

# Wireless Brainstorming: Overcoming Status Effects in Small Group Decisions

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## Abstract

*Social factors, such as status differences, may prevent some members from participating in group decisions. Computerized group decision support systems (GDSSs) can reduce social influences by allowing group members to contribute anonymously and in parallel. This study explores how a simple GDSS on a wireless handheld device can augment face-to-face group decisions. Small groups of men and women brainstormed potential names for a computer game and voted for the best name using the wireless devices. The names generated were either associated with the person who produced them or not, and group member status was manipulated through the nature of the task and the proportions of men and women in the groups; men were more knowledgeable computer gamers and were always the numeric majority. We found that men and women generated more ideas when they were anonymous, and voting patterns were biased in favor of the ideas generated by men when members knew the idea's source, but not when the source was anonymous. These results suggest that a wireless GDSS can be used to reduce social bias that influences face-to-face decision making tasks.*

## 1. Introduction

Organizations of all types entrust key decisions to groups because groups are often able to pool intellectual resources to make better decisions. However, group interactions can be fraught with difficulties brought about by interpersonal influences, such as differences in the social status of group members. In the past several years, improved technology-based collaboration and communication tools (e.g., Group Decision Support Systems or GDSSs) have been used to increase the quality of group decision making. Traditional GDSS tools generally include networked hardware and software that support collaboration and information sharing in face-to-face groups [5, 25]. In some situations, GDSSs can

moderate the influence of social factors that may otherwise negatively impact group decision making. Several research studies have demonstrated how GDSSs can impact problem solving and decision making groups, but few have examined how an increasingly pervasive technology, wireless handheld devices, might be used to augment face-to-face meetings to improve idea generation and decision making.

In this paper, we first describe how social status is conveyed and impacts face-to-face group decisions, and how computer mediated communication (CMC) can reduce or eliminate some of the effects. We then describe a simple GDSS we developed on a wireless handheld device and report both experimental and qualitative data from a study carried out to test its effectiveness in a small group decision making task.

### 1.1. Group decisions and social status.

Imagine a less senior employee (Sue) who is meeting with several of her co-workers to formulate potential marketing plans for the company's most important product and then select the best plan. Sue's manager, Ben, directs and dominates the meeting, even though the decision domain is outside of his area of expertise. Ben suggests a plan that Sue does not think is very good. However, she and the other members of the group stay silent. When Ben asks Sue for her opinion, she voices support for his brainchild because she fears reprisal and she infers that the other group members are silent because they think Ben's idea is a good one (a form of *pluralistic ignorance*; [14]). Due to Ben's status, important concerns that Sue and others had about the plan are never voiced, no alternative plans are suggested, and an important decision is made.

One of the benefits of group decision making is the increased exchange of members' knowledge, information and opinions. The diversity of information exchanged is enhanced when group members include men and women from different parts of the organization who possess

varied skills and knowledge that are important for the decision task (e.g., [16]). Not surprisingly, whether more ideas and information are actually shared by group members depends on a variety of factors. The group is influenced by the procedural aspects of the decision making process and structural aspects of the group, like a group's size and composition (e.g., [10, 27]). Extra-group variables, like time pressure and the nature of the task (e.g., "intellective" vs. creativity tasks; [18]), can also have a strong impact on the group dynamic. Intra-group social variables like trust, cooperation, and communication styles can also have a powerful effect on the group's performance [18, 32]. As the earlier example illustrates, differential social status among the group members is another intra-group variable that can influence the nature of the group's interactions and decision [12].

In face-to-face (FTF) groups, social distinctions like status are conveyed in a variety of ways (e.g., [17]). Some group members, such as managers or military commanders, are formally assigned higher status roles [28]. Others are imbued with higher status because of their expertise or knowledge in an area [26]. Status is also signaled through the social cues group members present. Dynamic cues, like a person's body language, facial expressions, and tone of voice, are strong indicators of status. Static cues, like where a person sits at a conference table, what he or she wears, and his or her sex, can also influence others' perceptions of his or her status [22].

Regardless of how a person's status is determined, it causes him or her to behave differently toward others. Those with high status often use assertive language, stare or ignore eye contact, adopt a relaxed posture, show little or no emotional expression, and give their opinions readily [7, 25]. In mixed-status groups, higher status group members tend to dominate meetings by talking more and exerting control over the meeting's agenda and goals. When differences in status are due to differences in members' task-relevant knowledge or expertise, domination by those with higher status may make the group process more efficient by keeping it on-task and focused. Domination by a high status member can cause problems, however, by preventing others from providing input.

Those with lower social status often behave very differently than those with higher status. They tend to be more polite, avoid eye contact, are tense in posture, show emotion and are guarded about their opinions [7]. Lower status group members tend to defer to those with greater status and self-censor their behavior in a group context; they refrain from forwarding their ideas and contribute less to the group process, even when they are given the opportunity to do so [1, 25, 8]. This lack of participation can stem from fear of a negative evaluation of their contributions or of the negative social consequences of disagreeing with higher-status others [25, 26]. The

negative consequences to the group are clear: when not all members feel free to contribute, potential good ideas and intellectual resources are lost.

Some of the influences of status on the decision process can have practical implications for the decision itself. Because only one person at a time "has the floor" in FTF meetings, when those with greater status dominate meetings by talking more, negative effects can result. *Production or thought blocking* occurs when an individual forgets what he or she was about to say while waiting for another to finish [4, 21]. A type of *social loafing* can also occur because an individual gets caught up in listening rather than contributing or because the individual feels his or her ideas are less important [30].

## 1.2. Computer-mediated communication (CMC) and social context

Computer-mediated communication (CMC), such as email and instant messaging, has become an essential part of many business environments. A group decision support system (GDSS) is a type of CMC that has been developed to augment face-to-face group decisions [29]. A GDSS is a computer-based system that enhances the group decision making process and performance [13, 25]. A typical GDSS often consists of a dedicated room with networked computer terminals (one for each group member) and a public screen that help members communicate, coordinate and collaborate during the decision making process [31, 9]. Using a GDSS, group members can interact FTF and use the GDSS to provide input at various points. Such systems can provide great benefits by helping organize complex input and information that is germane to the decision.

CMC is often contextually impoverished compared to FTF interactions [24]. For example, the message "That's a great idea!" could be interpreted as either sincere or sarcastic when transmitted through an email message because the receiver does not have the opportunity to experience the sender's facial expression and tone of voice. While the lack of contextual cues in an interaction may lead to misunderstandings, the benefits are also significant. If the sarcasm in a message is not perceived, for example, it will not affect the receiver's response. Thus, social cues that may prevent important contributions in a face-to-face situation may not have the same effect when the interaction is computer-mediated.

A GDSS, as a type of CMC, can be used to attenuate the influence of social variables in group decisions. One of the most effective means by which this is accomplished is by providing different levels of *anonymity* to group members, such that the individuals in the group do not know the source of any of the information presented. As discussed earlier, when a group member's identity is

known, he or she may fear that any input will be evaluated negatively by the other members of the group or that there may be negative social consequences of voicing dissent (i.e., normative influences; [2]). In addition to freeing up individual group members to participate in the group process [11, 24, 23], anonymity can also improve group interaction and decision making by evoking more unconventional and creative suggestions from group members and increasing the freedom to provide critical feedback [30, 24, 25, 19]. On the other hand, the disinhibition and deindividuation brought about through anonymity can lead to detrimental effects, such as increased negative uninhibited behavior, like name-calling or “flaming” (e.g., [24, 3]).

Jessup et al. [11] studied the effects of anonymity on a group’s brainstorming process by using a GDSS that consisted of an electronic file-sharing system and linked computers. They found that in groups where members were anonymous, individual contributions increased. The authors suggest that this result may be due to anonymity acting as a “buffer between people, disassociating them from their comments.” Compared to those whose contributions could be identified, participants who were anonymous also showed less inhibition, as demonstrated by an increase in critical comments.

Additional research has showed that a GDSS can reduce the influence of status on some group decisions. For example, Tan et al. [26] studied how the use of a GDSS can dampen status effects in both FTF and dispersed settings, where the group members participate together from different locations via a computer connection. In this study, the participants’ task was to reach a group decision and the researchers compared three conditions: a FTF meeting without a GDSS, a FTF meeting with a GDSS and a dispersed meeting with a GDSS. The researchers manipulated status by making some group members more knowledgeable than others. The results showed that high status members in FTF groups without a GDSS exerted greater influence in the decisions and these groups experienced less disagreement overall.

### 1.3. Wireless GDSS and groups

Complex decisions frequently involve multiple sources of detailed information and a rapid pace. To deal with the complexity that is often found in formal decision situations, many GDSSs consist of specially designed rooms with terminals for each participant and a shared whiteboard. Such “heavy” GDSSs can be used to keep track of the essential information and flow of the decision process. Even the most carefully constructed GDSSs have their drawbacks, however. The hardware, which is often large computer terminals and other devices, can obscure and overwhelm the FTF aspect of the decision process.

Group members may also have their views of the others obstructed and they may concentrate solely on their own displays. Further, the technical aspects of the setup and the specially fitted GDSS room may discourage more casual and spontaneous uses of such systems.

Portable wireless devices, such as cell phones and personal digital assistants (PDAs), are rapidly becoming integral parts of many modern workplaces [6, 20]. Small wireless devices are less physically intrusive than their larger, more cumbersome desktop cousins. While typical decision making meetings that use GDSS technology must take place where the technology is housed, wireless devices can be used in various locations and more spontaneously. The last point is important: the rather formal nature of group meetings that use elaborate GDSS technology probably have an impact on the nature of the interactions among members, and wireless decision support may represent a viable alternative. However, the impact of using wireless handheld technology on face-to-face decision making groups has not been widely explored [20].

## 2. Current Research

### 2.1. Overview

Our main goal in the current research was to further examine the ways in which a simple and inexpensive wireless GDSS might be flexibly integrated into a dynamic decision environment. The specific goal was to explore how such technology might be used to ameliorate negative social influences, particularly differences in the status of group members. We sought to capture a likely decision making scenario and task, a situation where the rich information that can be produced in a face-to-face interaction is beneficial, but where CMC may aid in key portions of the decision process. With this primary research goal in mind, we hoped to shed additional light on the complex issues surrounding the use of GDSSs in group decision making.

In the study reported here, we gave mixed-sex groups of 5 or 6 a task that asked them to brainstorm potential names for a computer game based on a description of the game. We chose this male-oriented task to create a status difference between male and female participants; men are more likely to have computer game expertise, though game knowledge was not critical for success in this primarily creative task. To further highlight status differences, women were the numeric minority in each group. Participants first brainstormed ideas individually by entering them into a handheld, wireless device, with the ideas appearing as a list on each device. In one condition, participants were *anonymous*; their names were not associated with the ideas they generated. In a second

condition, participants were *identified*; names were attached to the ideas they produced. After the brainstorming session, the group members discussed the ideas and then voted individually and anonymously for their top ideas using the handheld device. The idea that received the most votes was deemed the winner. We examined the quality and quantity of the ideas, and the group members' perceptions of the process and the wireless devices.

## 2.2. Hypotheses

Social characteristics of group brainstorming and decision making tasks (e.g., fear of evaluation and conformity pressure) often lead to marked changes in the quality and quantity of member participation and to biases in favor of those with greater status. We predict two possible benefits to the anonymity afforded by the GDSS and handheld wireless devices. The first benefit will be seen in the idea-generation phase of the task. Because anonymity decreases group members' inhibitions and increases their willingness to participate, we first hypothesize that lower status group members (females) will produce more ideas when they are granted anonymity compared to when their contributions can be identified. We predict the same pattern for the rated quality of the ideas that are produced. Our second main hypothesis is that anonymity will decrease potential status differences in the voting phase of the task. We predict that there will be a bias in favor of the names produced by higher status group members (males) when contributions are identified. The names contributed by male group members will receive proportionately more votes than those produced by women. However, we predict that this bias will disappear when the ideas each member contributes are anonymous at the time voting occurs.

## 3. Method

### 3.1. Participants and Design

Forty-four men and twenty-two women took part in this study in thirteen groups of five or six. Women were the numeric minority in all groups (i.e., each group comprised 3 or 4 men and 1 or 2 women). There were no differences between men and women in their self-reported experience using handheld devices or their experience in decision making meetings (both  $t_s < 1$ ,  $ns$ ). The experiment was a 2 (identification condition) X 2 (game description) within subjects design, with order of game description and order of identification condition counter-balanced. All participants received a gift for their participation.

### 3.2. Wireless devices

Cybiko (Cybiko, Inc.) wireless handheld devices were used to provide computer-mediated communication in the group decision process (see Figure 1). The Cybiko uses radio frequency to allow users to interact with one another within a limited range by entering text on a small keyboard. The device has an approximate transmission range of 150 feet indoors and 300 feet outdoors. Users can type with a stylus on the small QWERTY keyboard and scroll through the text chat using an arrow keypad. The Cybiko is 5.7 x 2.8" x 0.86" in size, weighs 4.3 oz and has a 160 x 100 pixel grayscale LCD display.



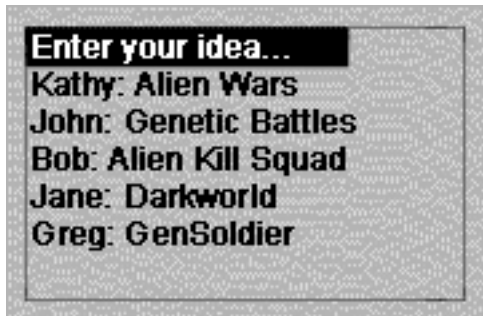
**Figure 1. The Cybiko wireless device by Cybiko Inc. with anonymous idea generation screen**

### 3.3. Decision making application

We developed a simple GDSS program that allowed users to input ideas so that the other group members could see a comprehensive list of the ideas as they were entered (see Figure 2). This allowed participants to experience one of the critical features of brainstorming, which is the ability to build on others' ideas. Users could unobtrusively scroll down the list to examine the ideas and who produced them

(in the identified condition), and add their own ideas at will.

In the application, simple commands were issued by the experimenter to control whether or not the user was identified with the ideas he or she produced; in the identified condition, users were required to input their names using the device's keyboard before the session began. The experimenter then entered another command that allowed users to "vote" (anonymously) for the ideas they preferred by selecting their choices from the list of possibilities. An additional command then tallied the votes each idea received after all group members had voted. Users were never able to see how the other participants voted, but the application allowed us to capture all input from the devices, which gave us a log of the ideas each person generated and his or her voting pattern. We used the beta version of the Cybiko software development kit to build the idea generation and voting applications for the study.



**Figure 2. Idea generation screen with participants' names**

### 3.4. Procedure

**3.4.1. Overview.** Each group of 5 or 6 was seated around a table and given the opportunity to interact for five minutes. They were then shown the wireless devices and told that the purpose of the study was to explore ways of using technology to improve group brainstorming and decision making, and that we were assessing the value of different interfaces for the handheld devices. They were told that their group would participate in three brainstorming and decision making sessions; the first session was to make them comfortable with the devices and the procedure. To give each group added incentive to do well, the groups were told that each member of the group that came up with the best market name for the description would receive an additional gift at the conclusion of the study.

In most uses of group decision support systems, there is typically a "facilitator" that leads the decision making process. This person generally walks the group through the procedure, prompts them when there is a lull and

steers the group process, though perhaps does not act as a group member in that he or she does not provide material input. It is important to note that the experimenter in the current study did not act as a facilitator in the conventional sense. Instead, he simply shepherded the groups from stage to stage of the process. No substantive feedback about the process or other prompts that may have impacted the groups' decisions were given.

**3.4.2. Game descriptions.** For each of the three brainstorming tasks (one training task and two experimental tasks), participants were given a short description of an action-type computer game and asked to come up with good market or trade names for the game based on the description. Each of the three descriptions was approximately the same length, and pre-testing suggested that each provided equally rich and generative sources of ideas for product names.

**3.4.3. Brainstorming, discussion and idea selection.** During each brainstorm, participants were told to generate as many game names as possible in seven minutes. Their names either appeared next to the ideas they generated or not, according to the condition. After seven minutes had elapsed, the brainstorm was halted, and the wireless devices were reset to present each group member with the same randomized list of ideas (or ideas and names). Participants were given an additional seven minutes to discuss the ideas in any way they desired and to select their top five choices from the list. After the seven minutes had elapsed, discussion was halted, and participants made their final selections if they had not done so already. When all had indicated that they were finished voting, the votes were tallied and all participants viewed the results on their handheld devices. The idea that received the most votes was designated the "winner". The names that were selected by the groups as their top choices were rated by two judges, who were expert gamers.

**3.4.4. Dependent measures.** We obtained background information about each participant, which included age, sex and experience with computer games, wireless devices and group decision making. We developed a questionnaire to capture participants' reactions to various aspects of each brainstorming task, including reactions to using the devices, their perceptions of the process, their own performance, the performance of the other group members, and the outcomes. Group members completed this questionnaire after each brainstorming session, and they made their ratings on Likert scales (5- or 7-point). We also obtained an objective log of the ideas each participant generated and their voting patterns for each session from the wireless devices, and the quality of the ideas selected by each group was also assessed by our

expert raters on a 7-point Likert scale (1 = *not a good name*; 7 = *very good name*).

## 4. Results

The data obtained before the groups interacted were considered independent observations and analyzed at the individual level. Data obtained after the groups interacted were analyzed using a within subjects design with group means as the units of analysis. In these analyses, task order and game description order, which were counterbalanced in the design, were included as between-subjects variables. All significance tests were two-tailed.

### 4.1. Manipulation check

Our choice of the computer game-naming task was intended to be male-oriented to highlight status differences in order to test the hypothesis that anonymity would be more beneficial to those of lower status (i.e., women). To confirm that the task served this purpose, participants rated their experience playing games (1 = *no experience*; 5 = *expert*) prior to the brainstorming task and before they interacted as a group. Consistent with predictions, men reported having significantly more game playing experience ( $M = 3.09$ ,  $sd = 1.0$ ) than women ( $M = 2.33$ ,  $sd = .56$ ),  $t(68) = 3.39$ ,  $p < .001$ . These differences also translated into self-reported differences in how creative the participants felt as they completed the tasks (1 = *not at all creative*; 7 = *very creative*). Women reported feeling less creative at the task than men,  $F(1, 9) = 5.36$ ,  $p = .046$ , so it appears our manipulation was successful. Men and women did not differ in their self-reported level of experience with handheld devices or group decision meetings (both  $ts < 1$ , *ns*).

### 4.2. Idea production

Our primary hypothesis was that women, having lower status, would benefit more from anonymity than men. Specifically, we predicted that women would produce more ideas when they were anonymous than when they were identified, while men would show no difference. Overall, the groups produced more ideas, on average, when they were anonymous ( $M = 37.54$ ,  $sd = 11.98$ ) than they did when their ideas were identified ( $M = 34.23$ ,  $sd = 8.80$ ),  $F(1, 9) = 5.99$ ,  $p = .037$ . Combining the number of ideas produced in both the anonymous and identified conditions, there was a marginal difference in the average number of ideas produced by men and women overall,  $F(1, 9) = 3.75$ ,  $p = .09$  (see Table 1). The predicted interaction between sex and condition was not significant, possibly due to a lack of power due to our limited sample size. So, we then tested the simple main effects for men

and women separately. Women, on average, generated a marginally greater number of ideas when they were anonymous than when their ideas were associated with their names,  $F(1, 9) = 3.75$ ,  $p = .085$ . Similarly, men showed a marginally significant difference in the average number of ideas they generated when they were anonymous, compared to when they were identified,  $F(1, 9) = 3.56$ ,  $p = .09$ . While we expected only women to produce more ideas when they were anonymous, it seems that both men and women were influenced by the identification manipulation, albeit only marginally.

**Table 1. Mean (sd) number of ideas produced and proportions of ideas receiving votes by condition and sex of contributor.**

	Anonymous		Identified		Total	
	M	F	M	F	M	F
Mean ideas produced (sd)	7.12 (1.58)	6.58 (2.36)	6.66 (1.42)	5.65 (2.37)	13.78 (2.8)	12.23 (4.47)
Proportion receiving votes	.68 (.67)	.32 (.33)	.74 (.68)	.26 (.32)	.71 (.66)	.29 (.34)

### 4.3. Idea quality

Recall that we asked two raters to assess the quality of the top names each group produced (1 = *not a good name*; 7 = *very good name*). Given that this task was creative, rather than intellectual, in nature (i.e., there no “right answer”; [18]), we expected our raters to be somewhat inconsistent in their ratings. To assess the reliability of the ratings our judges gave, we computed an intraclass correlation between their ratings of the names. Overall, the ratings showed an acceptable, though moderate, correlation across the two game descriptions ( $r = .59$ ,  $p < .001$ ). The correlations were similar for when the ratings of names based on each game description were considered separately ( $r = .56$  for the first description and  $r = .64$  for the second description; both  $ps < .001$ ). Based on these correlations, we combined the judge’s scores into a composite rating for each name, and subsequent analyses are based on this composite.

In general, the ratings for the top game names were fairly low ( $M = 2.55$ ,  $sd = 1.18$ ). This might be due to the fact that our participants had no experience with this type of task and were not trained beforehand. It might also be that our judges were particularly discerning in their ratings of the quality of the names. Composite ratings did not differ based on description ( $F < 1$ , *ns*). We then looked at whether ratings of the top names produced by the groups differed by condition. Though the means differed in the predicted direction ( $M_{ANON} = 2.62$ ,  $sd = .66$ ;  $M_{ID} = 2.50$ ,  $sd = .68$ ), the difference was not significant ( $F < 1$ , *ns*). Unfortunately, in 5 of the 13 groups, names proposed by females did not make the list of top names our judges

rated, so we were unable to make quality comparisons between the names women proposed and those proposed by men.

#### 4.4. Voting patterns

Our second primary hypothesis was that there would be a bias in favor of the ideas men produced when the contributor's name was attached. We tested this hypothesis by examining the pattern of votes cast by group members. Recall that each participant voted for the five ideas he or she thought were best in each of the conditions, for a total of 700 possible votes cast (the actual total was 694 votes due to 6 participants casting only 4 votes during a session). Men produced 66% of the ideas across conditions, while women produced 34%; these proportions match almost exactly the proportion of men and women in our study. We expected that ideas generated by men and women would receive votes proportionate to the number generated by each sex if there were no bias. This was not the case, however, as the ideas men generated were selected more often than those from women,  $X^2(1, n = 694) = 8.29, p = .004$  (see Table 1).

To explore this issue in more detail, we examined voting by sex of the idea's originator within each condition. In the anonymous condition, women produced 33.3% of the ideas, and their ideas received 31.8% of the votes, a proportion that is no different than expected. When ideas were identified with their originator, women produced 31.8% of the total, again no different than expected,  $X^2(1, n = 346) = .326, ns$ . However, in the identified condition, women's ideas received only 26.4% of the votes, which is significantly less than one would expect if there were no bias against the ideas they produced,  $X^2(1, n = 348) = 4.78, p = .03$ . The data from votes cast by participants, considered in conjunction with the other data, suggest that there is a real bias against the ideas women produced, but the bias is mitigated when contributions are anonymous.

#### 4.5. Post-session questionnaire

We suggested earlier that the anonymity provided by the wireless devices would impact users' perceptions of various elements of the decision process and outcome. To further explore how the wireless device affected group members' perceptions of group interactions, we compared their answers to several items on the questionnaire they completed after each session. Note that ratings were made on a 7-point Likert scale, where 1 = *not at all* and 7 = *very*. Of particular interest was a question that asked how the group communicated ("As a group, we communicated respect and consideration to each member."). According to their responses to this item, anonymous groups felt that

they communicated more respect and consideration to their members ( $M = 5.99, sd = .40$ ) than identified groups ( $M = 5.72, sd = .50$ ),  $F(1, 9) = 5.58, p = .042$ . A related item also addressed this issue by asking participants the extent to which they agreed that all ideas put forth were given consideration. On this item, groups agreed more strongly when they were anonymous ( $M = 5.70, sd = .68$ ) than when they were identified ( $M = 5.49, sd = .65$ ),  $F(1, 9) = 6.52, p = .031$ . These results taken together provide further evidence that group members experienced some of the benefits of the anonymity afforded by the wireless devices.

Two questions on the post-task questionnaire also asked participants about their satisfaction with the number of ideas the other group members produced and with the quality of the idea the group selected as the best one. Women were more satisfied with the quality of the other group members' ideas compared to men,  $F(1, 9) = 5.12, p = .05$ , but there was no main effect for condition ( $F < 1, ns$ ). Men and women did not differ in their perceptions of the quality of the final idea the group selected as the best, nor was there a main effect for condition (both  $F_s < 1.0, ns$ ).

#### 4.6. Post experiment questions

Recall that one of our goals in conducting this research was to explore the perceptions of users of the wireless devices in decision making meetings. We wished to get a sense of whether users would find the wireless devices and GDSS useful. After participants had completed both brainstorming and decision making sessions, we asked them to rate their willingness to use wireless devices on a similar task in the future and their willingness to work with their groups again (1 = *not at all*; 7 = *very*). Participants indicated that they would be willing to use wireless devices in a similar task in the future, if they were given an opportunity to do so ( $M = 5.48, sd = .82$ ). Generally, they also enjoyed the groups they worked with, as indicated by their willingness to work with them again ( $M = 5.84, sd = .74$ ).

#### 4.7. Open-ended comments

In the post-session debriefing and discussion, participants' comments indicated that they noticed the difference between the anonymous and identified conditions. While none voiced suspicion that anonymity was the issue we were interested in, they seemed aware of the benefits of anonymity. Even those who said they preferred to be identified noted that shy, quiet people would participate more if they were anonymous.

Consistent with our predictions, study participants often commented that they felt more free to contribute

ideas without fear of being criticized. One female participant said, "I felt the discussion was more open when ideas were anonymous. When we knew the identity of the person whose idea we were discussing it was more difficult to be objective." The second predicted benefit, that participants would benefit from anonymity when discussing and voting on ideas, was also supported by these comments. Several participants mentioned that it was easier to be critical of ideas in the anonymous condition, a result that supports past research in which anonymous group members broke norms and took more risks with their decisions. As one female participant said, "I think it helped me to come up with ideas when the list was anonymous so I didn't have to worry about others' criticism. It was also easier to criticize other ideas without a name on them."

Comments from the open-ended discussion also supported the notion that women had lesser status than men, but that using the wireless device helped eliminate effects due to these differences. One male participant said he thought the anonymous condition helped remove his bias against women: "...keep the names out though so biased views are not a factor—I admit some of the names the ladies chose I voted down because I felt the games were for guys and they knew better. If they were girls' games I would have taken their advice."

As expected, the groups recognized that social cues were reduced when their names were not attached to their ideas. One woman said in discussion after the session, "I'd probably use it [a wireless device] more when you're having to come up with a brainstorming solution and emotions are running high because sometimes the brainstorming technique doesn't work as well when you're in a hostile situation."

## 5. Discussion and conclusions

Group situations contain many potent social variables that can influence both the nature of interactions between group members and the outcomes of the group's tasks. While social context conveys valuable information, often the information is irrelevant to the task and can hinder the functioning of the group. In this study, female participants were relegated to a lower status by the nature of the task (a domain in which they were less knowledgeable) and by their minority status in the group. One male participant eloquently summed up the situation the female participants faced: "I didn't really take the women's suggestions into consideration, because I don't think they know much about games."

Our goal was to determine whether a simple and lightweight wireless GDSS could be an effective way to minimize the negative effects of social variables, like status, on group brainstorming and decision making.

Though we predicted that only women would benefit from the anonymity granted by the wireless GDSS, we found that both men *and* women produced a marginally greater number of ideas when they were anonymous compared to when they were identified, though we found no differences between conditions in the rated quality of the names. Further, group member votes showed a marked bias in favor of men's ideas when the origin of ideas could be identified, but this bias disappeared when ideas were anonymous. These results indicate that anonymity does help eliminate some of the detrimental effects of status on group decisions. Lower status individuals who are anonymous produce more ideas and have their ideas voted for proportionately. The results also support the notion that technologically lightweight devices can be used in a face-to-face group to provide benefits similar to those that have been demonstrated in past research using more traditional devices [11].

Some of the benefits that derived from the wireless GDSS were also evident in participants' reports of their perceptions of various parts of the decision making process. Interestingly, both men and women thought the group communicated more respect and gave all ideas fair consideration when they were anonymous. Having no identity attached to the ideas produced seemed to lead to at least the perception that group members were more respectful toward one another. An interesting follow-up study might examine the actual interactions among group members to determine if the reality of the interactions matches these perceptions.

We also found that there were differences between the sexes in their perceptions of some aspects of the process, and that the differences depended on the identification condition. Women, more than men, thought that both the quality of the ideas produced and the final idea selected were better when the groups were anonymous compared to when they were identified. Again it seems that being anonymous leads to differences in the perceptions of those with lower status.

We argued that in many group decision situations, women are seen as being of lower status than men. One criticism of the current research lies in our manipulation of "social status." When we manipulated status, we deliberately confounded sex of the group members with their majority/minority status; men were always the majority and women were always the minority. The nature of the task also led men to be granted higher status through perceptions that men are more likely to be "gamers" than women. We chose these manipulations to maximize the effect of our status variable, given our relatively small sample size. However, our overall goal was to demonstrate that some of the deleterious influences of status (and social variables generally) can be mitigated using the devices in group situations, irrespective of the

source of the status differentials. The results suggest that we succeeded.

The results reported here also suggest that it is possible to integrate small, wireless devices into a brainstorming and decision-making meeting with positive outcomes. Wireless devices in face-to-face meetings allow a great deal of social interaction and minimal intrusion, while providing a private screen and a quiet input mechanism. They can be used more spontaneously because they do not require a dedicated room and allow a more face-to-face “feel” to the group’s interaction because users do not have to deal with large pieces of hardware obstructing their views.

However, small wireless devices have limitations that limit their usefulness in some decision-making situations and groups. Inputting and manipulating information can be difficult, and interference from various sources can impede communication between the devices. Screen real estate is limited on many devices, so creating a usable user interface is more challenging. The rapid advances being made with the speed, capacity, input and display capabilities of wireless technology, however, make it likely that some current shortcomings will soon be overcome. Given the desire of many organizations to improve the product and process of diverse decision making groups, inexpensive and flexible alternatives to more traditional GDSSs will probably become more popular. Fewer impediments, like exorbitant cost, onerous setup and complex infrastructure, will make use easier and more likely [15]. Adoption will be even more probable if the less cumbersome wireless alternatives demonstrate benefits similar to those derived from traditional GDSS packages. The research presented here suggests that they do.

Our results also showed that users generally were favorable toward the use of the wireless devices. An obstacle to fostering the use of wireless technology might be moving users to naturally identify situations where the devices might be used and then to use them. One way to do so would be to expose users to these devices. In fact, one of our participants suggested spontaneously that he wished he had had such devices in a meeting he had been involved with the week before. His church group had been in the process of making a contentious decision, and he suggested that the wireless devices and GDSS would have been very helpful to avoid conflict. More research is needed to identify additional ways in which wireless devices might be utilized and additional unique benefits they might offer.

## 6. References

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