efficient than a FTF meeting ($M = 2.75$). The subjects were neutral as to whether the meeting was more enjoyable than a FTF meeting ($M = 3.667$).

In answering questions about the confidence ratings, the subjects were neutral as to whether the ratings helped them convince the other members of their position ($M = 4.167$), or shape their arguments ($M = 4.083$). They did somewhat agree that it was easy to indicate their confidence rating ($M = 5.083$). The subjects also indicated that they felt more effective when they knew the other members' confidence ratings ($M = 4.75$), and they preferred knowing the others' ratings ($M = 6.0$).

**Discussion**

**Social Influence**

In Experiment 1 the subjects were not able to access information regarding the confidence levels of the other members of the group during either the discussion or subsequent votes in each session. Therefore, the results from Experiment 1 could have been due to the subjects' inability to remember the confidence ratings of the other members of the group. This experiment was a repeat of Experiment 1 except that the system was modified so that the tables containing the preferences and confidences of the group members were displayed throughout the discussion and vote components of the tool.

The results of this experiment do not provide conclusive evidence regarding how the confidence ratings affect the probability that a subject
will change his or her opinion to that of the majority. While there were no significant differences in the number of subjects who changed their opinions in each condition, the difference is in the expected direction. Therefore, there is a hint of the expected effect. It is possible that the difference was not significant due to the limited power in the experimental design.

As shown in Table 4, only one additional subject changed her opinion in the majority high condition than in the control condition. This finding suggests that subjects may be interpreting interactions in the control condition (which contains no confidence information) as representative of high confidence. Therefore, the control and majority high conditions produced very similar results. However, comparisons in change scores in the two conditions, which is a more sensitive measure of the effect of the confidence manipulation, could not be made because no confidence data was collected in the control condition. This suggestion should be investigated through further experimentation.

Confidence in group decisions

The results of Experiment 2 are very similar to the results of Experiment 1 with regard to the subject confidence in the final group decision. The subjects felt more confident in the final decision when they had changed their opinion. Again, this is expected because when the subject changed his or her opinion, the final decision was consistent with the subject's choice of candidates.

However, again there were no significant differences in the final confidence ratings for the three conditions. As was discussed previously, this is counter-intuitive; one would expect subjects to feel more confident
in the final decision when other members felt more confident in their individual choices. This finding suggests that confidence ratings presented across a computer may not communicate as strong a message as one would expect based on what is known about FTF communication.

**Social Interaction Sequence Model**

Again, the results of this study support the assumptions put forth in the Social Interaction Sequence model by Stasser and Davis (1981). In general, subjects who changed their opinion had lower confidence ratings than those subjects who did not. However, this difference was not as large as the difference observed in Experiment 1, and failed to reach significance in either condition. It is possible that the subjects' confidence decreased during discussion, and thus was lower when they actually changed their opinion. However, this decrease was not detected due to the experimental procedure.

In addition, the majority of the subjects fell into the middle confidence category in this experiment. Of the 42 subjects who fell into this category, 34 did not change their opinion and eight did. These results are slightly different from Experiment 1, and suggest that when subjects are neither extremely certain of their opinion nor extremely uncertain, they are more likely to remain in their current state than change their opinion. When they do change their opinion, they are equally likely to fall into the middle or high certainty position in respect to their new opinion.

**Subjective Ratings**

The results obtained from the subjective ratings in Experiment 2 were very similar to Experiment 1. Again, the results indicate that the
subjects felt frustrated and hindered by the computer, even when the confidence feature was available. However, subjects seemed to prefer knowing confidence ratings and felt more effective when they did. Again, it can be suggested that a confidence feature may increase user satisfaction with CMC.

Experiment 3

The results of Experiment 1 and 2 do not provide conclusive evidence as to whether the expected effect of publicly expressed confidence is present. Experiment 3 is an attempt to clarify the results of the first two Experiments by replicating the results found in Experiment 2 using 16 subjects to increase power in the experimental design.

Furthermore, in examining the results from Experiment 2, some interesting questions emerged which warrant further investigation. In Experiment 2, approximately the same number of subjects changed their opinion in the majority high and control conditions. However, only about half as many subjects changed their opinion in the majority low condition. Comparisons in the change scores, which is a more sensitive measure of the dependent variable, could not be made with respect to the control condition because no confidence ratings were collected. In this experiment, subjects were asked to indicate their confidence ratings in all three of the conditions to allow for these analyses. However, in the control condition, they were not given feedback as to the other "members" confidence ratings.

One possible explanation for the results of Experiment 2 is that subjects were interpreting the interactions in the control condition as
representative of high confidence. Therefore, the control and majority
high conditions produced very similar results. In order to investigate this
possibility, in this experiment the subjects were asked to indicate how
confident they thought the majority and minority members of the group
felt about their choice of candidates in the control condition, in which no
certainty information was given.

Finally, in this experiment, each subject was asked to participate in
an audio-taped interview following the experimental session. During the
interview, the subject was walked back through each of the experimental
conditions and asked to indicate how they made their decision. If the
subject changed her opinion in a condition, she was questioned as to what
influenced her to change. The purpose of the interview was to provide
more information concerning the effects of publicly expressed confidence
ratings as well as more general information about computer-mediated-
communication.

Methods

Subjects

Sixteen undergraduate students at Rice University participated in
the study to complete a course requirement. Eight of the subjects rated
themselves beginner computer users, and eight rated themselves
intermediate computer users. In determining the subjects' previous
meeting experience, nine said they rarely attended meetings, and seven
attended meetings frequently. Furthermore, ten of the subjects had some
experience in leading meetings.
Design and Procedure

The computer system used in this experiment was the same system used in Experiment 2. In addition, the three experimental conditions were the same as Experiment 2: control, majority high, and majority low. Again, all subjects participated in five decision-making tasks, with two being filler tasks. This experiment differed from Experiment 2 in that the subjects were prompted to indicate their confidence in all three conditions, including the control condition. However, in the control condition the subjects were not given information concerning the other members' confidence ratings.

The procedure for the experimental session was identical to Experiment 2 except that at the end of each session, the subjects participated in an unstructured interview. During the interview, the subjects were reminded of the candidates, as well as the initial distribution of votes and confidences for the first task. The subjects then were asked open-ended questions concerning what occurred during that task, their feelings during the task, why they changed their opinion (if applicable), how the confidence information made them feel, and how they felt interacting across the computer. This process was then repeated for each experimental task. The interview was audio-taped.

Results and Discussion

In debriefing and probing the subjects for suspicion, all of the participants seemed to believe that they were actually participating with other students around the campus. Therefore, the research paradigm appeared to be valid.
Social Influence

In the three experimental conditions, the subject changed his or her opinion a total of 18 out of 48 possible times (37.5%). As shown in table 6, five subjects changed their opinion in the control condition, seven changed their opinion in the majority high condition, and six changed their opinion in the majority low condition. This difference is not significant with $F(2,28) = .085, p = .9184$.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Subjects changing opinion</th>
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</tr>
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<td>11</td>
</tr>
<tr>
<td>Majority low confidence</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Majority high confidence</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

*Table 6. Number of opinion changes in the three experimental conditions: Experiment #3*

Again, a total change score was obtained for each subject by calculating the difference between the subject’s initial confidence rating and final confidence rating in each task. In the control condition, the mean change score was 3.714, in the majority high condition, the mean change score was 4.214, and in the majority low condition, the mean change score was 2.857. This difference is not significant with $F(2,26) = .180, p = .8364$.

The subjects slightly agreed that they felt the other members of the group were giving accurate indications of their confidence. On a seven-
point Likert scale with one meaning they strongly disagreed that accurate indications were given, and seven meaning that they strongly agreed with this statement, the average rating was 4.688.

In order to determine if there was a relationship between subjects believing the confidence ratings of the other members and the effect of the confidence scores, a Pearson-Product correlation was obtained. For each subject, the difference between the change score in majority high condition and the change score in majority low condition was correlated with the subject’s rating on the questionnaire. This relationship was not significant ($r = .196$, $p = .5017$).

**Confidence in group decisions**

In assessing the subject confidence in the final group decision, there was not a significant difference between the three conditions ($F(2,28) = 3.102$, $p = .0607$). However, as was expected, the overall confidence in the group’s decision was related to whether or not the subject changed his or her opinion. As shown in Figure 3, the mean final confidence score was significantly higher in all three conditions when the subjects changed their opinion with $F(1,14)=26.838$, $p = .0001$ for the control condition, $F(1,14)=5.978$, $p = .0278$ for the majority high condition, and $F(1,13)=10.562$, $p = .0063$ for the majority low condition.
Figure 3. Overall confidence ratings in each condition: Experiment #3.

Social Interaction Sequence Model

The results of this experiment again supported the assumption stated by Stasser and Davis (1981) that the subjects would be more likely to change their opinion if they were less certain about their choice (Stasser and Davis, 1981). See Table 7.

As can be seen in Table 7, the results from Experiment 3 were similar to Experiment 1 and 2. There were more opportunities for analysis due to the increase in total number of subjects in this experiment, so a direct comparison of cell counts is not possible. However, as can be seen in the first row of Table 7, most subjects that indicated high confidence in their opinion at vote x did not change their opinion to the majority at vote x+1, and most maintained high confidence. However, as can be seen in the second row, most subjects that indicated medium
confidence in their opinion at vote x either maintained a medium 
confidence or increased their confidence at vote x+1. Row 3 of Table 7 
shows that most subjects who indicated low confidence in their initial 
opinion changed their preference or maintained a low confidence. As in 
Experiment 2, the lower left quadrant of Table 7 indicates that one 
subject that changed his opinion to that of the majority changed his 
opinion back to the minority. However, this one subject had low 
confidence in the majority opinion, so this result is still consistent with 
Stasser and Davis' predictions. Again, once subjects changed their 
opinions to the majority, they showed increasing confidence in the 
majority opinion (lower right quadrant).

<table>
<thead>
<tr>
<th>Initial Opinion at vote x and confidence</th>
<th>Minority Confidence</th>
<th>Majority Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIGH</td>
<td>MED</td>
</tr>
<tr>
<td>Minority High confidence</td>
<td>33</td>
<td>7</td>
</tr>
<tr>
<td>Minority Med confidence</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Minority Low confidence</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| Majority High confidence               | 0      | 0     | 0   | 2    | 0   | 0   |
| Majority Med confidence                | 0      | 0     | 0   | 1    | 7   | 0   |
| Majority Low confidence                | 0      | 0     | 1   | 0    | 3   | 3   |

*Table 7.* Subject position movement with respect to preference and 
confidence from vote x to vote x+1: Experiment #3.
The mean confidence rating at vote 1 across all subjects changing their opinion at vote 2 was calculated for each condition. This value was also calculated for all subjects who did not change their opinion at vote 2. In the control condition, the mean confidence rating at vote 1 was 7.33 across the subjects who change, and 6.385 for those who did not change. This difference is not significant with $F(1,14) = .773, p = .3942$. In the majority high condition, the mean confidence rating at vote 1 was 4.5 across subjects who changed. For subjects who did not change, the mean confidence rating at vote 1 was 6.667. This difference is significant with $F(1,14) = 8.331, p = .0120$. In the majority low condition, the mean confidence rating at vote 1 for those subjects changing their opinion at vote 2 was 5.0. The mean rating for subjects not changing their opinion was 6.818. This difference is not significant with $F(1,12) = 1.743, p = .2113$.

**Subjective Ratings**

Finally, in analyzing the results of the questionnaire containing 7-point Likert scales (1 = strongly disagree to 7 = strongly agree) given at the end of the session, the subjects somewhat agreed that they felt comfortable using the computer ($M = 4.562$), and enjoyed using the computer ($M = 4.5$). However, the subjects indicated that they did not agree that the computer was more efficient ($M = 2.875$) or more enjoyable ($M = 2.812$) than a FTF meeting.

In answering questions about the confidence ratings, the subjects were neutral as to whether the ratings helped them convince the other members of their position ($M = 4.188$). They did somewhat agree that it was easy to indicate their confidence rating ($M = 5.083$) and that the
confidence ratings helped them shape their arguments ($M = 4.5$). The subjects also indicated that they felt more effective when they knew the other members' confidence ratings ($M = 5.188$), and they preferred knowing the others' ratings ($M = 6.188$).

**Interview**

In the control condition, the subjects were asked to indicate how confident they felt the other members of the group were concerning their position. For the one member who agreed with the subject, the mean perceived confidence rating was 6.69, and for the members who did not agree with the subject, the mean perceived confidence rating was 7.50. This difference is not significant with $F(1,15) = 1.678$, $p = .2148$. This data suggests that the subjects were interpreting the comments in the control condition as representing high confidence.

During the interview, eight subjects (50%) indicated that they were determining the other members' confidence through the comments that were made. However, eight subjects (50%) also stated that it was very difficult to determine the confidence of the other members of the group across the computer. Furthermore, four subjects (25%) felt that the low confidence ratings were not as believable as the higher ratings.

When discussing how the confidence ratings affected them, nine subjects (56%) said that they used the confidence ratings to determine their chances of convincing the other members of the group to change their opinions. In general, if the other members were very confident of their position, then the subject did not feel that they would be able to convince them to change their minds. However, if the other members were not very confident, they felt that they had a good chance of
persuading them. Six subjects (37%) said that they thought they could have convinced the other members to change their opinions if they had been in the same room.

When comparing CMC to face-to-face interaction, ten subjects (62.5%) expressed frustration concerning the timing of the comments in CMC. In general, they felt that CMC was difficult because the interactions were not spontaneous and did not occur in a linear fashion. For example, a subject may not receive a response to a comment she had sent until after she had already typed in another comment. In addition, six subjects (36.%) felt hindered by the computer because they could not say as much as they would have wished because they had to type their comments into the computer.

General Discussion

Confidence Ratings

These experiments attempted to replace some of the non-verbal information lost in CMC by providing confidence information which would enable subjects to continuously monitor changes in the certainty levels of other group members. It was hypothesized that this information would contribute to social influence processes in the group interactions. If the majority of the group appeared confident in their position, it was suggested that the minority would be more likely to change their opinion, leading to a consensus decision. These experiments were designed so that the subject was always in the minority, and the group only reached consensus when the subject changed his or her opinion. Therefore, groups in the majority high confidence condition were expected to reach a
consensus decision more often than those groups in the majority low confidence condition. This hypothesis was not supported in any of the three experiments.

In addition, it was hypothesized that subjects would feel more confident in the group's final decision when the majority of the group felt confident in that decision. However, again, this hypothesis was not supported in any of the three experiments.

The data suggests that subjects were monitoring the changes in the confidence levels of the other members of the group, but were only using this information to help them shape their own arguments; this information did not affect their preference decision. In the interview, the subjects indicated that the confidence information helped them determine their chances of convincing the other members of the group to change their position, and thus affected their argument strategy. However, there was no evidence of differences in the number of words, statements, or questions the subjects typed in the three conditions. In addition, there was no evidence of differences in the content of the subject comments in the three conditions. It is possible that the subjects believed they were employing a different strategy in each condition even though there were no quantitative or qualitative differences found. However, these experiments were not designed to investigate the content of the subject arguments, and therefore, the manipulations may not have been sensitive to these differences. Further research is needed to investigate if individuals employ alternative argument strategies depending on the confidence levels of the group.
Even when the subjects felt their chances of convincing the other members of the group were small, they did not succumb to social pressure and change their opinion. One possible explanation for this finding is that the confidence ratings did not communicate the same information as face-to-face interaction. In this experiment, confidence ratings were included in an attempt to replace some of the non-verbal cues which are lost in CMC. However, due to the very nature and definition of CMC, all information must be communicated across the computer, and thus tends to be very sterile and poor in media "richness" (Daft & Lengel, 1984). In FTF interaction, people take into account many factors such as verbal inflections, subject matter, facial expressions, physical gestures, location and context, physical appearance, and duration (Nagasundaram & Wagner, 1992). This variety of cues allows the receiver to converge on a single interpretation of the message (Weick, 1985). Therefore, it is likely that presenting a numbered rating of confidence across a computer did not have the same effect as confidence information communicated non-verbally in FTF interaction. This finding suggests that when attempting to replace non-verbal cues in CMC, the information must be presented in a way which attempts to preserve the multiplicity of the cue.

Another fundamental difference between self-reported confidence ratings and non-verbal cues is that ratings seem very straightforward, whereas the latter requires the interpretation of the receiver. It is unclear which method is better, or if the results of the two methods converge. However, the subjects in this study did not seem to feel comfortable with only the self-reported ratings; they attempted to verify the confidence
ratings through the content of the arguments given. It seems that they did not trust the other members of the group to give accurate self-ratings. But, people do seem comfortable with their interpretations of confidence based on non-verbal cues given by others.

Because both of these methods of assessing confidence rely on cues given by others, either method could be manipulated by the cue-giver. If it is possible for people to give inaccurate self-reported ratings, it is also possible that people could give misleading cues through non-verbal communication. It is unclear why people seem to trust their ability to interpret non-verbal cues in assessing confidence, but do not trust self-ratings of confidence in CMC. Further research is needed to determine if: 1) people can accurately assess individuals' confidence levels through non-verbal cues in FTF interactions, 2) people can accurately assess individuals' confidence levels through message content in CMC, and 3) people employ tactics to communicate higher levels of confidence than they actually feel.

The results of this study also suggest that people tend to believe others have high confidence in their position. In the control condition, the subjects tended to perceive both the subject's confederate and the majority of the group as having high confidence (7 on a 10-point scale). In addition, the subject indicated in the interview that they questioned the low confidence ratings more than the higher ratings. It is possible that low confidence ratings are not realistic; people in FTF interactions may not behave in such a manner as to communicate low confidence. However, this experiment provides some evidence that people will indicate they have low confidence in CMC. The subjects gave low
confidence ratings for themselves on 13% of the votes taken. It may be that people will indicate low confidence in CMC if the interactions are anonymous. Again, further research is needed to determine the range of confidence portrayed in both FTF and computer-mediated interactions, and individual's ability to interpret this confidence.

It should be noted that one limitation of this study is that the simulated group members did not change their opinions, regardless of their simulated confidence. This could have led the subjects to believe that they had high confidence.

**User Satisfaction**

The results of the subjective questionnaire supported many previous experiments comparing FTF interaction to CMC (e.g., Adrianson and Hjelmquist, 1991; Valacich et al., 1991). The subjects felt frustrated and hindered by the computer, and did not feel that it was as efficient as FTF interaction. One of the factors contributing to this dissatisfaction was the lack of spontaneity and linearity in the messaging. Many subjects expressed frustration with the order in which messages were sent and received. Often, a subject would send a message and not receive a response to this message until after he had already sent another message on another topic. In addition, it was difficult to respond immediately to a message. These issues made it very difficult to have a cohesive discussion.

One of the benefits of CMC is parallel input. This feature saves time by allowing everyone to input their ideas and comments simultaneously, and encourages everyone to participate because one person is not able to monopolize the conversation (DeSanctis & Gallepe,
However, the results of these experiments suggest that this feature may also be detrimental to effective conversation in CMC. Enabling simultaneous input will invariably alter the natural patterns of communication (DeSanctis & Gallupe, 1987), possibly causing problems in complex communications such as decision-making conversations. In questionnaire data, relatively simple communicative functions such as exchanging opinions, giving/receiving information, and generating ideas received the highest satisfaction ratings in CMC communication, whereas more complex functions such as resolving disagreements, persuasion and getting to know someone received the lowest satisfaction ratings (Adrianson & Hjelmquist, 1988).

In addition to lowering the satisfaction ratings for CMC, the timing issues may also have an effect on social influence processes. It seems that the change in the communication patterns in CMC may require the subject to actively and consciously organize and structure the communication to a high degree (Adrianson & Hjelmquist, 1991). In contrast, the structure of the communication patterns in FTF does not require any conscious processing. It is possible that the conscious processing required in CMC consumes some of the limited attentional resources in the cognitive system, and therefore, subjects do not process the actual content of the messages. As a result, even very convincing arguments do not cause the subject to change his or her mind.

Adrianson and Hjelmquist (1991) have suggested that the difficulties in the coordination of CMC are a direct result of the lack of non-verbal information. However, it is possible that the lack of non-
verbal information, in addition to changes in the timing of CMC, may cause these problems. For example, spontaneous communication is very difficult in CMC even if non-verbal information is available because group members must type in their arguments and responses. Therefore, it seems that to overcome many of the satisfaction and social influence issues with CMC, it may be necessary to address both the lack of non-verbal information and the structure of the communication patterns.

Some Group Decision Support Systems are designed to induce group communication patterns and can include expert advice in the selection and arranging of rules to be applied during a meeting (DeSanctis & Gallupe, 1987). These types of systems may resolve the difficulties experienced with communication patterns in CMC, however, it is unclear whether this high level system will actually facilitate or hinder group decision making.

Another possible method which could be used to add structure to simultaneous messaging in CMC involves "threads". Threading is used in many public bulletin boards and allows an individual to follow a conversation and respond to comments concerning a particular topic. Possibly, communication systems designed for distributed group decision making could employ the use of threads to remove some of the effort group members must expend to consciously organize the conversation. Perhaps even separate windows could be used for each thread, and a specific process could be used for introducing a new thread within a particular discussion. Further research is needed to investigate the potential uses of threading in simultaneous distributed group decision making employing CMC.
A third possible method to achieve some structure in group communication patterns in CMC is to allow the group to impose some group process rules for communication. For example, a group leader could be selected who could control the conversation topic, focus the discussion, and manage the flow of communication. However, this person may need to be a neutral party to the decision making. Studies have suggested that a team facilitator is critical to insuring a team's effective use of a GDSS (DeSanctis, Poole, Desharnais, & Lewis, 1991), and it may be that when the team is communicating exclusively via a computer, this becomes even more critical. The facilitator can help structure the communication patterns as well as provide guidance in the decision-making session.

Limitations

There are some limitations in the current experiments. First, all group interactions were simulated. Therefore, some behaviors were controlled and not completely representative of normal interaction. For example, Stasser and Davis (1981), asserted that if group members are currently certain of their opinion, they will not change it. However, if group members are currently uncertain, they may change their opinion and be uncertain of this new position. In this experiment, the simulated group members did not change their opinions regardless of their confidence level. However, all subjects believed the experimental manipulations. In addition, the subjects with lower confidence were more likely to change their opinion than those with higher confidence. This suggests that the subjects were acting as would be predicted in real group interactions.
In addition, as with other laboratory experiments, the subjects were asked to complete a task in which they had no vested interest. This would suggest that the subjects would not feel committed to a certain decision and would tend to be persuaded to change their opinions easily. However, the opposite pattern of results emerged, suggesting that the subjects took the experimental task seriously.

Finally, when using undergraduate subjects for group tasks, many of the personal and political issues surrounding corporate group-decision making are lost. Therefore, there is some question concerning the generalizability of these results. However, in order to control many extraneous variables present in the real world, it is necessary to conduct laboratory research. This type of experiment provides insight into group processes and interactions which can be used to form hypothesis regarding interaction in the real world. It is important to follow laboratory experiments with investigations in the field.

Conclusions

The results of the current studies suggest that replacing non-verbal confidence information with confidence ratings in CMC does not increase the probability of a group reaching a consensus decision. In addition, the results suggest that the additional information provided through confidence ratings is used by group members to assess their chances of convincing the other members of the group of their position and to develop an argument strategy.

These results are counter-intuitive and lend further support to the idea that social influence processes do not occur as one would expect in
CMC. In addition, the results suggest that communication patterns in CMC are altered and, together with the lack of non-verbal cues, may result in changes in the social influence process.

Finally, it is important to note that social influence in group process is not always positive. For example, groupthink, a mode of thinking that people engage in when they are deeply involved in a cohesive in-group, can result in a less than optimum decision (Janis, 1972, 1982). The use of CMC may be able to overcome some of the process losses that result from group decision-making. Experiments such as these can lend understanding to the factors that contribute to social influence in both face-to-face and computer mediated interactions.
References


DeSanctis, Gerardine; Dickson, Gary W; Jackson, Brad M.; and Poole, Marshall Scott. (1991). Using computing in the face-to-face meeting: some initial observations from the Texaco-Minnesota Project. Submitted to Organizational Communication and Information Systems Division, Academy of Management.


Weick, K.E. (1985). Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organizational Dynamics (Fall)*, 50-64.
Appendix A
Task Instructions

In this experiment, you will be asked pretend that you work for a large retail corporation. You work in the personnel department with five other people. In this task, you and the five other members of your department will need to evaluate several candidates and determine which should be hired to fill a position with your company. The five other people are participating in this experiment at different locations around the campus.

Job Description: The candidate the group decides to hire will fill an entry level business administration job. He will enter a 3 year training program, after which he will be assigned to a particular department. Unfortunately, upon hiring the candidate you do not know where he will be eventually working, so it is beneficial to simply hire the best "overall" candidate.

The large number of résumés the company has received have already been sifted through and narrowed down to three for each available job. The group simply needs to decide which of these three candidates to hire for each job. Since there are five job openings, the group will do this five times, with different candidates each time.

The group should try to come to a consensus decision about which candidate should be hired. In other words, you should all try to agree on one candidate. However, while coming to a consensus decision is important, it is more important to hire the best candidate for the job.

You will be using the computer to communicate with the other members of the group. The following few screens will teach you how to do this. If you have any questions about the task, please ask the experimenter at this time. If you have questions about how to use the computer, please ask the experimenter as you go through the tutorial. Click on the "START" button below when you are ready to begin the tutorial.
Appendix B
RÉSUMÉ SYNOPSIS

CANDIDATE:  David Gilbert

AGE:  25

DEGREE:  Business Administration/ Marketing

GPA:  2.5/4.0

EXPERIENCE:
January 1989-May 1990
Amoco Production Corporation: worked in the materials department. Responsibilities included inventory and sell-off of used materials for three operating centers in West Texas. Had to deal with other corporations on a regular basis during the bidding process for materials.

CONTACT WITH PREVIOUS EMPLOYER:
"David has excellent people and technical skills."
RÉSUMÉ SYNOPSIS

CANDIDATE: Nick McDouglas

AGE: 24

DEGREE: Business Administration/Marketing

GPA: 4.0/4.0

EXPERIENCE:
May 1990-November 1990
Dillard's: salesperson in the shoe department.

CONTACT WITH PREVIOUS EMPLOYER:
"Nick seems to be a very good worker, but he is a little shy and has some trouble communicating."
RÉSUMÉ SYNOPSIS

CANDIDATE: Gilbert Morrison

AGE: 23

DEGREE: Business Administration/Marketing

GPA: 2.9/4.0

EXPERIENCE:
January 1990-December 1990
Peace Corps-stationed in Thailand. Duties included teaching people basic farming skills.

CONTACT WITH PREVIOUS EMPLOYER:
"Gilbert is a fantastic leader with a deep compassion for the human spirit, he makes a difference."
RÉSUMÉ SYNOPSIS

CANDIDATE: Rick Emerson

AGE: 23

DEGREE: Business Administration/Marketing

GPA: 3.8/4.0

EXPERIENCE:
January 1989-May 1989
Dow Chemical Company: Intern. Worked in the accounting department. Responsible for two specific areas of the chemical plant.

CONTACT WITH PREVIOUS EMPLOYER:
"Rick is technically sound, but has some trouble paying attention to detail."
RÉSUMÉ SYNOPSIS

CANDIDATE: Jerry Lee

AGE: 24

DEGREE: Business Administration/Marketing

GPA: 3.0/4.0

EXPERIENCE:
May 1990-December 1990
Dillard's Department Store-worked as a salesman in the men's department

CONTACT WITH PREVIOUS EMPLOYER:
"Jerry is a very congenial and likes helping people."
RÉSUMÉ SYNOPSIS

CANDIDATE: Alex West

AGE: 23

DEGREE: Business Administration/Marketing

GPA: 2.5/4.0

EXPERIENCE:
September 1989-December 1989:
IBM. Worked in the personnel department. Responsibilities included contact with potential employees, scheduling interviews, and scheduling office visits. Occasionally did some recruitment.

September 1990-December 1990:
IBM. Worked in the payroll department. Responsibilities included entering data for employees at several locations, especially shift workers. Also was the contact person for problems concerning paychecks.

CONTACT WITH PREVIOUS EMPLOYER:
"Alex is very innovative and aggressive. Occasionally he has some trouble with authority."
RÉSUMÉ SYNOPSIS

NAME:  James Kirkwood

AGE:  25

DEGREE:  Business Administration/ Marketing

GPA:  3.75/4.0

EXPERIENCE:
On-going volunteer work in the university library. Duties were to reshelve books and work at the information desk.

CONTACT WITH PREVIOUS EMPLOYER:
"James was a very helpful and polite young man."
RÉSUMÉ SYNOPSIS

CANDIDATE: Neil Fisher

AGE: 23

DEGREE: Business Administration/Marketing

GPA: 4.0/4.0

EXPERIENCE: None
RÉSUMÉ SYNOPSIS

CANDIDATE: Kevin Harris

AGE: 24

DEGREE: Business Administration/Marketing

GPA: 3.25/4.0

EXPERIENCE:

CONTACT WITH PREVIOUS EMPLOYER:
"Kevin is a hard worker, always willing to stay late or come in early."
Appendix C
**FINAL QUESTIONNAIRE**

Please indicate your opinion on the following questions by circling the number that corresponds to your opinion. Circle only one number for each question.

**GENERAL**

I felt comfortable using the computer to make these decisions.

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<tbody>
<tr>
<td>strongly disagree</td>
<td>disagree</td>
<td>somewhat disagree</td>
<td>neutral</td>
<td>somewhat agree</td>
<td>agree</td>
<td>strongly agree</td>
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I felt frustrated using the computer.

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<tbody>
<tr>
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<td>neutral</td>
<td>somewhat agree</td>
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The computer hindered our meeting process.

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<tbody>
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<td>somewhat disagree</td>
<td>neutral</td>
<td>somewhat agree</td>
<td>agree</td>
<td>strongly agree</td>
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I enjoyed using the computer for this task.

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<tbody>
<tr>
<td>strongly disagree</td>
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<td>somewhat disagree</td>
<td>neutral</td>
<td>somewhat agree</td>
<td>agree</td>
<td>strongly agree</td>
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**COMPARISION**

Compared to a regular meeting (when everyone is in the same room), using the computer for this meeting was more enjoyable.

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<tbody>
<tr>
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<td>somewhat disagree</td>
<td>neutral</td>
<td>somewhat agree</td>
<td>agree</td>
<td>strongly agree</td>
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</tbody>
</table>

Compared to a regular meeting, using the computer was more efficient for this task.

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<td>somewhat disagree</td>
<td>neutral</td>
<td>somewhat agree</td>
<td>agree</td>
<td>strongly agree</td>
</tr>
</tbody>
</table>
DISCUSSION

The discussion between each round of votes helped members to understand each other's position.

1 strongly disagree  2 disagree  3 somewhat disagree  4 neutral  5 somewhat agree  6 agree  7 strongly agree

The group did not give all points of view a fair consideration.

1 strongly disagree  2 disagree  3 somewhat disagree  4 neutral  5 somewhat agree  6 agree  7 strongly agree

Participation in the group discussion was evenly distributed.

1 strongly disagree  2 disagree  3 somewhat disagree  4 neutral  5 somewhat agree  6 agree  7 strongly agree

Group members responded to each other's statements in this meeting.

1 strongly disagree  2 disagree  3 somewhat disagree  4 neutral  5 somewhat agree  6 agree  7 strongly agree

OTHER GROUP MEMBERS

I have a lot of respect for the other members of my group.

1 strongly disagree  2 disagree  3 somewhat disagree  4 neutral  5 somewhat agree  6 agree  7 strongly agree

I feel the other members of my group were competent at this task.

1 strongly disagree  2 disagree  3 somewhat disagree  4 neutral  5 somewhat agree  6 agree  7 strongly agree

CONFIDENCE RATINGS

Knowing the other members' confidence rating helped me to convince them of my position.

1 strongly disagree  2 disagree  3 somewhat disagree  4 neutral  5 somewhat agree  6 agree  7 strongly agree
I used the confidence ratings to help shape my arguments.

1 strongly disagree 2 disagree 3 somewhat disagree 4 neutral 5 somewhat agree 6 agree 7 strongly agree

It was easy to indicate my confidence in my vote.

1 strongly disagree 2 disagree 3 somewhat disagree 4 neutral 5 somewhat agree 6 agree 7 strongly agree

I feel the other members of my group gave accurate indications of their confidence.

1 strongly disagree 2 disagree 3 somewhat disagree 4 neutral 5 somewhat agree 6 agree 7 strongly agree

COMPARISON

I understood the other members' positions better when I could see their confidence ratings.

1 strongly disagree 2 disagree 3 somewhat disagree 4 neutral 5 somewhat agree 6 agree 7 strongly agree

I felt more effective when I know the other members' confidence ratings.

1 strongly disagree 2 disagree 3 somewhat disagree 4 neutral 5 agree 6 agree 7 strongly agree

I preferred knowing the other members' confidence ratings.

1 strongly disagree 2 disagree 3 somewhat disagree 4 neutral 5 agree 6 agree 7 strongly agree