INFLUENCE OF ANONYMITY IN A

GROUP PROBLEM-SOLVING ENVIRONMENT

THESIS

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Robert A. Sylvester

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Abstract

A group support system (GSS) uses a combination of networked personal computers, software that collects, manipulates, and aggregates member's individual input, and human facilitation to improve the group decision-making process. Group support systems are being used in the Air Force today in a variety of capacities and in particular by the Warner-Robins Air Logistics Center (WR-ALC) to assess acquisition risks. GSS facilitators at WR-ALC are interested in achieving the optimal productivity out of their GSS system. Prior GSS research has found that content and process anonymity influence problem solving groups. However, previous studies report mixed results on which levels of anonymity positively influence group performance.

This thesis looked at content and process anonymity using four treatments to explore possible explanations for the mixed results found in previous GSS research. The study examined numerous theories including anonymity, identification, social loafing, and social comparison. An experiment was developed to assess how content and process anonymity influence participation rates, quality of the group decision, consensus levels, user attitudes, and user satisfaction with the group outcome. Groups participated in conditions of total anonymity, process anonymity, and no anonymity. The no anonymity condition included face-to-face discussion and use of a GSS in which comments were labeled and stations were labeled with placards. The results of the study were underwhelming. In general, it was found that face-to-face groups participated at higher levels, achieved a higher group decision quality, reached higher consensus and were more

satisfied with the group outcome. These findings cannot be attributed to the lack of process and content anonymity however, because the GSS labeled with placard treatment did not achieve the same results.

INFLUENCE OF ANONYMITY IN A GROUP PROBLEM-SOLVING ENVIRONMENT

I. Introduction

A Group Support System (GSS) is the combination of "communication, computer, and decision technologies to support problem formulation and solution in group meetings (DeSanctis and Gallupe, 1987: 589)." The basic purpose of this technology is "to increase the effectiveness of decision groups by facilitating the interactive sharing and use of information among group members and also between the group and the computer (Huber, 1984: 186)."

A GSS will normally increase participation allowing all meeting members to participate fully without regard to criticism, since idea generation can be anonymous (Jessup, Connolly, and Galagher, 1990). Consequently, ideas are evaluated on their worth rather than on the source of the idea. Anonymity, however also allows group participants to socially loaf (Sanna, 1992), which may minimize the benefits anonymity provides to other group members.

Previous research has shown that anonymity can influence the perceptions and social interactions of individual group members (Pinsonneault and Heppel, 1997). This influence can be both positive (increased participation) or negative (social loafing). Subsequently, the level of anonymity provided in a meeting is an important design decision that should be considered when setting up a meeting. A GSS provides meeting managers with multiple options in the area of anonymity that should be considered. This study will shed light on these options and highlight the strengths and weaknesses of different levels of anonymity.

1.1 Anonymity Types

Two types of anonymity will be discussed throughout this paper: content anonymity and process anonymity. Valacich, Jessup, Dennis and Nunamaker define content anonymity as "the extent to which group members can identify the source of a particular contribution by recognizing the author through an identifier embedded in a contribution (1992: 224)." Knowing the author does not mean that participation can be associated with a specific individual. Embedded identifiers typically use code names (e.g., Red, Green, Blue, Yellow) that protect the individual participant's identity. Protection of the participant's identity refers to process anonymity. For the purposes of this study, content anonymity will be achieved when participants do not have comment labels. When comment labeling is present, participants will not have content anonymity.

Process anonymity is defined as "the extent to which group members can determine who is participating by directly observing who is making a contribution to the process (Valacich et al., 1992: 223). Process anonymity is achieved when participants cannot directly observe (either in a face-to-face or GSS session) when another participant is contributing. When comment labeling is present, and when the participants' stations are labeled to reflect the comment labels (via placards), participants will have no content or process anonymity. Combining content and process anonymity produces three levels of anonymity within a GSS: process and content; content only; and no anonymity. Investigating the relative effects of these three levels may provide insight into the equivocal results of past GSS research.

1.2 The Need for Meetings and GSS

Corporate America spends an inordinate amount of time in meetings--time that is often poorly utilized and unproductive. Poole and DeSanctis label a meeting as a "cul de sac down which promising ideas are lured and quietly strangled (1990, 173)." Group Support Systems (GSS) have been hailed as a potential solution to these time-wasting events. Research suggests that groups that use GSS technology can often be more productive and satisfied than non-GSS groups (Dennis and Gallupe, 1993).

Individual managers seldom have access to all relevant information, so when truly important decisions have to be made, a group is formed to make the decision or to advise the individual who must make it (Hackman and Kaplan, 1974). Group discussion enables participants to share information so that the group as a whole can access a larger pool of information than any one person acting alone (Shaw, 1981). The exchange of information is the key difference between individual and group decision making -- and the key element of group decision making (Dennis, 1996).

As demands increase to "do more with less", our ability to improve our level of productivity through the effective implementation of computers will continue to grow. From the 1950s through the 1970s productivity gains were accomplished through the automation of repetitive information processing tasks. In the 1980s, the proliferation of computers grew at a rapid pace because of their lower costs, increased power and decreasing size. Since this explosion of growth, similar advances have taken place in networking technology. The interconnectivity now available to everyday users of the computer has increased their usefulness and effectiveness. Developing ways to capitalize on networked computers is now at the forefront as people continue to look for ways to

incorporate technology into their workday. This study looks at how anonymity can be adapted into group problem-solving processes and the benefits and drawbacks of doing so.

1.3 Groups as Barriers and Facilitators

Properties of group structure and social interactions act both as barriers and facilitators to the effectiveness of decision-making groups. Barriers may include accountability, information processing, production blocking, and social loafing. Facilitators may include collective learning and identifiability. "Accountability, the social pressure to justify one's views to others, has repeatedly been shown to influence how and what individuals think" (Green, Visser and Tetlock, 2000:1380). Information processing can result in information overload if the group is too large or if the task is not fully understood. This can hinder the group communicative process. Production blocking occurs when something or someone prevents verbalization of ideas as they occur (Shepherd, Briggs, Reinig and Yen, 1995). This may result in the member becoming too distracted to contribute new ideas or result in social loafing. In social loafing, "individuals tend to expend less effort in group tasks than they do in individual tasks, unless their contribution can be specifically identified, or unless they believe that their contribution is critical to the success of the task (Shepherd et al., 1995: 524)."

Hackman (1995) writes that fostering collective learning can result in a synergistic gain from group interaction. Groups that share what is learned should reach better decisions. Contrary to social loafing, some group members want

acknowledgement for their ideas. They want to be identified each time they speak and the group offers them a forum for their ideas and possibility the recognition they covet.

GSS technology has been developed to enhance the positive aspects (facilitators) of groups while minimizing the negative factors (barriers). According to Hackman (1995), "the design of a group—task structure, group composition, and group norms—should promote effective task behavior and lessen the chances that members will encounter built-in obstacles to good performance" (411). The challenge that exists today is to develop ways of understanding, designing and managing groups that help them meet or exceed standards of team effectiveness (Hackman, 1995).

A Group Support System may help teams meet and exceed these standards. The anonymity a GSS can provide may reduce the importance of team member's demographic attributes (e.g., gender, age, or rank) or behavioral style (e.g., talkativeness). In addition, member behavior can be self-regulated through the structure available in a GSS. The challenge is to create a task environment that promotes a shared commitment among members and minimizes social loafing.

By allowing anonymous communications, GSS are expected to reduce inhibition and evaluation apprehension, enhance participation, increase the number of ideas generated, and improve the quality of decisions (Nunamaker, Dennis, Valacich, Vogel, and George, 1993). Some GSS studies have found strongly positive results when comparing GSS meetings to face-to-face meetings, while other studies found mildly positive results, and others found mixed, neutral, or negative results (Lam, 1997).

Research on Group Support Systems has primarily focused on the efficiency realized by the technology, the abilities of facilitators, and the results of GSS meetings

when compared to face-to-face groups (Nunamaker, Briggs, Mittleman, Vogel, and Balthazard 1997: 202, Anson, Bostrom, and Wynne, 1996). Each of these previous efforts called for further investigation of other contextual factors that may influence GSS processes and outcomes. The goal of this line of research is to discover meeting processes and designs that can consistently increase the quantity and quality of comments and ideas generated in a meeting, and further the likelihood of improving decision quality (George and others, 1990). The future use of GSS will be determined by the potential to reach quality decisions in a GSS environment. The importance or lack of importance of anonymity will be realized by determining the impact anonymity has on those decisions. Pinsonneault and Heppel (1997) believe that more laboratory and field experiments should be conducted to determine the impact of anonymity on group processes. Given the conflicting findings on GSS effectiveness when comparing face-to-face and GSS meetings, and the promising results of recent research on contextual factors of GSS design, this topic is worthy of further investigation.

1.4 Research Applicability to the United States Air Force

Since the late 1980s, the United States Air Force has faced reductions in manpower and budgets. At the same time, demands have increased for more flexible, cost-effective operations. The days of attending expensive and time-consuming meetings at destinations around the world are rapidly dwindling. This has resulted in the demand to "do more with less" and to find more efficient and effective ways to hold meetings.

Reduced business-cycle times and improved process efficiencies are becoming increasingly critical to Air Force effectiveness (Air Force Research Laboratory

Sustainment Logistics Branch, 1999). The implementation of Lean Logistics during this timeframe was in response to the Air Force's quest to streamline its logistics infrastructures and processes (Office of the Secretary of Defense, 1996).

The Lean Logistics program focuses on improving operational units' capabilities by applying modern business practices across all logistics functions and processes. The program suggests the use of just-in-time asset management and repair systems instead of the traditional demand-driven, just-in-case asset management systems. The Air Force is advancing innovative concepts, such as the use of information systems, to support Lean Logistics in providing effective and less costly depot-level maintenance operations (Office of the Secretary of Defense, 1996, Office of the Secretary of the Air Force, 1997).

With DoD's focused logistics and the Air Force's agile combat support initiatives, the logistics community must continually re-evaluate the processes used to support the warfighter. The emphasis on cost cutting has also placed considerable pressure on logistics units at the base and depot levels to streamline their operations. Depots are also facing increased competition from commercial firms for aircraft repair and maintenance business. As a result, Air Force logistics units are confronted with the need to change their processes in an attempt to incorporate Lean Logistics to ensure success in this increasingly competitive and dynamic environment. Implementation of Lean Logistics concepts will require increased communication and collaboration among the affected units (Air Force Research Laboratory Sustainment Logistics Branch, 1999, Air Force Research Laboratory Sustainment Logistics Branch, 1998).

In support of Lean Logistics, the Air Force Research Laboratory (AFRL) has developed a distributed computer-mediated decision support system to allow

maintenance depots, base logistics units, and command headquarters to accomplish process redesign. The system is composed of two programs. The first is called RAPTR, or Readiness Assessment and Planning Tool Research. RAPTR, not in itself a distributed GSS, provides a business process reengineering toolkit intended to assist logisticians and managers in implementing changes within their organizations. The program will identify processes for reengineering and offer remedies to address them. (Air Force Research Laboratory Sustainment Logistics Branch, 1998).

The second component of the proposed system is the Depot Operations Modeling Environment, (DOME). It is this component that uses distributed GSS technology. The goal of the DOME system is to aid in the design and modeling of Air Force logistics processes using a collaborative environment which establishes connectivity between dispersed groups and installations. The DOME system relies heavily on an existing commercial product known as GroupSystems® developed by the University of Arizona. Many of the tools developed for the DOME project extend the capabilities of GroupSystems® to offer greater functionality. The DOME system has been successfully installed and demonstrated at the Warner-Robins ALC, Robins AFB, Georgia and the 366th Wing at Mountain Home AFB, Idaho. (Final Dome, Air Force Research Laboratory Sustainment Logistics Branch, 1998)

These examples demonstrate the fact that GSS use is becoming more widespread throughout the Air Force to meet the tougher demands of a "do more with less" military environment. Determining what level of anonymity can optimize the use of Group Support Systems is essential in facilitating their use and ultimately their success.

1.5 Problem Statement and Purpose of Research

This study will be one of four theses that delve into different aspects of GSS research. All four studies will use the same experimental sessions to collect data, but each study will concentrate on different manipulations, measured independent variables, and outcomes. One study will evaluate the influence of the participant's individual characteristics in a GSS environment (Hartmann, 2001). A second study will look at the impact an expert (or perceived expert) has on a problem-solving exercise in a GSS environment (Thompson, 2001). The third will examine how real time feedback through comment labeling and process feedback will influence the quantity and quality of ideas generated in a GSS environment (Denney, 2001). The purpose of this study was to determine the influence of varying levels of anonymity on the group problem-solving process. Success will be determined by evaluating group members' satisfaction levels with both the process and the group outcome, group participation levels, group consensus, and ultimately group decision quality. For the purposes of this study, anonymity will be defined as "the identifiability of group member contributions (Jessup and Connolly, 1990: 314)."

Many studies have looked into the impact of anonymity in a GSS environment by comparing these meetings with face-to-face meetings. However, Connolly, Jessup and Valacich (1990) believe that based on the potential power of the anonymity manipulation in a GSS that there seems to be real research potential in further clarifying the interaction between task, group and individual characteristics and anonymity. This study will look closer at the different levels of anonymity a GSS can provide and compare them with

each other and with face-to-face meetings in an effort to identify the best setting for achieving highly productive meetings and satisfied participants.

1.6 Summary

A GSS offers problem-solving teams a variety of system configurations and provides today's teams with many possible levels of anonymity. Subsequently, identifying the level of anonymity which results in the highest level of consensus, increased participation levels, or the highest quality decision would be very valuable to leaders who are establishing problem-solving teams.

While many studies have been published on the influence of anonymity, little research has been conducted on different levels of anonymity in problem-solving groups outside of anonymous GSS and face-to-face. This study will identify which level of anonymity will enhance the quality of a group's performance, increase their level of consensus, facilitate participation and increase user satisfaction with the process and the group outcome.

1.7 Sequence of Presentation

Chapter II reviews the relevant GSS literature with emphasis on literature that pertains to the dependant variables studied in this thesis. Chapter III describes the methodology used to conduct the research for this study. Chapter IV presents the data collected and results of this study. Finally, Chapter V interprets the results obtained in Chapter IV along with implications, study limitations, and suggestions for future research.

II. Literature Review

2.1 Introduction

This chapter explores group decision-making approaches and the evolution of GSS research from the initial studies conducted in the 1970s to current research that focuses on the technology's ability to support decision-making groups. Emphasis will be placed on the role of anonymity and comment labeling in problem-solving groups, and subsequently their impact on participation, group performance, consensus, and satisfaction with the process and the outcome. Finally, this chapter presents the theoretical basis and the hypotheses investigated for the research contained in this study.

2.2 GSS Development and Process

The forerunner of Group Support Systems (GSS) was developed at the University of Texas when Dr. Gerald R. Wagner created a system called Mindsight. Mindsight provided the inspiration for the basic configuration for GSS replete with computer terminals, projection screens and décor designed to promote group discussions. The lineage of the GSS system can be traced to the University of Arizona in the early 1980s. There they developed software called Plexsys and the first GSS room, which was called the PlexCenter. Both were developed to support group-process talks such as idea generation, idea organization, voting, and policy formulation (Wagner, Wynne, and Mennecke, 1993).

The system used in this study, Group Systems, has resulted in numerous research studies over the years. With Group Systems, a facilitator runs the session, users are placed in front of terminals (either locally or distributed), and a toolkit is provided for

each user. Tools from the toolkit deemed pertinent to the session are selected by the facilitator and made available to the users. The session follows the outline presented in the Group Systems Agenda. The Agenda items each are linked to a specific tool from the tool kit, which help keep the meeting structured. For instance, a brainstorming agenda item would use the Brainstorming tool and the need to vote would use the Group Systems Vote tool. As the agenda progresses, the facilitator can incorporate new tools from the toolkit as needed. During the meeting, the GSS display can be displayed on a large screen. Often this screen is referred for clarification or further discussion. The GSS can provide a group memory by recording all electronic comments. This allows participants to "decouple themselves from the group to pause, think, type comments, and rejoin" the session without missing anything (Nunamaker, Dennis, Valacich, Vogel and George, 1993: 132). Once the meeting concludes, the system maintains a complete record of the session for future reference.

2.3 Group Research Background

The conceptual framework for the study of groups starts with two givens: the characteristics of individual members of the group and the environment in which those people are immersed (McGrath, 1984). Individual characteristics include demographics such as gender, age, rank, and level of education. They also include personality, beliefs, attitudes and values, moods, state of mind, needs, motives, goals, and expectations (McGrath, 1984). Environmental characteristics include the cultural and technological environment. The cultural environment includes socially transmitted behavior patterns

based on beliefs and institutions. The technological environment includes the characteristics of the system being used.

A conceptual framework for the study of anonymity was developed by Valacich et al. (1992). Their model described five factors that influenced anonymity. The factors map very well to McGrath's conceptual framework (see Table 1).

Table 1.

Linkage between McGrath and Valacich, Jessup, Dennis and Nunamaker.

McGrath	**Valacich, Jessup, Dennis and Nunamaker**
Individual Characteristics	Group Composition
Cultural Environment	Group History, Group Size and Member Proximity
Technological Environment	System Characteristics

The focal point of Valacich et al's (1992) model are the two types of anonymity. Content anonymity is provided when embedded identifiers, which identify a contribution's source, are absent. Process anonymity is provided when the contributor cannot be determined by direct observation. A GSS normally provides a greater amount of process anonymity over face-to-face groups when GSS participants and comments are unlabeled. Increased process anonymity is also more prevalent in a GSS because contributions cannot be directly attributed to participants through direct observation. Process anonymity, however, can be minimized in a GSS environment if comments are labeled and participants are identified through placards linking the labels to the participants.

The individual's inclination to act, and the nature of the act, is influenced by the motives and actions of other group members. The model introduced by Valacich et al. (1992) separates effects on the individual because the group process is a compilation of the individual communicative episodes. Some of the individual effects are social loafing, social comparison, and production blocking. The effect on the individual can be evaluated by measuring their satisfaction with the process, their satisfaction with the outcome, and their participation rate. The model further breaks down the effects of anonymity on the group into effects on the group process and effects on the group outcome. These can be measured by evaluating the quality of the decision and the level of consensus reached by the group. This study modifies the model developed by Valacich et al. (1992), incorporating McGrath's conceptual framework of groups. (See Figure 1).

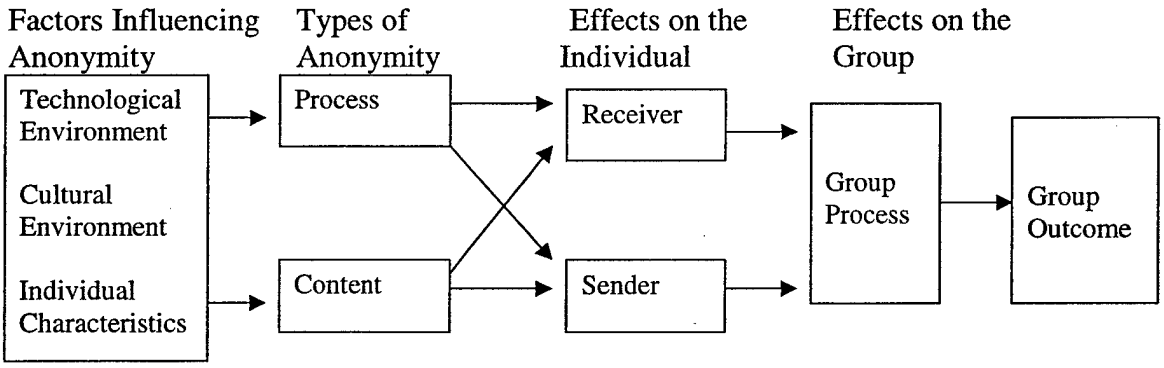


Figure 1. Conceptual framework for GSS anonymity adapted from Valacich, Joseph S., Leonard M. Jessup, Alan R. Dennis, and J.F. Nunamaker Jr. "A Conceptual Framework of Anonymity in Group Support Systems." Group Decision and Negotiation, 1: 223 (1992).

When studying groups, the environment can take an infinite number of forms because of the many differences between people (individual characteristics) and the different cultural and technological situations in which the groups can be placed. This makes it important to carefully select the environment and the participants to be included in a study.

Some common problems experienced by decision-making groups include the extreme influence exerted by high-status members, the lack of acknowledgement of low-status members' ideas, and a low tolerance exhibited toward minority or controversial opinions (DeSanctis and Gallupe, 1987). Group members with low status characteristics (age, rank and level of education) have difficulty achieving influence over group decisions (Ridgeway, 1982). DeSanctis and Gallupe (1987) add that some group members are reluctant to participate because of their shyness, low status or the controversial ideas being discussed. Another significant problem that arises in problem solving groups is production blocking. "Production blocking occurs when something prevents verbalization of ideas as they occur. One may forget an idea while waiting for a turn to speak, or may devote attention to remembering an idea, becoming too distracted to generate new ideas (Shepherd, Briggs, Reinig, Yen, and Nunamaker, 1995: 157)." With the GSS, all participants can contribute simultaneously and all ideas are immediately displayed for all group members to review. "Because nobody has to wait for a turn to speak, production blocking is eliminated (Shepherd et al., 1995: 157)." This study aims to answer many of the questions revolving around the applicability of content and process anonymity in trying to overcome these common problems.

2.4 Evolution of GSS Research

The beginnings of GSS empirical research can be traced back to a study conducted by Chapanis and his associates. He was among the first researchers to study computer messaging versus face-to-face communication. In his study (Chapanis, 1972) two-person teams solved problems using either computer messaging, remote handwriting, audio only, or face-to-face discussions. He found that groups using computer messaging took longer to solve the problems and sent fewer messages than face-to-face groups.

The early 1980's saw the emergence of exploratory studies of computer-based support for group processes. "These early efforts were conducted by pioneers who recognized that computer and communication technology offered the potential to improve the productivity of groups (Jessup and Valacich, 1993: 62)." These early studies attempted to develop GSS systems and examine their affects. The lessons learned during this early phase of research included (1) GSS has the potential to improve group processes and performance, (2) better GSS systems are needed, and (3) in order to understand their true impact, more rigorous GSS research is needed (Dennis and Gallupe, 1993).

The next phase of GSS research primarily consisted of studies that compared face-to-face groups with computer mediated groups. These studies often evaluated decision quality, time to reach decision, consensus and participant satisfaction with both the process and the group outcome. "The results of these early experiments can be summed up in one word: mixed (Dennis and Gallupe, 1993: 66)." What these studies did make clear was that using GSS made a difference. Further efforts are needed to determine what factors cause the mixed findings.

At this point, the majority of studies were conducted in the field. One of the areas focused on during this time was anonymity. Again, the results were mixed. In general, GSS field studies found positive reactions to GSS and anonymity (Dennis and Gallupe, 1993). However, Jessup and Connolly (1990) stated that "we are far from understanding the true impacts of anonymous GSS interaction (314)."

More recent research has shifted away from investigation of the capabilities of the technology itself toward investigating the group dynamics of GSS supported group meetings. Many of these studies have looked closely at the number of comments contributed and the anonymity a GSS can provide to meeting members.

2.5 Role of Anonymity in Problem-Solving Groups

The anonymity provided through a GSS session has been hailed as the primary way through which a GSS helps problem-solving groups overcome process losses. Kerr and Bruun (1981) define process loss as "the difference between the group's potential and actual performance (224)." By keeping the identity of GSS participants unknown, anonymity reduces the fear of social disapproval and of evaluation, increases the number of ideas generated, and lowers inhibition and censorship (Pinsonneault and Heppel, 1997). Research has also shown that keeping the identity of members involved in the GSS unknown can bring negative results to the meeting (DeSanctis and Gallupe, 1987; Jessup, 1989; Jessup, Connolly, and Tansik, 1990; Nunamaker et al., 1988).

2.5.1 Problem-solving Methods

There are many ways in which groups can strive to reach a decision. They include the "Plop" method, decision by authority rule, decision by minority rule and decision by majority rule. The following paragraphs briefly explain each of these methods and how different levels of anonymity can be applied to each.

Schwartz (1994) defines the "Plop" method as "someone suggests an idea and, before anyone else has said anything about it, someone else suggests another idea, until the group eventually finds one it will act on" (60). This is probably the most common problem-solving method implemented by groups (Schwartz, 1994). The problem with this approach is ideas are rejected before they are considered. "But because the rejections have been simply a common decision not to support the idea, the proposers feel that their suggestions have been 'plopped' (Schwartz, 1994: 60)." This problem-solving method is likely to occur when the group has a dominant person or when there are varying levels of status within the group. The "Plop" method is less likely in face-to-face groups with equal status. One of the benefits of a GSS, the elimination of production blocking, can help reduce the likelihood of "plopping." Participants can contribute equally because all participants have to type their inputs. This reduces the impact of "plopping." Subsequently, the less process anonymity you have the greater the likelihood of "plopping." However, content anonymity should have little, if any effect, on "plopping." With high content anonymity, ideas are either addressed or ignored one at a time.

In the decision by authority method, groups use a power structure that has one person with ultimate authority over the final decision. The problem-solving group can discuss the problem at length and make recommendations, but the anointed leader has the

final input. "Whether this method is effective depends a great deal upon whether the chairman is a sufficiently good listener to have culled the right information on which to make the decision (Schwartz, 1994: 60)." It would be difficult (if not impossible) for a known power structure to evolve if content and process anonymity are provided. However, if only content anonymity is provided it is possible for some type of power structure to evolve. As inputs are made, a trend could develop in which a certain label(s) (e.g., Green, Blue) is thought to be the authority on the topic. This could result in decision by authority although comments cannot be associated directly with the individuals participating.

"One of the most often heard complaints of group members is that they feel railroaded into some decision (Schwartz, 1994: 60)." Decision by minority rule often occurs when small subsections of the group use tactics that produce action and ultimately decisions, but that occur without the consent of the majority. This often occurs when a group of high-ranking members unite and take action before the majority has a chance to respond. This method often is successful for the minority because the majority remains silent and "silence means consent (Schwartz, 1994: 61)." The use of this problem-solving method can be reduced when content and process anonymity are provided.

Decision by majority rule is one of the most well known methods of problem-solving. Two simple implementations of this method include polling everyone's opinion following a period of discussion or asking for a formal vote after the discussion period. Often decisions made by this method are not well implemented, even by the group that made the decision (Schwartz, 1994). The primary problem behind voting is that it creates coalitions and the minority feels misunderstood and often resentful (Schwartz, 1994).

Group Support Systems attempt to minimize the problems associated with each of these methods and ensure that each participant's voice is "heard" during the group discussion period. More control can be exerted through the technology to minimize the impact of a dominant group subset or one dominant person because each participant's comments remain on the screen throughout the session. "Problems of group think, pressures to conformity, and dominance of the group by strong personalities or particularly forceful speakers are minimized within a GSS environment (Nunamaker, Applegate and Konsynski, 1988: 839)."

2.5.2 Social Loafing

One way content and process anonymity can decrease participation is through social loafing. Latane, Williams and Harkins (1979) define Social Loafing as "a decrease in individual effort due to the social presence of other persons (823)." Literature on social loafing suggests that accountability is one of the essential factors in ensuring that each team member contributes to the best of his/her ability (Hollenbeck, 1998). Users may participate less because they feel that anonymity will protect them from group pressures to perform. If participants lack process and content anonymity they are accountable (either through embedded identifiers or through direct observation) for their participation or lack thereof.

Williams et al. (1981) have shown that when participants were led to believe that their outputs could be individually identified, social loafing was eliminated. However, Harkins and Jackson (1985) have shown that the identifiability of individual performance alone is insufficient to eliminate social loafing. In the Harkins and Jackson (1985) study,

social loafing was eliminated only when outputs were identifiable (content anonymity) and when participants felt they were performing the same task. In this instance, they felt they could be compared with other co-workers.

2.5.3 Social Comparison

Social comparison is a phenomenon wherein people match their rate of performance to the rate of the people working around them. Participants working in an environment where others are performing at a high level also tend to perform highly. Participants working in an environment where others are performing at a low level match the inferior performance rate (Goethals and Darley, 1987). One study found that the productivity of manual brainstorming sessions can be improved by inducing group members to compare themselves to a mythical average group (Paulus, Dzindolet, Poletes, and Camacho, 1993). Content and process anonymity prevents this comparison.

The level of anonymity (both content and process) provided in a GSS environment can thus prove to be detrimental to participants because they have no means of comparing their performance to others. This can be overcome by comparing participant's performance with an average group performance level derived from previous sessions. Shepherd et al. (1995) found social loafing may actually occur in anonymous electronic brainstorming sessions (EBS), and that invoking social comparison with a mythical average group reduces the social loafing phenomena. They added that any effort to compare them with an average group encourages them to work "quickly at the beginning of the session and will lead to high productivity throughout the session (Shepherd et al., 1995: 530)."

2.6 Hypotheses

The body of empirical GSS research has grown rapidly since the early 1980s. This section organizes these studies into the conceptual framework outlined earlier in this chapter and develops hypothesis relevant to each of these constructs. A revised conceptual framework is depicted in Figure 2. The constructs used in each of the hypothesis are included under effects on the individual and effects on the group. Effects on the individual are analyzed by measuring the level of user participation, user attitudes and user satisfaction with the group outcome. Decision Quality and Group Consensus are evaluated to determine the effect of anonymity on the group.

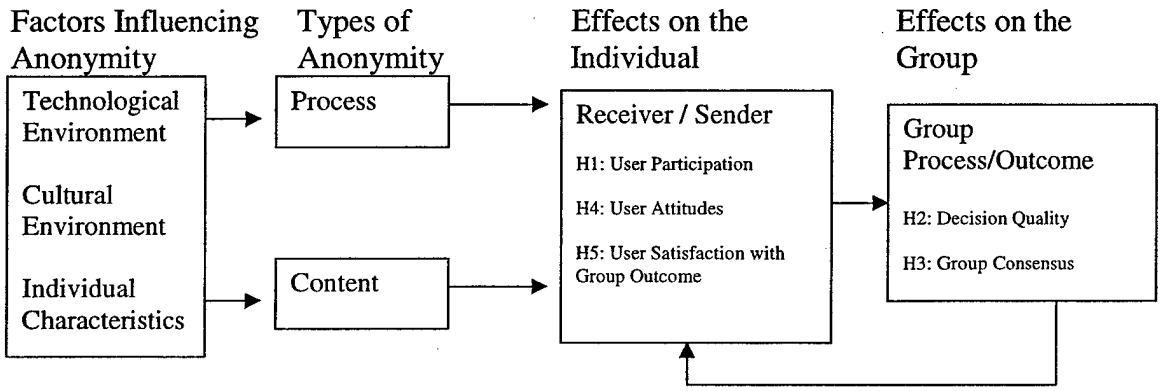


Figure 2. Conceptual framework for GSS anonymity with study constructs incorporated adapted from Valacich, Joseph S., Leonard M. Jessup, Alan R. Dennis, and J.F. Nunamaker Jr. "A Conceptual Framework of Anonymity in Group Support Systems." Group Decision and Negotiation, 1: 223 (1992).

Previous research has looked at process anonymity by comparing GSS use to manual group meetings. Content anonymity has been studied by comparing labeled GSS to unlabeled GSS meetings. Both types of studies have tended to look at the same dependent variables. Numerous studies and their findings are listed chronologically in Table 2 and 3. Table 2 lists studies that compared results in GSS sessions with face-to-

face groups. The studies included looked at a variety of computerized conferencing methods including Electronic Brainstorming (EBS), computer-aided conferencing and typical GSS. The studies listed in Table 2 were included because they analyze the effects of process anonymity. The face-to-face groups have no process anonymity and GSS groups, if configured with labels and placards, have process anonymity. Two significant patterns emerge from these studies: GSS groups reach a higher quality decision and face-to-face groups achieve higher levels of consensus. Another, less significant, pattern was found in the area of participation rates. Many of the studies evaluated equality of participation (instead of number of comments) and found that GSS participants more equally participated. These studies patterns lead into the hypothesis discussed in the following sections. Table 3 lists studies that compared results in unlabeled GSS sessions with labeled GSS sessions. These studies primarily address the effects of content anonymity. The unlabeled GSS sessions have both content and process anonymity and the labeled GSS sessions only have process anonymity. Many of the content anonymity studies only evaluated participation rate, which made finding patterns for the other constructs difficult. One clear pattern was that groups with content anonymity would achieve higher participation rates. The findings listed in table 3 are discussed in the following sections and in this study's hypothesis.

2.6.1 Influence of Anonymity on User Participation

Some people talk more than others do, while others tend to be more reserved with their comments. In addition, "persons who talk more get talked to more (McGrath,

Table 2.

Findings from studies which compared results in GSS sessions with face-to-face sessions.

Studies	Participation Rate	Decision Quality	Consensus	Satisfaction w/Process	Satisfaction w/Outcome
Steeb & Johnston, 1981	No report	GSS better	-	Increased with GSS	Increased with GSS
Lewis, 1982	GSS reduces individual dominance	GSS better	-	No effect	-
Turoff & Hiltz, 1982	-	No effect	Less likely in GSS	-	-
Ruble, 1984	-	No effect	-	-	-
Hiltz, Johnson & Turoff, 1986	Less information exchanged in GSS	No effect	Lower level of consensus in GSS	-	-
Beauclair, 1987	No effect	No effect	-	-	No effect
DeSanctis & Gallupe, 1987	-	-	Lower level of consensus in GSS	-	-
Nunamaker, Applegate & Konsynski, 1988	-	-	-	Increased with GSS	-
Gallupe & DeSanctis, 1988	-	GSS better	Lower level of consensus in GSS	Reduced by GSS	Reduced by GSS

(table continues)

Table 2. (continued)

Studies	Participation Rate	Decision Quality	Consensus	Satisfaction w/Process	Satisfaction w/Outcome
Watson, DeSanctis & Poole, 1988	No effect	-	Lower level of consensus in GSS	FTF groups most "positive"	Reduced by GSS
Zigurs, Poole & DeSanctis, 1988	More even distribution of influence in GSS	GSS better	-	-	-
Jarvenpaa, Rao & Huber, 1988	No effect	GSS better	-	No effect	-
Easton, 1988	No effect	No effect	-	No effect	GSS more satisfied
Ho, Raman, & Watson, 1989	-	-	Lower level of consensus in GSS	-	-
George, Easton, Nunamaker & Northcraft, 1990	More equal participation in GSS	No effect	Less likely in GSS	No effect	-
Olaniran, 1994	-	No effect	Takes longer in GSS	-	-

(table continues)

Table 2. (continued)

Studies	Participation Rate	Decision Quality	Consensus	Satisfaction w/Process	Satisfaction w/Outcome
Dennis, 1996	-	No effect	Takes longer in GSS	No effect	-
Mejias & Shepherd, 1996	Equal rate in both	-	No Effect	-	No effect

Table 3.

Findings from studies which compared results in unlabeled GSS sessions with labeled GSS sessions.

Studies	Participation Rate	Decision Quality	Consensus	Satisfaction w/Process	Satisfaction w/Outcome
Hiltz, Turoff & Johnson, 1989	No Effect	-	No Effect	-	-
Connolly, Jessup & Valacich, 1990	More comments in Anonymous Groups		-	No Effect	-
George, Easton, Nunamaker & Northcraft, 1990	No Effect	-	-	-	-

(table continues)

Table 3. (continued)

Studies	Participation Rate	Decision Quality	Consensus	Satisfaction w/Process	Satisfaction w/Outcome
Jessup, Connolly & Galegher, 1990	More comments in Anonymous Groups	Higher quality in Anonymous Groups	-	Less inhibited in Anonymous Groups	-
Jessup, Connolly & Tansik, 1990	Higher participation in Anonymous Groups	-	-	-	-
Jessup & Tansik, 1991	Higher participation in Anonymous Groups	-	-	Labeled Groups more satisfied	-
Valacich, Dennis & Nunamaker, 1992	No Effect	No Effect	-	Labeled groups more satisfied	Labeled groups felt more effective

(table continues)

Table 3. (continued)

Studies	Participation Rate	Decision Quality	Consensus	Satisfaction w/Process	Satisfaction w/Outcome
Wilson & Jessup, 1995	Higher participation in Anonymous Groups	-	-	No Effect	-
Kahai, Avolioi & Sosk, 1995.	Higher participation in Anonymous Groups	-	-	Increased satisfaction in Anonymous groups	-

1984:145)." The person who talks the most tends to direct their comments to the entire group, while most other group members tend to direct their comments to specific group members, with the most talkative member being the direction of most comments (McGrath, 1984).

In addition, "any given individual's rate of interaction will be affected by the individual's 'position' in the group (McGrath, 1984:146)." This position is determined by their location at the meeting table, by their status position in the group, by their motivation level, and by their perceived value to the group (McGrath, 1984).

Finally, nonverbal aspects play a significant part in group interaction. These include distance between group members, physical contact (touch), visual orientation (eye contact), and facial expression (especially smiling) (McGrath, 1984). Each of these nonverbal actions plays a role in the group communication process.

Anonymity can facilitate group processes by moderating those who dominate group discussions (decision by minority rule), have a high position in the group (decision by authority method), and rely on nonverbal cues to get their point across. Hiltz and Turoff (1978) note that computer-based media yield a notion of impersonality and that this effect is further heightened by user anonymity. Some researchers have hypothesized that anonymity enhances group member participation by reducing inhibitions (DeSanctis and Gallupe, 1987).

Numerous studies have compared participation rates between GSS aided groups and face-to-face groups. Many studies (Lewis, 1982; Zigurs, Poole and DeSanctis, 1988; George, Easton, Nunamaker and Northcraft, 1990; Mejias and Shepherd, 1996) have found that the GSS reduces individual dominance and that there is a more equal

distribution of comments. However, it was further discovered that "there is unquestionably a greater amount of communication flow during a face-to-face conference than during a computerized conference that lasts the same amount of time (Hiltz, Johnson and Turoff, 1986: 236)." They found that every face-to-face group had more comments than every GSS group. This can be attributed to the fact that people can talk much faster then they can type. This may also be attributed to people trying to avoid long periods of silence.

One method through which anonymity can be manipulated is comment labeling. Comment labeling removes content anonymity. In a labeled environment, the participant's comments are labeled with a unique identifier. In an unlabeled environment, the participant's comments are not labeled so their comments are not distinguishable from other participant's comments. When participation is labeled, either through comment labeling or in face-to-face meetings, participants receive real-time feedback on the performance and contributions of other group members. Labeling comments can impact the group process both positively and negatively. On the negative side, labeling can obstruct some users who require anonymity in order to participate in a meeting. On the positive side comment labeling provides real-time feedback to group members and may reduce user tendencies to socially loaf, while concurrently providing information on participation rates to the entire group.

Of the ten comment labeling studies included in Table 3, three found no difference in the participation rate between unlabeled and labeled GSS groups, but the other seven studies all found a higher level of participation in unlabeled (anonymous) groups.

Wilson and Jessup (1995) propose that anonymous GSS groups should allow more ideas to be generated during a meeting, because group members with low-status can contribute ideas more freely and openly. Wilson and Jessup's study found that anonymous GSS groups generated more total comments than did identified GSS groups (1995). Jessup et al. (1990) found a higher level of comments contributed in anonymous GSS groups. They determined that "by disassociating individuals from their comments and buffering group members from one another, anonymity appears to have reduced behavioral constraints on group members and led them to contribute more freely, and less inhibitedly, to the group (Jessup et al., 1990: 320)."

Hypothesis 1: Effect of anonymity on user participation

The level of anonymity provided in a problem-solving environment (GSS only) will positively impact user participation levels; however, face-to-face groups will achieve the highest participation levels (see Figure 3).

Hypothesis 1a: Face-to-face groups will achieve the higher levels of user participation then all GSS treatment groups.

Hypothesis 1b: The level of anonymity in GSS environment will positively impact user participation levels.

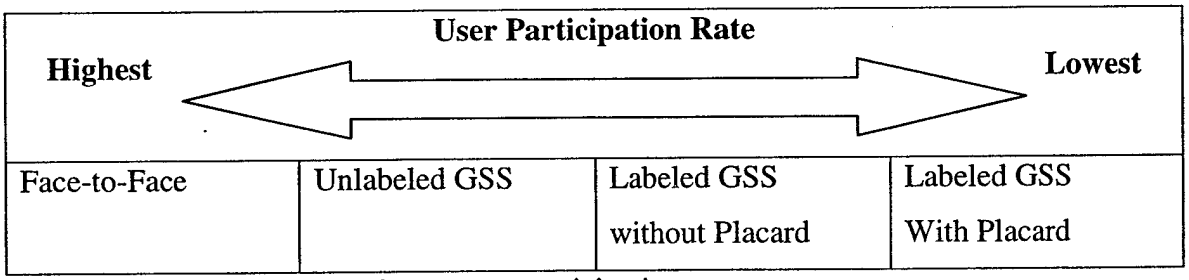


Figure 3. Effect of anonymity on user participation rate.

2.6.2 Influence of Anonymity on Decision Quality

One of the benefits of anonymity is that it may reduce the pressure to conform to the groups thought process and minimize evaluation apprehension. These process gains are often tempered by an increase in free riding because it is more difficult to determine when someone is free riding (Albanese and VanFleet, 1985). Other benefits attributed to anonymity and ultimately resulting in improved decision quality include more objective evaluation and the creation of a low-threat environment (Nunamaker et al., 1993). Anonymity may encourage participants to challenge each other resulting in process gains (catching errors before the group decision). The low-threat environment created in an anonymous meeting can also increase the number of contributions from less skilled members (Nunamaker et al., 1993).

Of the studies included in table 2, five (Steeb and Johnston, 1981; Lewis, 1982; Gallupe and DeSanctis, 1988; Zigurs et al., 1988; Jarvenpaa, Rao and Huber, 1988) found that a higher quality decision was reached in GSS aided groups. Eight studies found no effect on decision quality.

Gallupe and DeSanctis (1988) found that a GSS improved decision quality for both low and high difficulty decision tasks. They found that the GSS acted as the "group memory" and enabled the group to analyze information without unnecessarily repeating the analysis. This in turn allowed the group to consider more alternatives and improved decision quality (Gallupe and DeSanctis, 1988).

Hiltz et al. (1986) determined decision quality by comparing the group score to the mean of the individual choices before the discussion and with the best individual decision before the group discussion. They found no significant differences in

percentage of improvement in the sixteen groups evaluated. Of these groups, twelve produced an equal or better decision as a group after discussion than any of their individual members before the discussion. Two of the groups that produced poorer-quality decisions were face-to-face groups and two were GSS groups (Hiltz et al., 1986).

Only two studies compared decision quality between labeled GSS and unlabeled GSS groups. One (Valacich, Dennis and Nunamaker, 1992) found no difference and the other (Jessup et al., 1990) found higher quality decisions were reached in unlabeled (anonymous) GSS sessions.

Using the chronic campus parking problem as the focal point of their problem-solving group, Jessup et al. (1990) found that groups working anonymously generated more solutions to the problem then did identified groups.

The process gains (reduced evaluation apprehension, more errors caught, low-threat environment) outweigh the process losses (free riding) in an anonymous group problem-solving environment. Subsequently, based on the literature findings and the process gains associated with increased anonymity the quality of group decisions should improve when participants are provided with a greater level of anonymity.

Hypothesis 2: Effect of anonymity on group decision quality

The level of anonymity provided in a problem-solving environment (either GSS or face-to-face) will positively impact group decision quality (see Figure 4).

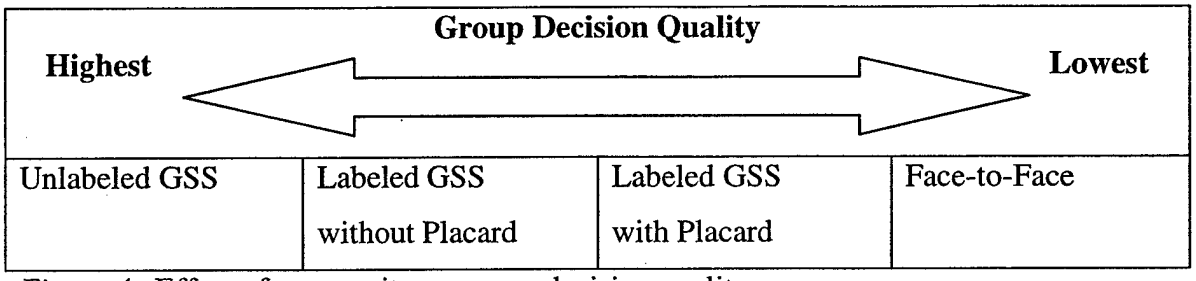


Figure 4. Effect of anonymity on group decision quality.

2.6.3 Influence of Anonymity on Consensus Making

"In the case of consensus decision tasks, decision theorists propose that groups can solve complex problems more effectively if their discussion includes high member participation and a decision-making structure (DeSanctis, D'Onofrio, Sambamurthy and Poole, 1989: 132)." However, when higher levels of anonymity are provided to participants the discussion tends to be "more open, honest, and free-wheeling" (Nunamaker et al., 1993). Often increasing levels of anonymity can result in flaming. Flaming is where group members begin to demonstrate uninhibited interaction and begin to send critical comments to other members of the group. Flaming occurs when anonymous group members begin to lose their individuality which results in a reduction of normal inhibitions, enabling group members to engage in behavior they would not normally display in a labeled situation (Jessup and Connolly, 1990).

Among the studies included in table 2, six found that consensus was either less likely in a GSS environment or that a lower level of consensus was likely in a GSS environment. In two studies (Olaniran, 1994; Dennis, 1996) that evaluated time to reach consensus, it was found that it takes longer to reach consensus in a GSS environment. In

only one study (Mejias and Shepherd, 1996) was their no difference between face-to-face and GSS sessions when striving to achieve consensus.

Turoff and Hiltz (1982) found that there is more opinion giving in computerized conferencing and that this negatively impacts the ability to reach consensus. In their study, Turoff and Hiltz (1982) found that half of face-to-face groups successfully reached 100 percent consensus while none of the computerized conference groups did.

Watson, DeSanctis and Poole (1988) related post-meeting consensus to pre-meeting consensus and determined that in GSS conditions group members apparently became aware of their pre-meeting agreement and differences and subsequently reached a higher level of post-meeting consensus than did face-to-face groups.

Despite the findings presented by Watson et al. (1988), many attributes of anonymity leads one to believe that anonymity will have an adverse effect on consensus. The fact that increased opinion-giving negatively relates to consensus and the fact that anonymity reduces conformance pressures (occasionally resulting in flaming) indicates that increasing the level of anonymity in a problem-solving group should result in lower levels of consensus.

Hypothesis 3: Effect of anonymity on group consensus

The level of anonymity provided in a problem-solving environment (either GSS or face-to-face) will negatively impact group consensus (see Figure 5).

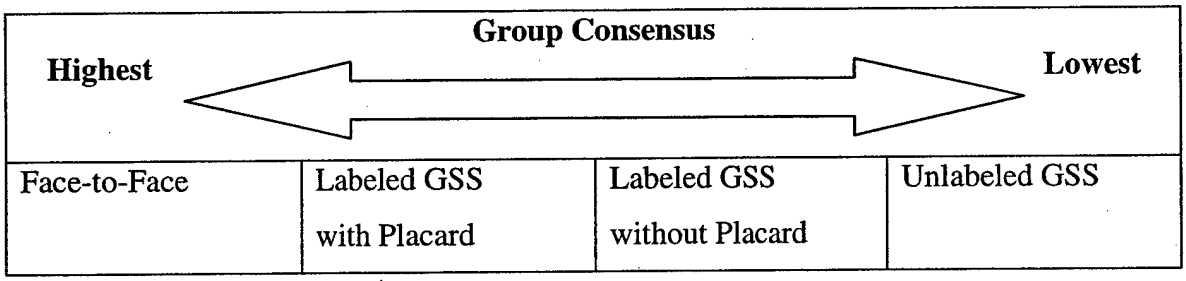


Figure 5. Effect of anonymity on group consensus.

2.6.4 Influence of Anonymity on User Attitudes

Despite the risk of flaming, there are some positive effects from depersonalization provided by increased anonymity. For instance, anonymity increases objective evaluation. In this case, contributions are judged based on their merits rather then on the source of the contribution. Criticism is perceived as being directed at the idea, not the contributor (Nunamaker et al., 1993).

The findings on satisfaction with the process when comparing GSS sessions to face-to-face sessions is contradictory. Two studies found GSS groups to be more satisfied (Steeb and Johnston, 1981; Nunamaker et al., 1988), two found higher satisfaction levels in face-to-face groups (Gallupe and DeSanctis, 1988; Watson et al., 1988), and five found no differences (Lewis, 1982; Jarvenpaa et al., 1988; Easton, 1988; George et al., 1990; Dennis, 1996).

Watson et al. (1988) found that GSS groups appeared to struggle with how to effectively use the GSS technology. They also found that GSS groups often entered comments such as "What do you want to do next? (Watson et al., 1988: 474)." This lack of GSS knowledge and meeting direction may explain the improved user attitudes in the

face-to-face sessions. Including training and a structured agenda might mitigate this perception.

Nunamaker et al. (1988) found that despite some difficulty, their participants reported high levels of satisfaction with the computer technology for generating ideas during organization planning sessions. They further found that "while there are some factors inherent in the technology that tend to inhibit idea generation, the benefits of the technology appear to far outweigh the problems (Nunamaker et al., 1988: 18)."

When comparing GSS labeled to GSS unlabeled research on satisfaction with the process the results are once again contradictory. Two studies found labeled GSS groups to be more satisfied with the process (Jessup and Tansik, 1991; Valacich et al., 1992), one found unlabeled groups to be more satisfied (Kahai, Avolioi and Sosk, 1995), and two found no effect (Connolly et al., 1990; Jessup et al., 1990).

Valacich and Nunamaker (1992) found that labeled groups were both more satisfied with the process and felt more effective than anonymous groups. Jessup and Tansik (1991) found that group members working under conditions of anonymity thought the system was more helpful and effective. Nunamaker, Dennis, Valacich and Vogel (1991) proposed that anonymity reduces satisfaction because it makes it difficult for participants to get credit for their comments.

Jessup and Connolly (1990) found that users felt more satisfied with the process in an unlabeled GSS environment because they felt criticism was aimed at their comments rather than them personally. Kahai et al. (1995) found that anonymity increases user satisfaction and attributed this to the fact that in a meeting where little differences of opinion exist, there will be less evaluation apprehension

and less critical remarks. Subsequently the users attitudes will increase in the anonymous condition.

Finally, despite finding no effect of anonymity on user satisfaction with the process, Wilson and Jessup (1995) hypothesized that anonymous group members should be more satisfied than identified group members, because anonymous group members will be able to contribute ideas more freely and openly than would identified group members.

Despite the contradictory findings listed in Tables 2 and 3 it is hypothesized that increased anonymity should improve user attitudes because of the depersonalization of the comments and ultimately the critiques of those comments.

Hypothesis 4: Effect of anonymity on user attitudes

The level of anonymity provided in a problem-solving environment (either GSS or face-to-face) will positively impact user attitudes (see Figure 6).

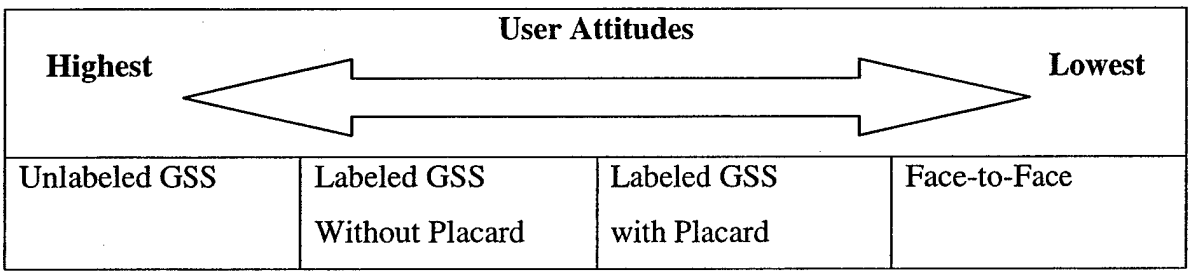


Figure 6. Effect of anonymity on user attitudes.

2.6.5 Influence of Anonymity on User Satisfaction with the Group Outcome

A study by Rao and Monk (1999) stated that if participants made a decision anonymously, the need for external justification would not exist and the participants level

of commitment to the group decision would be lower than the commitment of identified participants because the identified participants would require external justification. If the participants are anonymous, then they only "need to maintain an internal sense of competence (Rao and Monk, 1999: 502)." This difference in desire to appear externally competent results in a higher level of commitment when participants are identified.

Table 2 depicts the differences in satisfaction with outcome findings in previous face-to-face and GSS studies. Of the six studies included, two found no effect on satisfaction with the group outcome between GSS groups and face-to-face groups. Two found a higher level of satisfaction in GSS groups and two found the GSS reduced the satisfaction level of participants.

Steeb and Johnston used a group decision aiding system, which aided users with decision tree structuring, identification of critical issues, conflict resolution, and decision recommendation. Unaided users (face-to-face) were given paper, pencils and a blackboard. Their study found that seventy-seven percent of the aided users fully supported the team's chosen course of action and only fifty-three percent of the unaided users fully supported their group's decision (Steeb and Johnston, 1981). Easton (1988) found that GSS groups using structured approaches were more satisfied with the process and ultimately were more satisfied with the outcome.

Gallupe and DeSanctis (1988) found groups that used the GSS were slightly less confident in the decision they had made and had a slightly lower level of agreement with the final solution compared to face-to-face groups. Positive sentiments following use of a GSS may be particularly important in organizational settings where group meetings are

used to gain acceptance of ideas, rather than to gain better ideas per se (Gallupe and DeSanctis, 1988).

Only one study, which compared labeled GSS sessions with unlabeled GSS sessions, reported findings in the area of satisfaction with the group outcome. Valacich et al. (1992) found that labeled groups felt more effective than anonymous groups. They further found that the identified condition most closely resembled a traditional face-to-face meeting, thereby enhancing the member's perceptions of their effectiveness in this condition (Valacich et al., 1992).

Hypothesis 5: Effect of anonymity on user satisfaction with the group outcome

The level of anonymity provided in a problem-solving environment (either GSS or face-to-face) will negatively impact user satisfaction with the group outcome (see Figure 7).

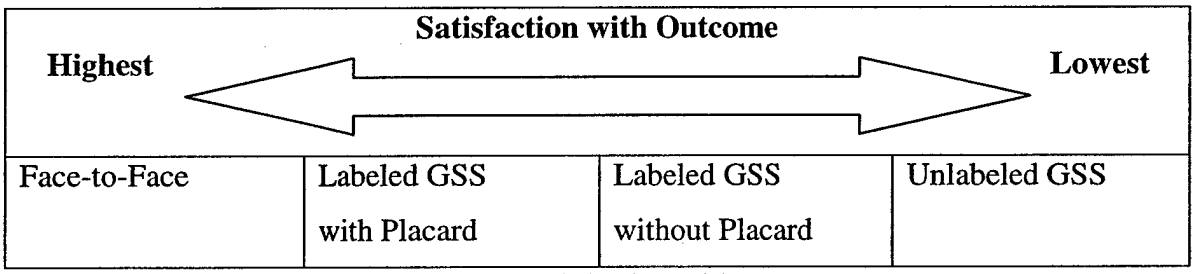


Figure 7. Effect of anonymity on user satisfaction with group outcome.

2.7 Summary

The GSS has been offered up as the solution for effectively improving group processes to improve user participation and decision quality. Many proponents of GSS

enthusiastically advertise the ability of the technology to improve the generation and sharing of information (Nunamaker, 1997). However, the studies described in this chapter indicate that GSS may not be the best option. Current GSS research presents contradictory results and indicates most clearly, the need for further research.

The next chapter describes the methodology used to determine the influence of process anonymity and content anonymity on participation rates, decision quality, consensus levels, user satisfaction with the process, and user satisfaction with the group outcome.

III. Methodology

3.1 Overview

The purpose of this study was to determine what effect anonymity might have on group members' perceptions of the problem-solving environment, group consensus and ultimately the group decision quality. The previous chapter summarized the relevant research literature and expanded on the theoretical framework developed in the area of Group Support System anonymity. This chapter describes how data were collected; quantified, and analyzed to test the hypotheses described in Chapter II.

3.2 Participants

The 320 subjects who participated in this study were drawn from the graduate student body of the Air Force Institute of Technology (n=48), students enrolled in the Basic Communications and Information Officer Course (BCOT) at Keesler AFB, Mississippi (n=216) and Reserve Officer Training Corps (ROTC) students enrolled at the University of Pittsburgh in Pennsylvania (n=32), Ohio University in Athens, Ohio (n=16), and Wright State University in Fairborn, Ohio (n=8). The age of the participants ranged from 18 to 53 years old. Table 4 below presents the study's demographic breakdown. Their military ranks ranged from ROTC Cadet 4th class to commissioned officers through the rank of Lieutenant Colonel. The treatments were applied randomly across all participants to ensure that no individual group of participants from one location could bias the results.

Table 4.

Demographic Breakdown

Age (in years)	Participants	Percentage
< 20	29	9%
20 – 29	205	64%
30 – 39	74	23 %
40 – 49	10	3%
> 50	2	1%
Sex (Gender)	**Participants**	**Percentage**
Male	254	79 %
Female	66	21 %
Marital Status	**Participants**	**Percentage**
Married	144	45%
Single	176	55%

3.3 Experimental Design

This study used a fully randomized experiment to investigate the effect of anonymity on the perceptions, attitudes, and subsequent performance of all members of a four-person problem-solving team. A 1 x 4 between subjects experimental design manipulated the level of anonymity experienced by each of the participants through the use of GSS comment labeling and placards (see Table 5).

Table 5.

Level of Anonymity in comparison to Experimental Treatment

Level of Anonymity	Treatment
Very High	Unlabeled GSS Session
High	Labeled GSS Session without Placards
Low	Labeled GSS Session with Placards
Very Low	Face-to-face Session

As can be seen in Table 5 the highest level of anonymity is provided in unlabeled GSS sessions because each comment input into the system cannot be associated with any group member. The labeled GSS sessions without placards follow closely behind since comments are labeled by colors, but the colors cannot be associated with any single group member. This only allows group members to mentally group comments labeled with the same color. Both GSS sessions labeled with placards and face-to-face sessions provide low levels of anonymity, however, associating a comment with the member that provided it orally is instantaneous thus reducing the anonymity even further. In the GSS sessions labeled with placards the members apply a three-step process to correlate comments with the originator. The member has to first look at the comment, then identify the color at the end of the comment and match that with the terminal it came from and ultimately the member sitting behind that terminal.

When compared to anonymity in the face-to-face condition, the factors of explicitness and revocability must be applied to the labeled/placard condition. Explicitness is defined as "the extent to which an action can be said to have taken place" (Salancik, 1995: 285). In a GSS labeled with placard session subjects comments are

clearly observable and associated with the sender. In a face-to-face meeting a subject can deny having made a comment if the session was not recorded. Salancik defines revocability as the "reversibility of the action" (1995: 285). Contrary to a face-to-face session, a comment input in a GSS labeled with placard session remains on the screen for all to see. It cannot be reversed.

One other significant difference between these treatments is the different human senses utilized. In face-to-face sessions, members use sight and hearing simultaneously to assign comments to the sender. In all three GSS treatments, the member is confined to one sense (sight). Thus, the ability to receive information through non-verbal clues (such as facial expressions) and tone of voice is minimized in a GSS environment.

3.4 Experiment Manipulations

Two experiment manipulations were used in this study: process anonymity and content anonymity (comment labeling). To manipulate content and process anonymity, subjects were randomly assigned to face-to-face groups, labeled with placard GSS groups, labeled without placard GSS groups, or unlabeled GSS groups. At the conclusion of each session, a survey (questions 34 – 39) measuring the effectiveness of the manipulation checks was given. This survey is attached in Appendix A. ANOVA was used to assess the effectiveness of a manipulation, by comparing the means of survey data collected from groups which experienced the manipulations to those which did not.

3.4.1 Anonymity Manipulation

Four levels of anonymity were created through the structural design of the group session. A consolidated series of comment-member association steps for each level of anonymity is listed in Table 6.

Table 6.

Association Steps for each Level of Anonymity

GSS – Unlabeled	GSS – Labeled – No Placard	GSS – Labeled – Placard	Face-to-face
	Anonymity Provided		
Content Anonymity Process Anonymity	Process Anonymity	None	None
	Associated Steps		
1. Read comment. 2. Color and placard not available so comment cannot be associated with member or color.	1. Read comment and color. 2. Placard unavailable so comment is associated with previous comments made by same color.	1. Read comment and color. 2. Identify placard with comment color. 3. Associate placard with member. 4. Associate comment with member.	1. Hear comment. 2. See member speak. 3. Associate comment with member.

GSS anonymity was manipulated by using the labeling feature provided in Group Systems software. The highest level of anonymity provided was accomplished by leaving all subjects as unlabeled participants. In this case, only the time stamp followed comments. No information was available for participants to group comments. Subsequently, other session participants could not identify who made each comment and

could not group comments by color. Participants in this condition experienced both process and content anonymity.

The next level of anonymity was accomplished by only labeling each participant's comments. In this case, the time stamp was accompanied by the subject's color (red, green, yellow, and blue). Each session participant could identify which comments belonged to each "color". This would allow them to associate one comment with another from the same source, but did not allow them to "put a face with each comment." This condition offered no content anonymity.

The lowest level of GSS anonymity labeled subjects and placed a placard identifying their color (red, green, yellow, and blue) above their computer terminal. In this treatment, the placard allowed each participant to put a face with the comments by associating the color who made the comment with the placard above the monitor and ultimately with the participant using that monitor. This condition contained no content or process anonymity.

Finally, a quarter of the groups solved the problem face-to-face around a table. The face-to-face treatment provided virtually no anonymity since participants sat around a table facing each other and could see who was contributing.

One of the challenges encountered during the development of this study was to ensure both GSS and face-to-face groups were treated as similarly as possible excluding the manipulations themselves. Great effort was put forth to ensure that the scripts were as close to identical as possible. Where discussion revolved around the computer technology in the GSS sessions, similar conversation was built into the face-to-face script. The overhead projection of the team votes and the display screen shown for GSS

groups was replicated and projected on a whiteboard for face-to-face groups. Every effort was made to ensure the four groups had similar experiences during the sessions so the focus could be on the manipulations. Further details for each configuration will be explained in the following sections.

Table 7.

Reliability Analysis – Anonymity Manipulation Checks

	M	*SD*	α
Manipulation Check 1: Anonymity	5.10	1.59	0.85
I could recognize the originator of most comments.	5.00	1.74	
Other group members could connect me to the comments I made.	5.03	1.54	
Other group members knew when I made a contribution to the group.	5.26	1.48	

A one-way analysis of variance compared the mean anonymity manipulation checks of decision making groups using unlabeled GSS sessions, labeled without placard GSS sessions, labeled with placard GSS sessions, and face-to-face sessions. The alpha level was .05. This test was found to be statistically significant, $F(3, 268) = 39.53$, $p < .01$. The strength of the relationship, as indexed by eta^2, was .31. A multiple comparison was accomplished using the Bonferroni procedure to control for experiment-wise error. The results of this test indicated that the mean for unlabeled GSS sessions ($M = 3.77$, $SD = 1.30$) was statistically ($p < .01$) less than the mean for labeled without placard GSS sessions ($M = 5.12$, $SD = 1.30$). In addition, the mean for labeled without placard GSS sessions was statistically ($p < .05$) less than the mean for both labeled with placard GSS sessions ($M = 5.70$, $SD = 1.21$) and face-to-face sessions ($M = 5.71$, $SD = .77$). There

was no statistically reliable difference between the mean for labeled with placard GSS sessions and face-to-face sessions. The results indicate the manipulation to create process anonymity was very effective for the unlabeled groups and less effective for the labeled without placard group.

3.4.2 Comment Labeling

The labeling manipulation check was accomplished in the same manner as the anonymity manipulation check as described in paragraph 3.4.1. Most participants had never used a GSS before the experiment and likely did not know they could be labeled or unlabeled. In four unlabeled GSS sessions participants actually decided to label themselves, thus circumventing the labeling process provided in the GSS environment. These participants indicated they wanted to know who was making the comments during the session. After the fourth self-labeling session, the script was modified asking participants not to label themselves and the four self-labeling sessions were eliminated from the experiment data set.

A one-way analysis of variance compared the mean comment labeling manipulation checks of decision making groups using unlabeled GSS sessions, labeled without placard GSS sessions, labeled with placard GSS sessions, and face-to-face sessions. The alpha level was .05. This test was found to be statistically significant, $F(3, 268) = 41.51, p < .01$. The strength of the relationship, as indexed by eta^2, was .32. A multiple comparison was accomplished using the Bonferroni procedure to control for experiment-wise error. The results of this test indicated that the mean for unlabeled GSS

Table 8.

Reliability Analysis – Comment Labeling Manipulation Checks

	M	*SD*	α
Manipulation Check 2: Comment Labeling	**4.87**	**1.63**	**0.88**
I could tell if someone was sharing more information than other members of the group were.	4.85	1.62	
I could tell if someone participated less than other members of the group did.	4.74	1.70	
Other group members could judge the extent that I participated in the group.	5.02	1.57	

sessions ($M = 3.41$, $SD = 1.38$) was statistically ($p < .01$) less than the mean for labeled without placard GSS sessions ($M = 5.17$, $SD = 1.11$), labeled with placard GSS sessions ($M = 5.21$, $SD = 1.29$), and face-to-face sessions ($M = 5.60$, $SD = 1.10$). There was no statistically reliable difference between the mean for labeled without placard GSS sessions, labeled with placard GSS sessions, and face-to-face sessions. The results indicate that the manipulation to create content anonymity in the unlabeled group was effective.

3.5 Equipment and Room Configuration

All experiment sessions were conducted in rooms with no windows. Rooms were reserved for the study to minimize any chance of interruptions. Each participant had a chair and a desk surface. GSS teams used PC-type computers loaded with Group

Systems software, developed by Ventana Corporation (now known as GroupSystems.com). Face-to-face teams were provided with pencil and paper, as well as a white board with markers. Face-to-face and GSS teams were trained and shown the results of group votes using an overhead projector. Excel charts were developed to mirror the look of results from GSS sessions.

A single GSS room configuration (Appendix B) was used in all fifty-two GSS sessions. Special effort was made to ensure the distance between user terminals was the same. Approximately four feet separated subjects in order to minimize the observation of other subjects' monitors. For sessions requiring placards, they were placed on top of each participant's computer monitor making them highly visible. In addition, in sessions where a placard was used the participants' attention was directed to the location of the placards. All face-to-face sessions were conducted in rooms configured like the primary GSS room configuration minus the PC-type computers for the subjects. The face-to-face configuration is depicted in Appendix C. In the GSS and face-to-face room configurations, all participants had easy viewing access of the viewing screen. Since the screen was only used during the training session and when displaying the group vote this minimized the impact of any possible differences between the two configurations.

3.6 GSS Tasks and Procedures

The tasks and procedures for all GSS groups were identical with only two notable exceptions. Before each GSS session, the experiment equipment was configured for one of the three types of GSS sessions (unlabeled, labeled without placard, and labeled with placard) according to the two GSS scripts (GSS labeled and GSS unlabeled). In the

unlabeled session, the GSS software was configured to ensure participant's comments were unlabeled. In the labeled without placard and labeled with placard sessions the GSS software was configured to ensure participant's comments were labeled. The script was modified for the labeled scripts to point out that the comments had a color after each comment. The script was modified slightly more for the labeled with placard sessions to allow the participants to recognize the location of the placards and how they corresponded to the color after each comment. These scripts are included in Appendix D and E. The experiment procedural flow is depicted in Figure 8.

Four experimental subjects interacted with two experiment administrators using a GSS running Group Systems software. One experiment administrator was the group facilitator and the other was the assistant. Both administrators worked from scripts. Four subjects were scheduled for each session and sessions were not held unless all four subjects were available.

Subjects were welcomed in the preparation room (separate from the room with the GSS equipment). Subjects were instructed to read and sign a consent form (see Appendix F) stating their rights as an experiment participant. Consent forms were collected by the experiment assistant and placed in a folder separate from other experiment information. Next, subjects completed an introductory personality questionnaire (see Appendix G) and individually completed the first problem-solving task (moon scenario) (see Appendix H). Before departing the preparation room for the GSS room, the subjects received a brief introduction to problem-solving and reaching consensus through voting.

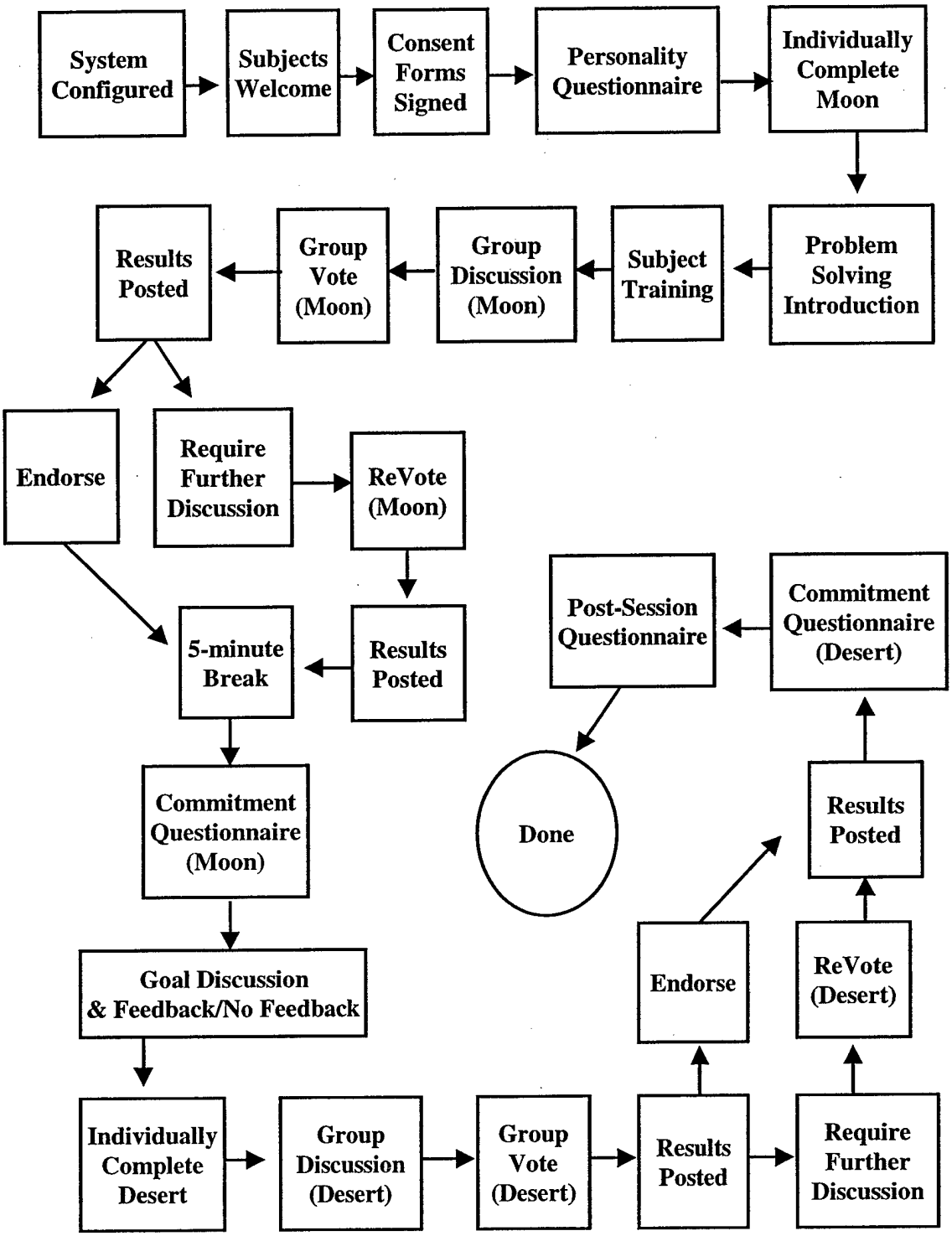


Figure 8. Experiment procedural flow.

Once within the GSS room, subjects were allowed to pick their own GSS station (red, yellow, green or blue). At this point, the experiment assistant documented which participant sat at each station. This was later transferred to each participant's questionnaires and individual problem-solving exercises. The experiment facilitator then introduced subjects to the Group System software package, focusing the discussion on two tools (Categorizer and Vote) that would be used in the experiment. The subjects training consisted of discussing ranking methods for a list of names and departments using the Categorizer tool and then using the Vote tool to rank order the list. The facilitator used this training time to familiarize subjects on how to join an activity, approve their author tag (only applicable for labeled sessions), input comments, recognize other subjects' comments (whether labeled or not), and vote. Finally, the facilitator displayed the results for their training session vote, described how the software determined the final group ranking, and discussed the results.

Following the training, experiment administrators instructed subjects that they would answer any questions dealing with the Group Systems software, but would not answer any questions dealing with the moon scenario. Subjects were also instructed to limit their discussion to the GSS (no verbal comments) so all comments would be collected. Once the GSS training was complete, group members were instructed that they would now have fifteen minutes to complete the moon scenario as a group. After a question and answer period, subjects were invited to join the moon Categorizer activity and the fifteen-minute discussion period began. Participants were not given access to their original individual solutions although a few participants requested them. The experiment facilitator notified subjects when there were two and five minutes left to

discuss the scenario. Once the subjects exhausted their discussion time, the experiment facilitator instructed the subjects to submit their final comment (if they were still typing); close their group discussion window and the facilitator stopped the moon scenario Categorizer activity.

Subjects were then invited to join a voting activity for the moon scenario. All items provided in the voting activity were alphabetized to replicate the list in the Categorizer activity and in the individual problem-solving task. Once all four subjects had cast their ballots, the experiment facilitator presented the results to the group and asked the group if all members were willing to endorse this list or if they would like an additional five minutes to discuss the scenario. If all subjects endorsed the list, subjects were given a five-minute break and were instructed not to discuss the scenario or which participant color they were (only applicable to labeled sessions). If any of the subjects preferred to continue discussion, then all subjects were re-invited to join the moon Categorizer activity where subjects could review previous comments or provide new comments. The experiment facilitator notified subjects when there were two minutes left for discussion. Once the second five-minute discussion period was complete, subjects were again invited to join a voting activity for the moon scenario. Instead of receiving the original alphabetized list from which to vote, subjects received the list in the order of their previous vote. After all subjects modified their vote and cast their ballots, the facilitator presented the final results of their vote, subjects were given a five-minute break and subjects were instructed not to discuss the scenario or which participant color they were (only applicable to labeled sessions).

At the conclusion of their break, the subjects and the experiment assistant met back in the preparation room. Subjects first completed a short 5-question commitment to ranking questionnaire (see Appendix I) for the group moon results. The purpose of this questionnaire was to quantify the level of confidence each participant had in the group's final decision in comparison to their original individual ranking and also to gauge whether individuals truly were willing to endorse the group decision.

After completing the questionnaire, the experiment assistant discussed participation rate goals with the subjects focusing on the point that the more comments input during a meeting, the greater the chances to reach a high quality decision. At this point, half of the groups received feedback, which showed their participation rates in the moon scenario. Once feedback was complete, individuals completed the second problem-solving task (desert scenario) (see Appendix J). Before departing the preparation room for the GSS room, subjects were reminded of the goal to participate equally while maximizing comments.

Once back in the GSS room, subjects were invited to join the desert Categorizer activity and the fifteen-minute discussion period began. At this point, the steps for the desert GSS activity are identical to the steps performed above for the moon GSS activity. After all subjects modified their vote and cast their ballots, the facilitator presented the final results of their vote and the experiment assistant accompanied subjects back to the preparation room. The feedback manipulation and subsequent performance and participation data collected from the desert activity were analyzed by one of the other thesis efforts associated with this experiment.

While in the preparation room, subjects completed a short 5-question commitment to ranking questionnaire for the group desert results. Next, subjects completed a post-session questionnaire, which assessed user attitudes towards the problem-solving environment and checked the applied manipulations (feedback, labeling and anonymity). (see Appendix A). After completion of all experiment tasks, the experiment assistant debriefed subjects on the purpose of the study.

After dismissing the participants, the experiment facilitator saved the logs from each subjects GSS station and the group results from the two problem-solving tasks onto a diskette and backed up the GSS session to a diskette and to the hard drive.

3.7 Face-to-face Tasks and Procedures

All steps included in the face-to-face sessions were identical to the GSS sessions with two exceptions. In each step where Group Systems software was used in the GSS sessions, a pencil and paper were used in the face-to-face sessions. Face-to-face sessions were also provided with a whiteboard, markers and erasers to facilitate their discussions. Other areas that were replicated in the face-to-face sessions to mirror the GSS sessions included the use of a projection screen, scenario item formatting, and training. The use of the projection screen to display team voting results in the GSS sessions was incorporated into the face-to-face sessions to ensure all participants were shown team voting results in the same manner. During the group vote, the items voted on in both the moon and desert scenarios were provided in the same format as the GSS groups, again ensuring the starting point for all participants was identical. Finally, the training procedure was modified for the face-to-face sessions to more closely resemble the computer training

provided to GSS participants ensuring that extra group interaction training was available to all participants.

3.8 Hypothesis Measures

As stated in Chapter II, this study is based upon the belief that manipulation of anonymity will effect user participation, group decision quality, group consensus, user attitudes and user satisfaction with the group outcome. The constructs are defined in Table 9.

The first construct, user participation, measured the number of inputs each subject contributed during the initial 15-minute discussion period.

Group Decision Quality, the second construct, was based on two factors: the team score on the moon scenario and the average improvement for each individual when comparing their initial solution to the team's final solution. Average improvement was calculated by subtracting the team score from each individual score and determining the average improvement percentage.

The next construct, group consensus, was measured using Ventana's Coefficient of Concordance (VCC), which is based on Kendall's Coefficient of Concordance (KCC). The formula used to calculate consensus is as follows:

$$VCC = 1.00 - ((STD/(RHV - RLV)) * 2)$$

Where STD = Standard Deviation, RHV = Highest Possible Allowed Value, and RLV = Lowest Possible Allowed Value (Ventana GroupSystems Workgroup Edition 2.0 Concepts Guide, 1998).

To ensure consistency in measurements, consensus in face-to-face groups was measured by inputting the face-to-group votes into the GSS system post-experiment and letting the software calculate the consensus levels.

Table 9.

Construct Definitions

User Participation
Definition: The extent to which participants in a group contribute.
Group Decision Quality
Definition: Average value of individual decisions reached by participants in a group, measured relative to an optimal decision set. (Lea, 1998)
Group Consensus
Definition: The degree of agreement generated among group members in the ranking of the group's main ideas. (Mejias and Shepherd, 1996: 140)
User Attitudes
Definition: Users' dispositions towards the performance of the meeting facilitator, utility, usefulness, and perceived ease of use of the GSS, and dynamics of the participant group. (Lea, 1998)
User Satisfaction with the Group Outcome
Definition: The extent to which participants in a group are committed to the group decision.

A benefit of using the NASA Moon Survival Problem and the Desert Survival Problem is that an actual consensus number can be obtained by comparing the group ranking to each individuals ranking. This comparison results in a set of deviation scores identifying the level of agreement between the group ranking and each individuals ranking of the problems fifteen item list. Calculating an average of the deviations for each groups four members results in the level of complete agreement or consensus among the group members. The lower the sum of the deviations the higher the level of consensus and the higher the sum of the deviations, the lower the level of consensus (Hirokawa, 1982).

User attitudes employed six scales that measured satisfaction of group dynamics, perceived ease of use, perceived utility, perceived ability to communicate, perceived status effects, and perceived group participation.

The final construct, user satisfaction with the group outcome, was measured through a 5-question commitment to group ranking questionnaire (see Appendix I).

3.9 Survey Design and Validation

The user attitudes construct was broken down into six measured variables described in Table 10. Each variable was measured using a seven-point Likert scale. This scale ranged from 1 (Strongly Disagree) to 7 (Strongly Agree) and 4 (Neither Agree Nor Disagree) in the middle. Each of the measured variables final values are analyzed on a summative scale by combining the results of five questions and evaluating the mean. The questionnaire was developed by combining questions for user satisfaction with the dynamics of the participant group, user belief in meeting utility, user perception of ease

of use, and user participation of group participation used by Herberlie and Tolbert (1999) with user perception of group status effects used by Davison (1997) and user perception of ability to communicate used by Sperano (1999). These questions were modified

Table 10.

Measured Construct Variable Definitions

User Attitudes
User Satisfaction with the Dynamics of the Participant Group.
Definition: Degree to which the user was pleased with the interactions of the group.
User Perception of Ease of Use.
Definition: Degree to which the user believes that using the Group Support System will be free from effort (Davis, 1989).
User Belief in Meeting Utility.
Definition: Degree to which the user feels the meeting format (GSS or Face-to-face) provided was a useful aid to the group and the group meeting process.
User Perception of Ability to Communicate.
Definition: Degree to which the user feels they were able to share information with and receive information from other group members.
User Perception of Group Status Effects.
Definition: Degree to which the user believes
User Perception of Group Participation.
Definition: Degree to which the user feels group members are participating and contributing to the group.

slightly to more fully address the processes used in this study. The final post-session questionnaire included thirty-nine items ([6 measured variables * 5 questions each] + [3 manipulation checks * 3 questions each] = 39 questions total).

Survey data was first analyzed to ensure inter-item reliability. Data was entered into an EXCEL spreadsheet and then analyzed using SPSS 10.0 statistical software. The result was a correlation matrix, reliability coefficient, mean, and standard deviation for each set of questions by measured variable. Cronbach's coefficient alpha (α) was used to estimate the internal consistency of multi-item scales. A reliability analysis for each of the dependent variables which constitute the user attitudes construct are presented in Tables 11 – Table 16.

Table 11.

Reliability Analysis – User Satisfaction with the Dynamics of the Participant Group

	M	SD	α
User Satisfaction with the Dynamics of the Participant Group	**6.02**	**0.99**	**0.87**
I would not mind working with this group again.	6.24	0.88	
I am pleased with the performance of our group	6.00	0.89	
In my opinion, we worked effectively as a group.	5.82	1.12	
I found the other group members easy to work with.	6.03	0.94	
I enjoyed participating in the group activity.	6.04	1.04	

Table 12.

Reliability Analysis – User Perception of Ease of Use

	M	*SD*	α
User Perception of Ease of Use	**6.07**	**1.09**	**0.90**
Learning to use the tools and process provided was easy for me.	6.52	0.70	
I found it easy to use the tools and process to share information.	6.07	1.17	
I found it easy to use the tools and process to receive information.	6.05	1.12	
I found it easy to use the tools and process to make sense of shared information.	5.89	1.08	
I found it easy to use the tools and process to help my group complete the task.	5.83	1.20	

Table 13.

Reliability Analysis – User Belief in Meeting Utility

	M	*SD*	α
User Belief in Meeting Utility	**5.68**	**1.25**	**0.87**
The tools and processes helped us exchange information.	5.83	1.16	
The tools and processes helped us make good use of the information we shared.	5.61	1.22	
The tools and processes helped us to know about the things we agreed on.	5.74	1.19	
The tools and processes helped us to focus on the points where we disagreed.	5.38	1.39	
The tools and processes helped us to know the extent we achieved consensus.	5.85	1.23	

Table 14.

Reliability Analysis – User Perception of Ability to Communicate

	M	*SD*	α
User Perception of Ability to Communicate	**5.94**	**1.18**	**0.70**
I experienced few problems expressing my ideas to the other group members.	5.50	1.54	
I felt comfortable putting forward my own ideas.	6.39	0.83	
I had little trouble understanding the points made by other group members.	5.66	1.24	
I was able to comment on the ideas submitted by other group members during the session.	6.06	0.99	
I think the other group members received the information I shared.	6.07	0.99	

Table 15.

Reliability Analysis – User Perception of Group Status Effects

	M	SD	α
User Perception of Group Status Effects	**2.23**	**1.48**	**0.81**
One or more of the group members tried to intimidate the others.	2.10	1.49	
One or more of the group members tried to force their opinions on the group.	2.74	1.74	
I felt inhibited from participating in the discussion because of the behavior of one or more of the other members.	1.67	1.01	
I felt pressure to conform to a particular viewpoint.	2.29	1.43	
One or more of the group members tried to dominate the discussion.	2.32	1.45	

Table 16.

Reliability Analysis – User Perception of Group Participation

	M	*SD*	α
User Perception of Group Participation	**5.82**	**1.07**	**0.82**
Everyone in the group was very involved in the group's discussion.	5.82	1.13	
I got a lot of good ideas about ranking from the other members of my group.	5.80	1.04	
Everyone in my group seemed to contribute all of the ideas they had about the task.	5.72	1.08	
No one seemed to be holding back information.	5.82	1.16	
My group shared a lot of information while we completed this task.	5.92	0.91	

3.10 Data Analysis

The hypotheses identified in Chapter II tested the basic belief that increasing the level of anonymity in a problem-solving group would increase decision quality and user attitudes. In addition, increasing the level of anonymity would decrease the level of group consensus and user satisfaction with the group outcome. Finally, it was stated that face-to-face groups (in relation to all GSS treatments) would have higher user participation and that increased anonymity in GSS treatments would result in higher levels of user participation.

The data was analyzed using multivariate ANOVA (MANOVA) procedure in SPSS 10.0. This procedure tests for differences in outcome variables among the treatment levels while controlling for the overall experiment-wise error rate. The procedure was then followed with the univariate ANOVA procedure. The ANOVA procedures compared the variance within the sample for each outcome measure that can be explained by the treatment conditions to the total variance across all groups. The tests

of the null hypothesis for the effects of anonymity on each measured variable were assessed through a series of *F*-tests. The *F*-statistic is the ratio of the variability between treatment groups to the sampling error (McClave, Benson, and Sincich, 1998). The acceptable statistical reliability threshold was set at $\alpha < 0.05$. Each univariate ANOVA procedure was followed by a set of pair wise comparisons using a Bonferoni procedure to control for experiment wise error. Therefore, the probability of a Type I error (falsely rejecting a null hypothesis) was kept to less then five percent. The variation is attributed to the difference between the treatments and the null hypothesis is rejected if the *F*-statistic is greater than the critical value of *F* associated with $\alpha < 0.05$.

The ANOVA table provided an *F*-statistic for anonymity. The means for each measured variable were plotted according to the four levels of anonymity. The data was analyzed separately for unlabeled groups who remained completely anonymous or chose to label themselves. When the unlabeled GSS session procedures were first developed, verbiage was not included to dissuade subjects from labeling themselves. Subsequently, four groups (16 subjects) chose to label themselves. At that point, the unlabeled GSS procedures were modified to specifically ask the subjects "not to identify themselves" once any subject attempted to do so. This development did not impact the unlabeled GSS session sample size since the four groups that chose to label themselves were thrown out and the sessions were rerun. A comparison of the unlabeled groups that remained anonymous and the unlabeled groups that chose to label themselves is discussed further in Chapter IV.

The index eta-squared (eta^2) was used to assess the strength of relationships between measured variables. Eta^2 denotes the amount of variability in the dependent

variable that can be attributed to the independent variable. Eta^2 values can range from 0.00 to 1.00. As eta^2 approaches 1.00 a stronger relationship between variables is signified, however, the relationship is weaker as eta^2 approaches 0.00. An eta^2 less then or equal to 0.05 is considered a weak effect, 0.10 a moderate effect, and greater than 0.15 a strong effect. These measures, however, must be considered somewhat arbitrary and can be revised downward (Jaccard and Becker, 1997:275-276).

3.11 Summary

The purpose of this chapter was to outline the steps used to administer an experiment which investigated the impact of different levels of anonymity on user participation, group decision quality, group consensus, user attitudes towards the problem-solving environment, and user satisfaction with the group outcome. This chapter described the methodology employed throughout the experiment, along with operationalized constructs and variables that will be applied to measure those constructs. Lastly, this chapter described the statistical methods used to analyze the data collected.

The results of this analysis are described in Chapter IV. The interpretation of this analysis, findings, and recommendations for future research are presented in Chapter V.

IV. Analysis of Data

4.1 Introduction

This chapter presents an analysis of collected data. The result of this information in terms of the research hypotheses of interest to this work is described in Chapter V

A multivariate analysis of variance (MANOVA) was used to determine if significant differences on measured variables existed between groups. Results of this test indicated that differences between treatment types did exist $F(3, 268) = 14.42$, $p < .01$, for at least one of the dependent variables. For each construct, a one-way analysis of variance compared the means of decision making groups using unlabeled GSS session, labeled without placard GSS sessions, labeled with placard GSS sessions, and face-to-face sessions. The alpha level used for all comparisons was .05. In addition, a multiple comparison was accomplished using the Bonferroni procedure to control for experiment-wise error. The means and standard deviations of all the constructs, as well as the level of significance (if any) are included in Table 17. Where significant differences were discovered a box and whiskers diagram is included for clarity. A description of the box-and-whisker diagram is presented in Appendix K. A discussion of the findings presented in Table 17 are further discussed in the following sections.

4.2 User Participation (H1)

The ANOVA test for user participation was found to be statistically significant, $F(3, 268) = 117.33$, $p < .01$. The strength of the relationship, as indexed by eta^2, was .57. The results of this test indicated that the mean for face-to-face sessions was statistically ($p < .01$) higher than the mean for labeled with placard GSS sessions, labeled without

Table 17.

ANOVA Results

	Face-to-face	Labeled GSS with Placard	Labeled GSS without Placard	Unlabeled GSS	Statistically Reliable Differences
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	
H1: User Participation	58.80 (20.41)	22.00 (8.50)	26.51 (11.12)	22.95 (9.74)	FTF > LP, LN, LN **
H2: Group Decision Quality					
Improvement (%)	61.25 (63.8)	55.48 (52.57)	47.92 (42.98)	31.16 (38.85)	FTF > NN ** LP > NN *
Group Score	27.75 (9.07)	28.94 (7.23)	28.61 (8.28)	30.94 (6.06)	
H3: Group Consensus (%)	97.25 (2.77)	89.61 (8.92)	87.56 (6.89)	89.94 (4.88)	FTF > LP, LN ** FTF > NN *
H4: User Attitudes					
User Satisfaction with Group Dynamics	6.26 (0.68)	6.07 (0.71)	5.85 (0.94)	5.93 (0.77)	FTF > LN *
User Perception of Ease of Use	6.10 (0.82)	6.08 (0.90)	6.06 (0.90)	6.04 (0.99)	
User Belief in Meeting Utility	6.08 (0.68)	5.51 (1.17)	5.46 (1.05)	5.74 (0.94)	FTF > LP, LN **
Individual's Ability to Communicate	6.09 (0.65)	5.93 (0.84)	5.83 (0.83)	5.91 (0.74)	
Status Effects of the Group	2.26 (1.04)	2.17 (1.03)	2.24 (1.18)	2.24 (1.15)	
Participation in Task Related Areas	5.99 (0.74)	5.80 (0.86)	5.69 (0.83)	5.81 (0.80)	
H5: User Satisfaction with Group Outcome	5.89 (0.83)	5.59 (0.80)	5.35 (0.83)	5.41 (0.73)	FTF > LN, NN **

Note: * $p < .05$ ** $p < .01$

placard GSS sessions, and unlabeled GSS sessions. There was no statistically significant difference between the mean for labeled with placard GSS sessions, labeled without placard GSS sessions, and unlabeled GSS sessions. The dispersion of the different treatment user participation level group scores is displayed in Figure 9.

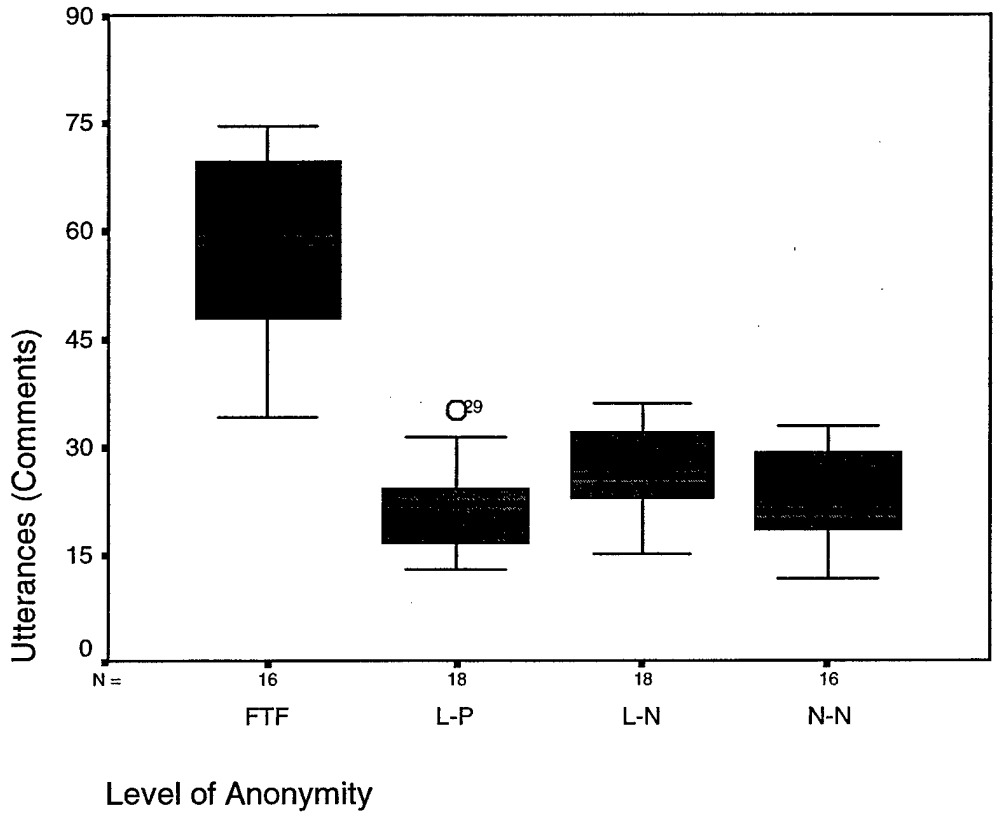


Figure 9. Average number of comments submitted per group member by treatment type.

4.3 Group Decision Quality (H2)

4.3.1 Improvement

The ANOVA test for improvement of decision making groups was found to be statistically significant, $F(3, 268) = 4.15, p < .01$. The strength of the relationship, as indexed by eta^2, was .04. The results of this test indicated that the mean for unlabeled

GSS sessions was statistically ($p < .01$) lower than the mean for face-to-face sessions. In addition the mean for unlabeled GSS sessions was statistically ($p < .05$) lower than the mean for labeled with placard GSS sessions. Figure 4.2 highlights the caution that should be used when interpreting this effect. The percentage of improvement for face-to-face is skewed. No difference is indicated in the median values between face-to-face and unlabeled GSS sessions. There was no statistically significant difference between the mean for face-to-face sessions, labeled with placard GSS sessions, and labeled without placard GSS sessions. The dispersion of the different treatment improvement percentages is displayed in Figure 10.

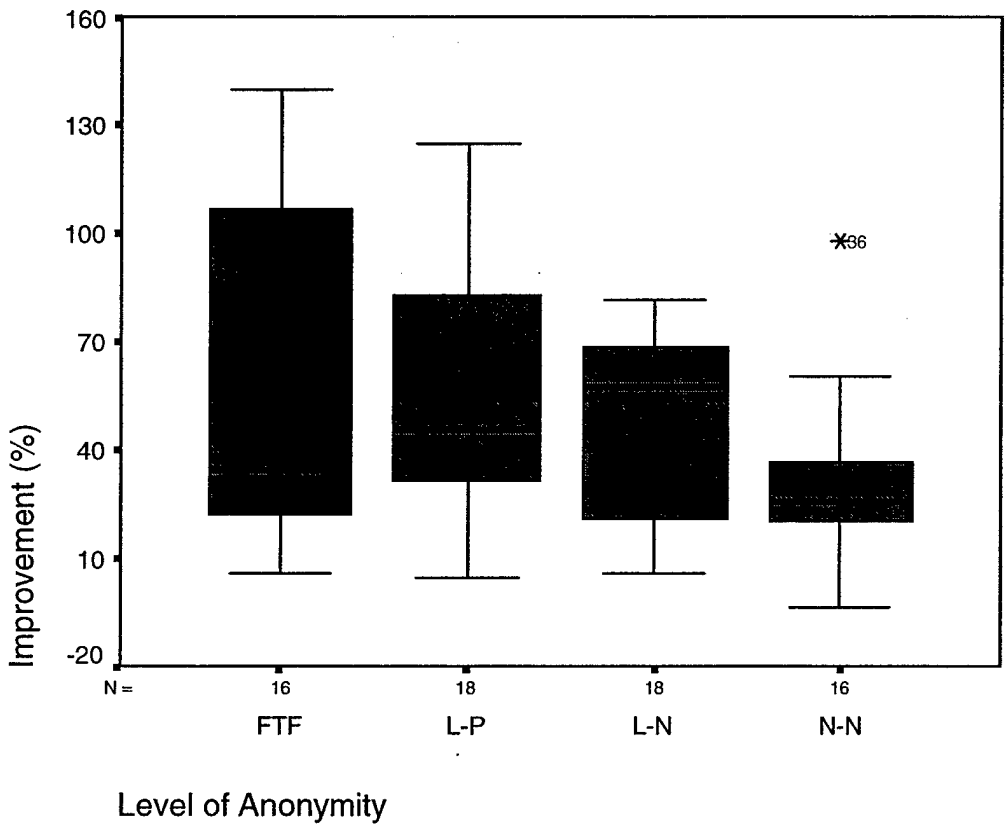


Figure 10. Average improvement of group score when compared to individual scores by treatment type.

Of the 68 groups, 44 produced better decisions as groups after discussion than the highest score of any individual group member before the group discussion. When broken down by treatment, nine of the groups that produced a poorer-quality decision than their best member were in unlabeled GSS sessions. The other fourteen were equally distributed between face-to-face sessions (5 groups), labeled with placard GSS sessions (5 groups) and labeled without placard GSS sessions (4 groups). Finally, only one group (an unlabeled GSS session) achieved a lower group score then the average of the individuals prior to the discussion period.

4.3.2 Group Score

The ANOVA test for group score was not found to be statistically significant, $F(3, 268) = 1.94, p > .05$, indicating no differences between the mean for face-to-face sessions, the mean for labeled with placard GSS sessions, the mean for labeled without placard GSS sessions, and the mean for unlabeled GSS sessions.

4.4 Group Consensus (H3)

The ANOVA for consensus levels was found to be statistically significant, $F(3, 64) = 7.23, p < .01$. The strength of the relationship, as indexed by eta^2, was .25. The results of this test indicated that the mean for face-to-face sessions was statistically ($p < .01$) higher than the mean for labeled with placard GSS sessions and labeled without placard GSS sessions. In addition, the mean for face-to-face sessions was statistically ($p < .05$) higher than the mean for unlabeled GSS sessions. There was no statistically significant difference between the mean for labeled with placard GSS sessions, labeled

without placard GSS sessions, and unlabeled GSS sessions. The dispersion of the different treatment consensus levels is displayed in Figure 11.

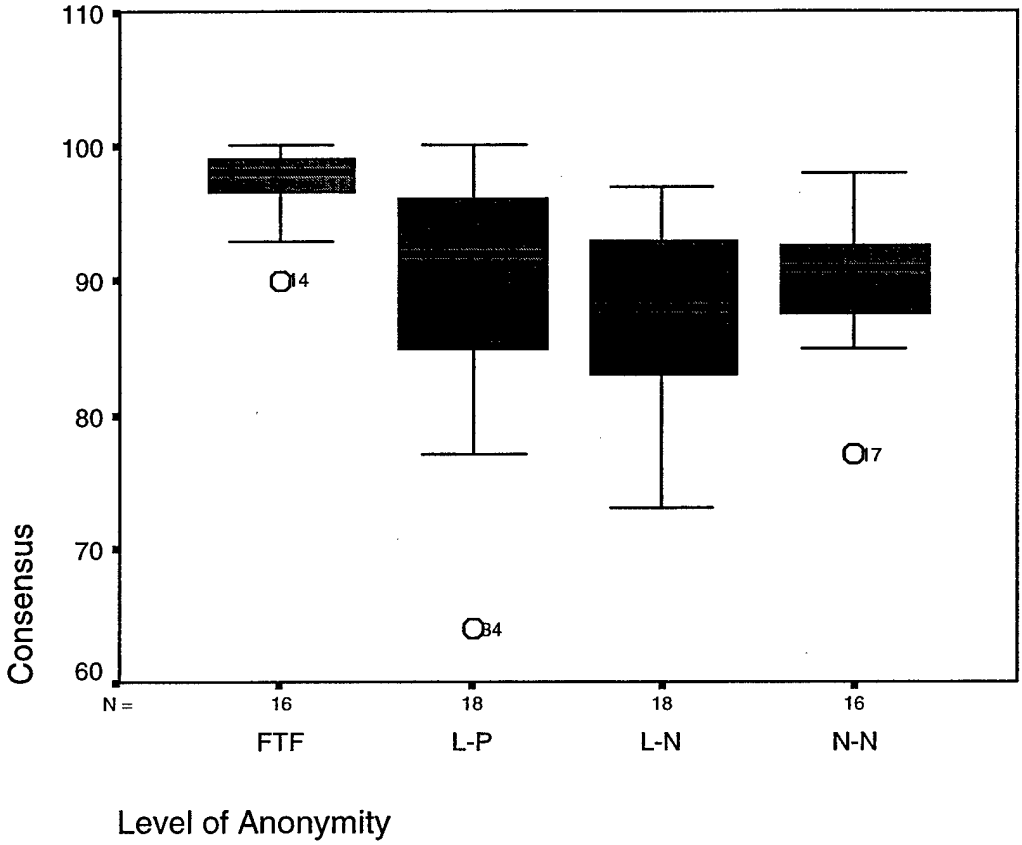


Figure 11. Group consensus levels by treatment type.

4.5 User Attitudes (H4)

4.5.1 User Satisfaction with Group Dynamics

The ANOVA test for user satisfaction with group dynamics of decision making groups was found to be statistically significant, $F(3, 268) = 3.54$, $p < .05$. The strength of the relationship, as indexed by eta^2, was .04. The results of this test indicated that the mean for face-to-face sessions was statistically ($p < .05$) higher than the mean for labeled without placard GSS sessions. There was no statistically significant difference between

labeled without placard GSS sessions and labeled with placard GSS sessions or unlabeled GSS sessions. The dispersion of the user satisfaction with group dynamics group scores is displayed in Figure 12.

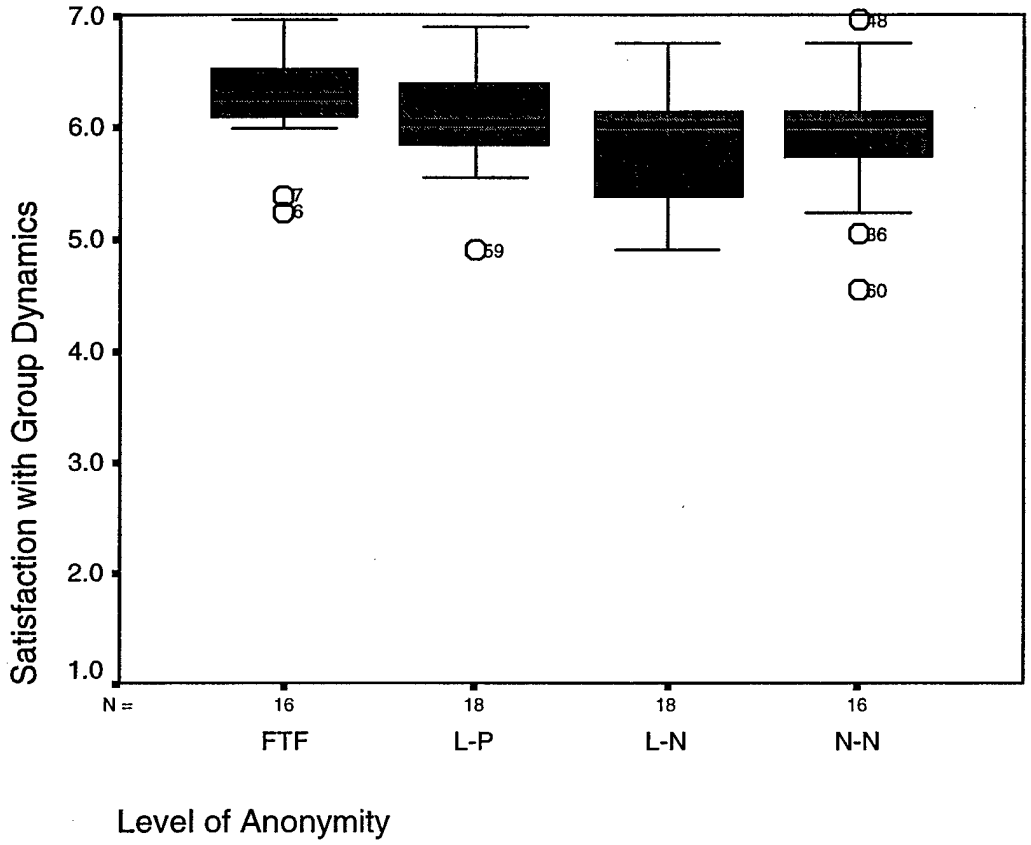


Figure 12. User satisfaction with group dynamics by treatment type.

4.5.2 User Perception of Ease of Use

The ANOVA for user perception of ease of use of decision making groups was not found to be statistically significant, $F(3, 268) = 0.05$, $p > .05$, indicating no differences between face-to-face sessions, labeled with placard GSS sessions, labeled without placard GSS sessions or unlabeled GSS sessions.

4.5.3 User Belief in Meeting Utility

The ANOVA test for user belief in meeting utility of decision making groups was found to be statistically significant, $F(3, 268) = 5.43, p < .01$. The strength of the relationship, as indexed by eta^2, was .06. The results of this test indicated that the mean for face-to-face sessions was statistically ($p < .01$) higher than the mean for labeled with placard GSS sessions and the mean for labeled without placard GSS sessions. There was no statistically significant difference between labeled with placard GSS sessions, labeled without placard GSS sessions or unlabeled GSS sessions. There was also no difference between face-to-face and unlabeled GSS. The dispersion of the different user belief in meeting utility group scores is displayed in Figure 13.

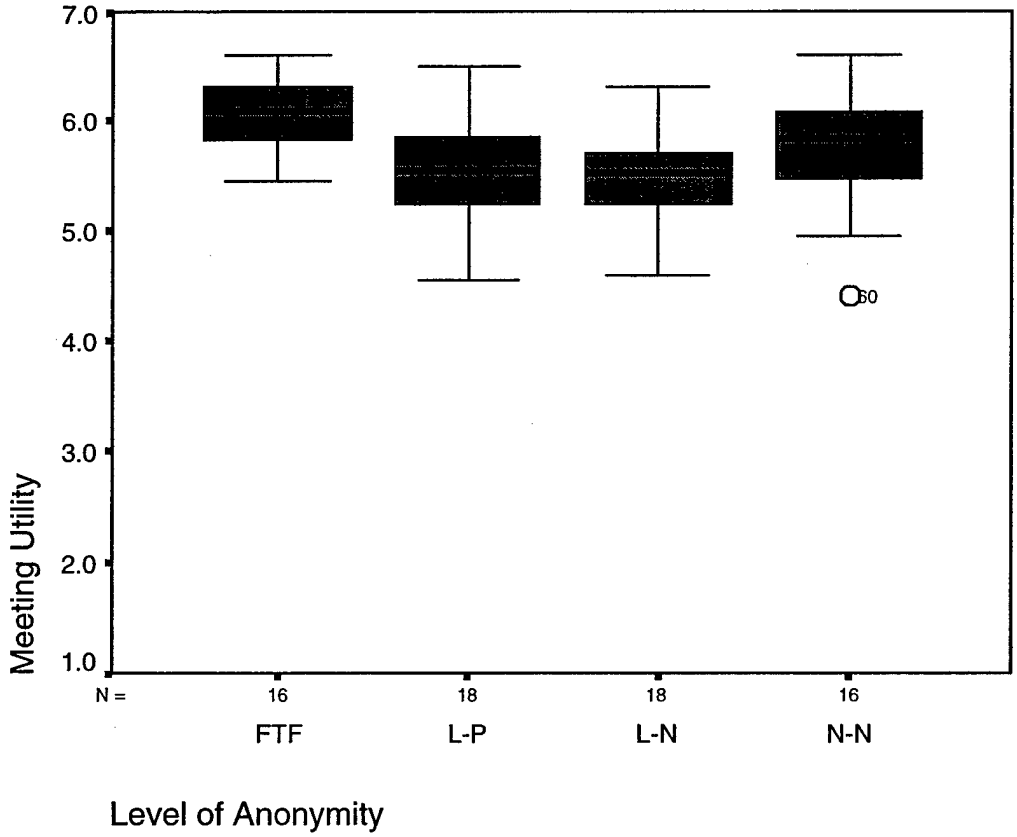


Figure 13. User belief in meeting utility by treatment type.

4.5.4 Individuals Ability to Communicate

The ANOVA test for individuals ability to communicate of decision making groups was not found to be statistically significant, $F(3, 268) = 1.37, p > .05$, indicating no differences between the mean for face-to-face sessions, the mean for labeled with placard GSS sessions, the mean for labeled without placard GSS sessions, and the mean for unlabeled GSS.

4.5.5 Status Effects of the Group

The ANOVA test for status effects of the group members was not found to be statistically significant, $F(3, 268) = 0.10, p > .05$, indicating no differences between the mean for face-to-face sessions, the mean for labeled with placard GSS sessions, the mean for labeled without placard GSS sessions, and the mean for unlabeled GSS sessions.

4.5.6 Participation in Task Related Areas

The ANOVA test for participation in task related areas was not found to be statistically significant, $F(3, 268) = 1.54, p > .05$, indicating no differences between the mean for face-to-face sessions, the mean for labeled with placard GSS sessions, the mean for labeled without placard GSS sessions, and the mean for unlabeled GSS sessions.

4.6 User Satisfaction with the Group Outcome (H5)

The ANOVA test for user satisfaction with the group outcome was found to be statistically significant, $F(3, 268) = 5.95, p < .01$. The strength of the relationship, as indexed by eta^2, was .06. The results of this test indicated that the mean for face-to-face

sessions was statistically ($p < .01$) higher than the mean for labeled without placard GSS sessions and unlabeled GSS sessions. There was no statistically significant difference between the mean for labeled with placard GSS sessions, labeled without placard GSS sessions, and unlabeled GSS sessions. The dispersion of the different treatment user participation level group scores is displayed in Figure 14.

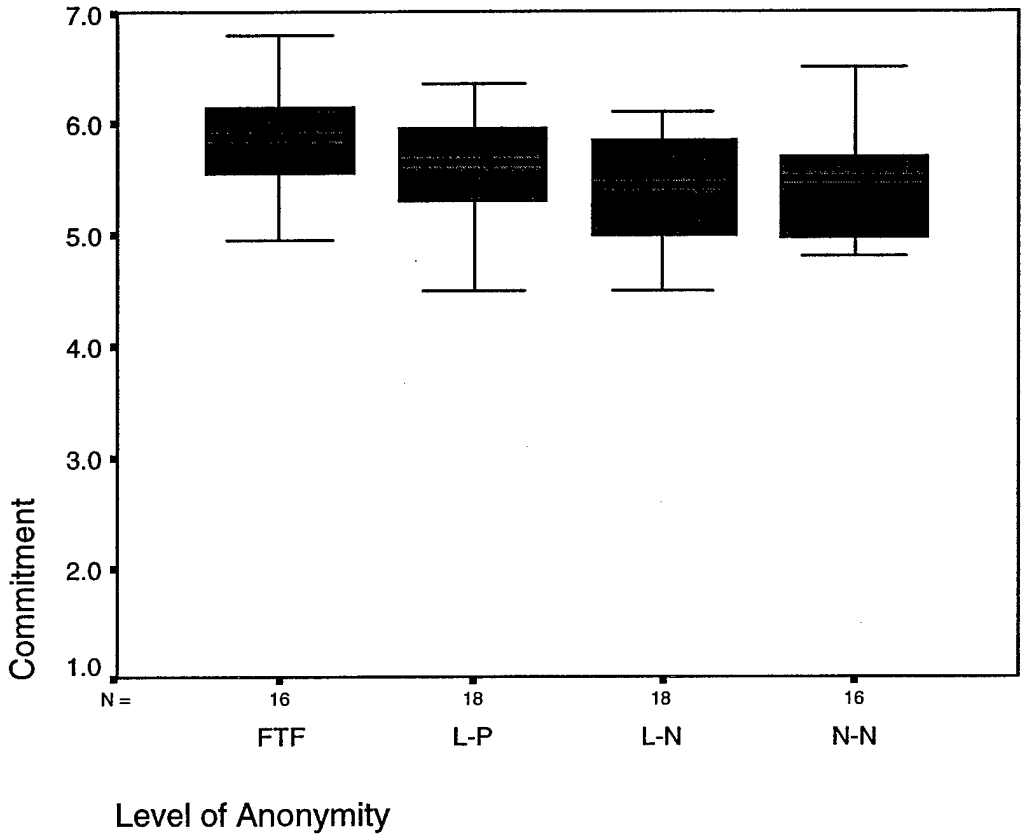


Figure 14. Average level of user commitment to group decision by treatment type.

4.7 Comparison of unlabeled groups that remained anonymous and unlabeled groups that chose to label themselves.

As mentioned in Chapter III, four unlabeled GSS groups chose to identify themselves during the GSS session, thus circumventing the anonymity manipulation

check. The data for these participants was excluded from the analysis in the above sections, but further analysis between truly anonymous GSS groups and self-labeled GSS groups is provided in Table 18 and the following sections.

Table 18.

Summary of Means between unlabeled and self-labeled GSS groups

Measure	**Unlabeled GSS groups**	**Self-labeled GSS groups**
Comments	28.16	33.75
Improvement	32%	20%
Group Score	30.94	35.50
Consensus	91%	83%
User Satisfaction with Group Dynamics	5.90	5.96
User Perception of Ease of Use	6.08	5.80
User Belief in Meeting Utility	5.79	5.50
Individuals Ability to Communicate	5.88	5.86
Status Effects of the Group	2.36	2.36
Participation in Task Related Areas	5.81	5.46
User Commitment to Group Decision	5.44	5.54
Anonymity Manipulation Check	3.82	5.56
Comment Labeling Manipulation Check	3.45	5.02

Table 18 compares the results of the experiment measures between unlabeled GSS groups that remained anonymous and groups that chose to label themselves. Self-labeled GSS groups provided, on average, five more comments per participant than

unlabeled GSS groups. Group decision quality was lower in both measures (improvement and group score) in groups that chose to label themselves. In addition, consensus was much lower in self-labeled GSS groups. As for the user attitudes and user satisfaction with group outcome constructs there were minimal differences between self-labeled and unlabeled GSS groups.

4.7.1 Anonymity

A one-way analysis of variance compared the mean anonymity manipulation checks of decision making groups using unlabeled GSS sessions and self-labeled unlabeled GSS sessions. This test was found to be statistically significant, $F(1, 18) = 19.24$, $p < .01$. The strength of the relationship, as indexed by eta^2, was .52. The results of this test indicated that the mean for unlabeled GSS sessions ($M = 3.82$, $SD = 0.76$) was statistically ($p < .01$) less than the mean for self-labeled unlabeled GSS sessions ($M = 5.56$, $SD = 0.43$).

4.7.2 Comment Labeling

A one-way analysis of variance compared the mean comment labeling manipulation checks of decision making groups using unlabeled GSS sessions and self-labeled unlabeled GSS sessions. This test was found to be statistically significant, $F(1, 18) = 10.88$, $p < .01$. The strength of the relationship, as indexed by eta^2, was .38. The results of this test indicated that the mean for unlabeled GSS sessions ($M = 3.45$, $SD = 0.90$) was statistically ($p < .01$) less than the mean for self-labeled unlabeled GSS sessions ($M = 5.02$, $SD = 0.58$).

4.8 Summary

This chapter presents an assessment of the success of manipulations included in the experimental design and the results of analysis performed on data collected through survey administration and direct observation of experiment participants. The results of this analysis effort, excluding the discussion of manipulation success, are presented in Table 19. In Chapter V, these results are discussed more specifically in relation to the hypotheses outlined in Chapter II.

Table 19

Summary of Effect Size and Statistical Significance

Hypothesis		Strength of Effect (Eta^2)	Significant Differences
H1	*User Participation*	0.57 **	FTF > LP, LN, LN **
H2	*Group Decision Quality*		
	Improvement (%)	0.04 **	FTF > NN **
			LP > NN *
	Group Score	-	-
H3	*Group Consensus*	0.25 **	FTF > LP, LN **
			FTF > NN *
H4	*User Attitudes*		
	User Satisfaction with Group Dynamics	0.04 *	FTF > LN *
	User Perception of Ease of Use	-	-
	User Belief in Meeting Utility	0.06 **	FTF > LP, LN **
	Individual's Ability to Communicate	-	-
	Status Effects of the Group	-	-
	Participation in Task Related Areas	-	-
H5	*User Satisfaction with the Group Outcome*	0.06 **	FTF > LN, NN **

Note: * $p < .05$ ** $p < .01$

V. Conclusions and Recommendations

5.1 Introduction

The purpose of this study was to determine the impact of different levels of anonymity on decision-making groups in an effort to improve user participation rates, group performance, group consensus, user attitudes and user satisfaction with the group decision. The study presented a conceptual framework in Chapter II and discussed numerous studies that have looked at content and process anonymity. In order to examine the hypothesis presented in Chapter II, an experiment was developed that manipulated anonymity. The main effects could then be studied to determine which level of anonymity was significantly better then the others in terms of user participation, group performance, group consensus, user attitudes, and user satisfaction with the group decision. The results of the experiment are described in this chapter and presented in relation to the hypothesis from Chapter II. Finally, this chapter will present overall conclusions from this study, limitations of the research and recommendations for future research.

5.2 Hypothesis 1: Effects of anonymity on user participation

Hypothesis 1 proposed that the level of anonymity provided in a problem-solving environment (GSS only) would positively impact user participation levels, but that face-to-face groups would achieve the highest participation levels. For the purpose of evaluation, the four levels of anonymity were broken into two sub-hypotheses that are described and discussed further.

5.2.1 Hypothesis 1a

Hypothesis 1a presented the idea that face-to-face decision making groups would achieve the highest level of user participation of all treatment groups. Review of data analysis presented in Chapter IV presents strong support for this hypothesis. Face-to-face groups had nearly twice as many comments as each of the GSS treatment groups. This supports Hiltz et al's statement introduced in Chapter II that "there is unquestionably a greater amount of communication flow during a face-to-face conference than during a computerized conference (1986: 236)." These results can be attributed to the fact that people can speak faster than they can type.

5.2.2 Hypothesis 1b

Hypothesis 1b posited that higher levels of anonymity in a GSS environment would positively impact user participation levels. The results of ANOVA performed on data collected from the experiment participants, however, presented no evidence to support this hypothesis. Participants in the two GSS treatments offering the highest anonymity (Unlabeled GSS) and the least anonymity (Labeled with placard GSS) contributed nearly equally. This comparison is trivial, but could be disproved or identified as significant if the power was increased. The higher number of comments from labeled without placard GSS groups might be attributed to the fact that they had process, but not content anonymity. Consequently, any entry they provided could not be associated with them, but, since they were able to identify their own comments, it allowed them to socially compare their level of performance with others in the group.

5.3 Hypothesis 2: Effects of anonymity on group decision quality

Hypothesis 2 proposed that the level of anonymity provided in a problem-solving environment (either GSS or face-to-face) would positively impact group decision quality. Group decision quality was measured in two ways: group improvement when compared to individual scores and group score. Evidence provided through ANOVA showed no support for this hypothesis for either measurement.

After a closer look, the ANOVA results for group improvement reported exactly the opposite results from what was hypothesized. Process anonymity in this study negatively influenced group decision quality. This contradicts previous research that the process gains associated with anonymity (reduced evaluation apprehension, more errors caught, low-threat environment) outweigh the process losses (free riding). This indicates there must be other significant factors, other than anonymity, that influence group decision quality.

5.4 Hypothesis 3: Effects of anonymity on group consensus

Hypothesis 3 proposed that the level of anonymity provided in a problem-solving environment (either GSS or face-to-face) would negatively impact group consensus. The results from the ANOVA for group consensus fail to support the above hypothesis. Face-to-face groups achieved a significantly higher level of consensus then all three GSS treatments, but there was no significant difference between the GSS treatments. This difference cannot be attributed to anonymity because there was no difference between the GSS groups. This finding is probably attributable to other differences between GSS and face-to-face meetings. This result could be attributed to the fact that computerized

conferences tend to facilitate opinion giving and that this negatively impacts their ability to reach consensus. This result could also be attributed to the limitations imposed on the GSS problem solving groups. The GSS has tools that allow participants to review comments while they vote, this could result in a higher consensus levels. However, the experimental design used did not allow the participants to use this GSS capability, thus limiting the effectiveness of the GSS.

5.5 Hypothesis 4: Effects of anonymity on user attitudes

Hypothesis 4 proposed that the level of anonymity provided in a problem-solving environment (either GSS or face-to-face) would negatively impact user attitudes. There was no evidence from the ANOVA results that supported this statement. The only effects were found with the user belief in meeting utility measurement and meeting utility. As with consensus and participation, the differences are due to characteristics of face-to-face meetings. The contradictory findings of the studies presented in Chapter II indicated that the level of anonymity would not influence user attitudes. The lack of user attitude findings in this study may be attributed to the fact that great effort was put forth to make the face-to-face sessions mirror the GSS sessions, thus reducing the impact on user attitudes.

5.6 Hypothesis 5: Effects of anonymity on user satisfaction with the group outcome

Hypothesis 5 proposed that the level of anonymity provided in a problem-solving environment (either GSS or face-to-face) would negatively impact user satisfaction with the group outcome. ANOVA results showed a weak positive effect for face-to-face when

compared to the two GSS treatments with process anonymity. These findings support Rao and Monk's (1999) belief that anonymous participants need for external justification is not supported, subsequently their level of commitment to the group decision is lower. Identified participants achieve higher levels of satisfaction with the group decision because their need for external justification is satisfied.

5.7 Conclusions and Recommendations

Overall, the conclusion of this study suggests that process anonymity has a weak detrimental effect on problem-solving groups in terms of improvement in decision quality and satisfaction with the group outcome. The findings outlined in Table 19 indicate moderate to strong effects on user participation and group consensus attributed to differences between face-to-face and GSS. Whether these differences are due to the quality of face-to-face meetings or method effects cannot be determined. For instance, the strong effect on user participation might be due to the method of generating comments (i.e. you can talk faster then you can type or that participants dislike periods of silence and are motivated to fill voids with chatter). The moderate effect on group consensus may be attributed to limitations imposed on GSS participants which did not allow them to fully use the GSS capabilities, thus reducing the chances of achieving high levels of consensus.

Tables 2 and 3 presented many contradictory findings between different levels of anonymity. This study continued the trend of contradictory findings by finding mixed results when analyzing anonymity in problem-solving groups. The positive and negative

benefits of anonymity presented in this study can be added to the GSS body of knowledge.

Despite the underwhelming results, this study is important for its attempt to measure the independent effects of process and content anonymity. The introduction of labeled GSS sessions with placards went one step beyond the present research. Including labeled with placard GSS sessions in future GSS research efforts could prove beneficial. Since both labeled with placard GSS sessions and face-to-face sessions provided neither content or process anonymity the lack of findings on three of the five constructs when comparing these two treatments was not unexpected. Further analysis between these two treatments could provide more detail on the benefits of a GSS compared to a face-to-face session. This analysis would reduce the focus on anonymity and direct it more towards the technology, since the results of the anonymity manipulation checks found nearly identical results between face-to-face groups and labeled with placard GSS groups.

Finally, the findings presented in this study should emphasize to group facilitators and leaders that users perceive different levels of anonymity and that caution should be used when anonymity is manipulated for problem-solving groups. Consideration should be given to the true goal of the meeting (i.e. consensus or decision quality) and then a level of anonymity should be chosen based on that goal.

5.8 Limitations and Recommendations for Future Research

The underwhelming results considered here present one overarching implication to practitioners and academicians alike: the results from any one study do not apply to all group work. It is important to consider all the limitations before applying this research to

future efforts. Chapter IV highlighted the differences present between the different levels of anonymity. This studies findings and noted limitations provide a platform for future anonymity studies. The need for further research in the area of anonymity and problem-solving groups is clear.

A limitation of this study was the length of the experiment (approximately two hours). Since four studies were consolidated into one experiment the study had to incorporate multiple questionnaires and manipulations that could influence the participants perceptions of the anonymity manipulations. The post-questionnaire, which measured user attitudes, was the last step of the experiment and possibly could have been impacted by the experiment length because of task saturation. On one occasion, the length of the experiment clearly affected a participant. The participant was so rushed to get to his next activity that on the post-questionnaire, they rushed through and marked all Likert-scale items with a "4". The data point was not used but indicated the possibility that the experiment length could have been too long.

A second limitation of the study was group size. This study used a group size of four, which is common in many GSS experiments. However, a larger group may be necessary to more accurately measure the effects of anonymity on problem-solving groups. In smaller groups, it may still be possible for group members to identify the source of comments even if they are unlabeled because of certain terms an author is known to use. If the group were larger, this likelihood would be reduced. Larger groups would likely enhance the benefits and drawbacks of anonymous problem solving groups. With a larger group, more comments would likely be generated, but this could also result in a participant's tendency to free ride. In a face-to-face group, only one person can

speak at a time. Subsequently, in a fixed period, there is a maximum limit on the number of comments generated. This is not the case in a GSS session. Logically there should be a group size in which the GSS can provide more comments than a face-to-face group. This would likely require a task that can generate many comments. Once you exceed the minimum group size, the question then becomes whether people can or will pay attention to the additional information. One final concern regarding group size is real world group support systems often have many more participants. Analyzing the impact of anonymity in different sized groups is another direction future research could take.

A third limitation of the study was that the task used was strictly an experimental task. In this study, participants had no strong personal involvement in completing the task and were not challenged emotionally. Using a more emotionally charged task or one that facilitated a higher level of personal involvement likely would have shown different effects attributable to the anonymity manipulation. Thus, future research might be usefully directed at studying the impact of anonymity when accomplishing an emotionally loaded task.

A final limitation of the study was that the majority of the participant groups already knew each other before the experiment. In some cases, participants had know each other for only a short time (one week), while in other cases, participants had know each other for as long as three years. This level of familiarity may have an interactive effect with anonymity on the results and was not measured. Future studies should look at the impact of anonymity when groups are familiar/unfamiliar with each other.

5.9 Summary

Anonymity has been one of the most-studied GSS components. The results provided in this studies literature review and findings are mixed indicating the need for further research in the area of anonymity and problem-solving groups.

As Nunamaker, Dennis, Valacich, Vogel and George (1993) point out "anonymity is not always appreciated or warranted (144)." Finding the right situation and environment in which anonymity is appreciated and warranted is still a challenge facing researchers and practitioners alike. Finding the correct balance between freely contributing without fear and the desire for recognition remains a significant challenge.

Appendix A: Post-Test Questionnaire

Answer the questions using the following scale

1. Strongly Disagree
2. Disagree
3. Disagree Somewhat
4. Neither Agree Nor Disagree
5. Agree Somewhat
6. Agree
7. Strongly Agree

_____ I would not mind working with this group again.

_____ I am pleased with the performance of our group.

_____ In my opinion, we worked effectively as a group.

_____ I found the other group members easy to work with.

_____ I enjoyed participating in the group activity.

_____ Learning to use the tools and process provided was easy for me.

_____ I found it easy to use the tools and process to share information.

_____ I found it easy to use the tools and process to receive information.

_____ I found it easy to use the tools and process to make sense of shared information.

_____ I found it easy to use the tools and process to help my group complete the task.

_____ The tools and processes helped us exchange information.

_____ The tools and processes helped us make good use of the information we shared.

_____ The tools and processes helped us to know about the things we agreed on.

_____ The tools and processes helped us to focus on the points where we disagreed.

_____ The tools and processes helped us to know the extent we achieved consensus.

Answer the questions using the following scale

1. Strongly Disagree
2. Disagree
3. Disagree Somewhat
4. Neither Agree Nor Disagree
5. Agree Somewhat
6. Agree
7. Strongly Agree

_____ I experienced few problems expressing my ideas to the other group members.

_____ I felt comfortable putting forward my own ideas.

_____ I had little trouble understanding the points made by other group members.

_____ I was able to comment on the ideas submitted by other group members during the session.

_____ I think the other group members received the information I shared.

_____ One or more of the group members tried to intimidate the others.

_____ One or more of the group members tried to force their opinions on the group.

_____ I felt inhibited from participating in the discussion because of the behavior of one or more of the other members.

_____ I felt pressure to conform to a particular viewpoint.

_____ One or more of the group members tried to dominate the discussion.

_____ Everyone in the group was very involved in the group's discussion.

_____ I got a lot of good ideas about ranking from the other members of my group.

_____ Everyone in my group seemed to contribute all of the ideas they had about the task.

_____ No one seemed to be holding back information.

Answer the questions using the following scale

1. Strongly Disagree
2. Disagree
3. Disagree Somewhat
4. Neither Agree Nor Disagree
5. Agree Somewhat
6. Agree
7. Strongly Agree

_____ My group shared a lot of information while we completed this task.

_____ My group received information on how well we shared information during the first task.

_____ Each member of my group knew how much they had contributed to the group during the first task.

_____ I knew how much information other members of my group shared during the first task.

_____ I could recognize the originator of most comments.

_____ Other group members could connect me to the comments I made.

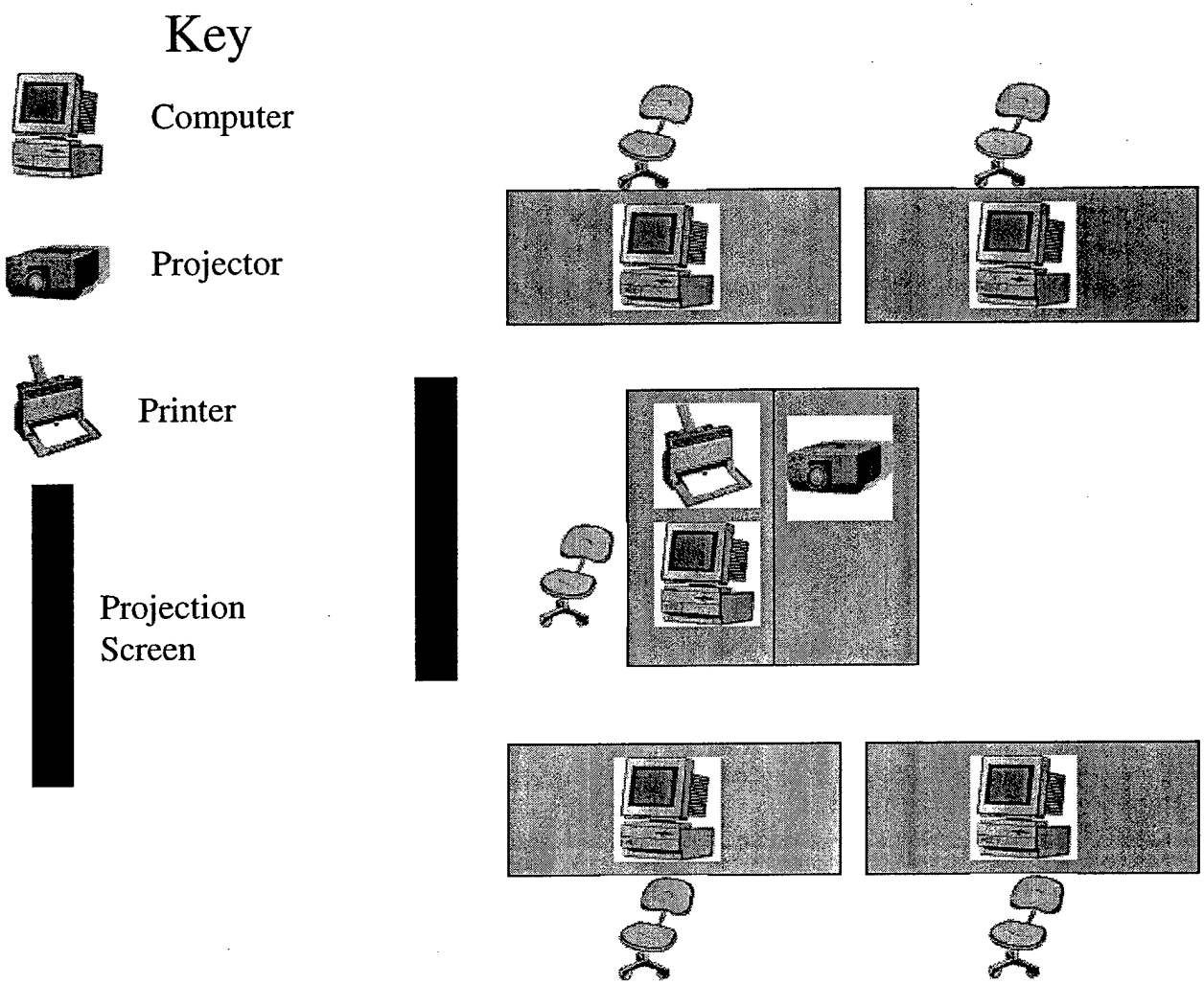
_____ Other group members knew when I made a contribution to the group.

_____ I could tell if someone was sharing more information than other members of the group.

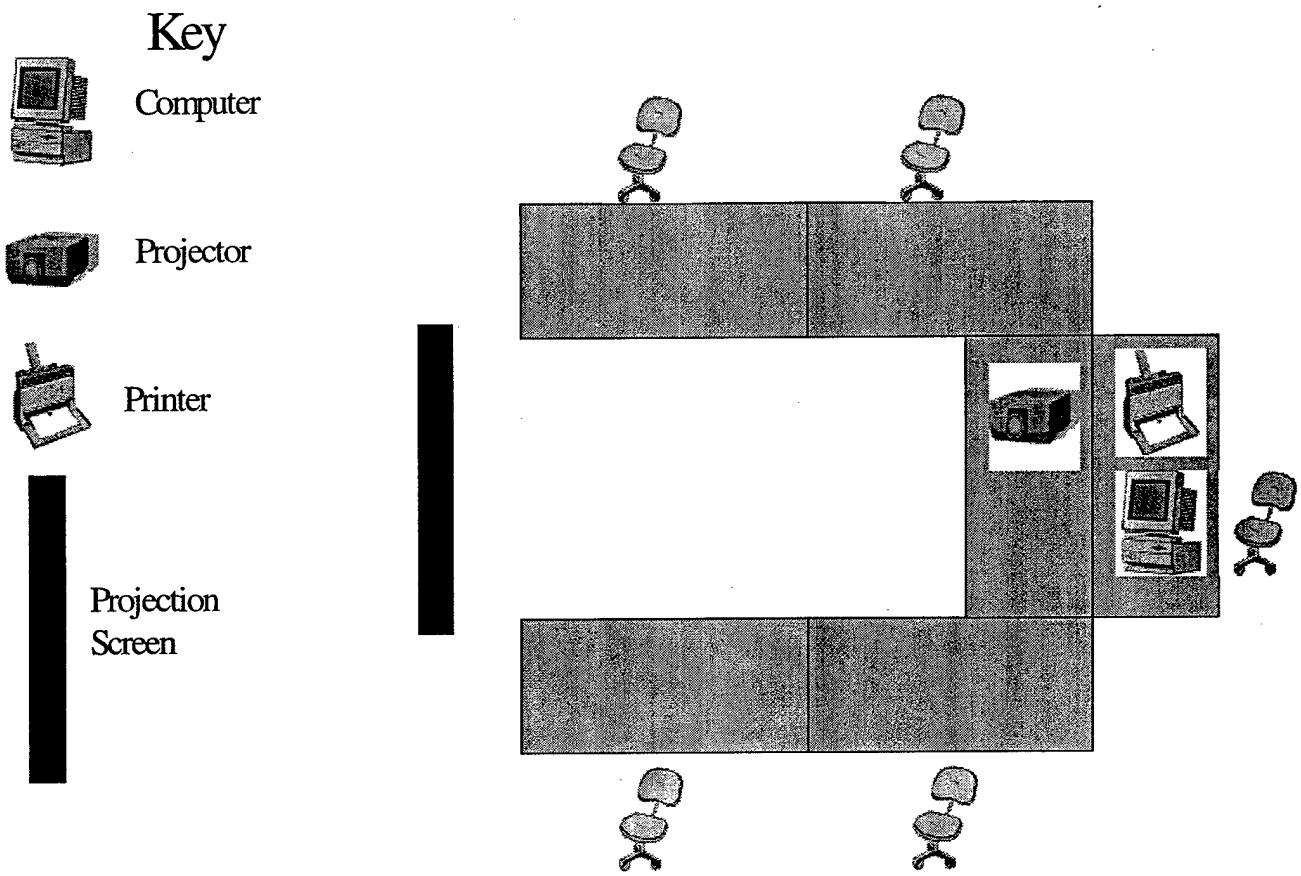
_____ I could tell if someone participated less than other members of the group.

_____ Other group members could judge the extent that I participated in the group.

Appendix B: GSS Room Configuration



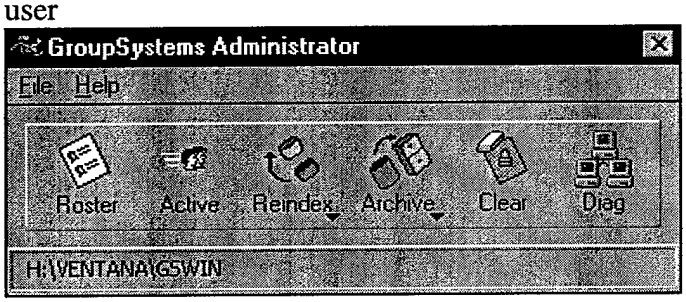
Appendix C: Face-to-face Room Configuration

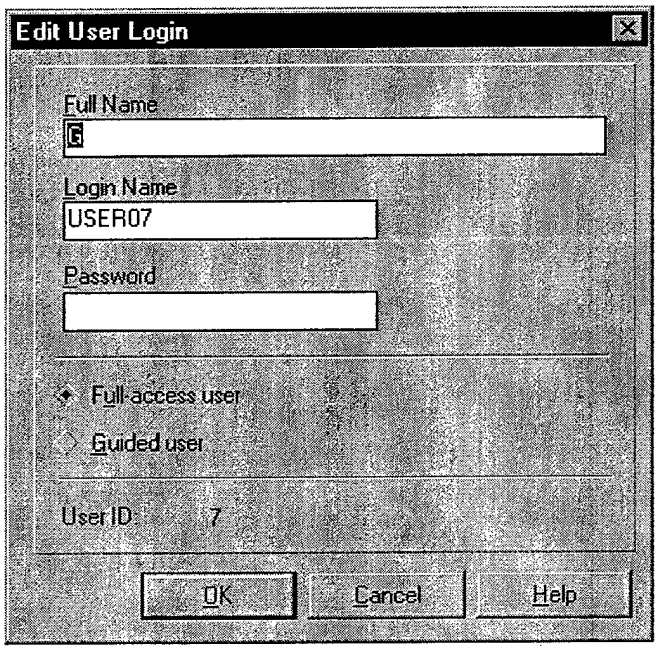


Appendix D: GSS Experiment Script

GSS: Pre-Experiment Steps

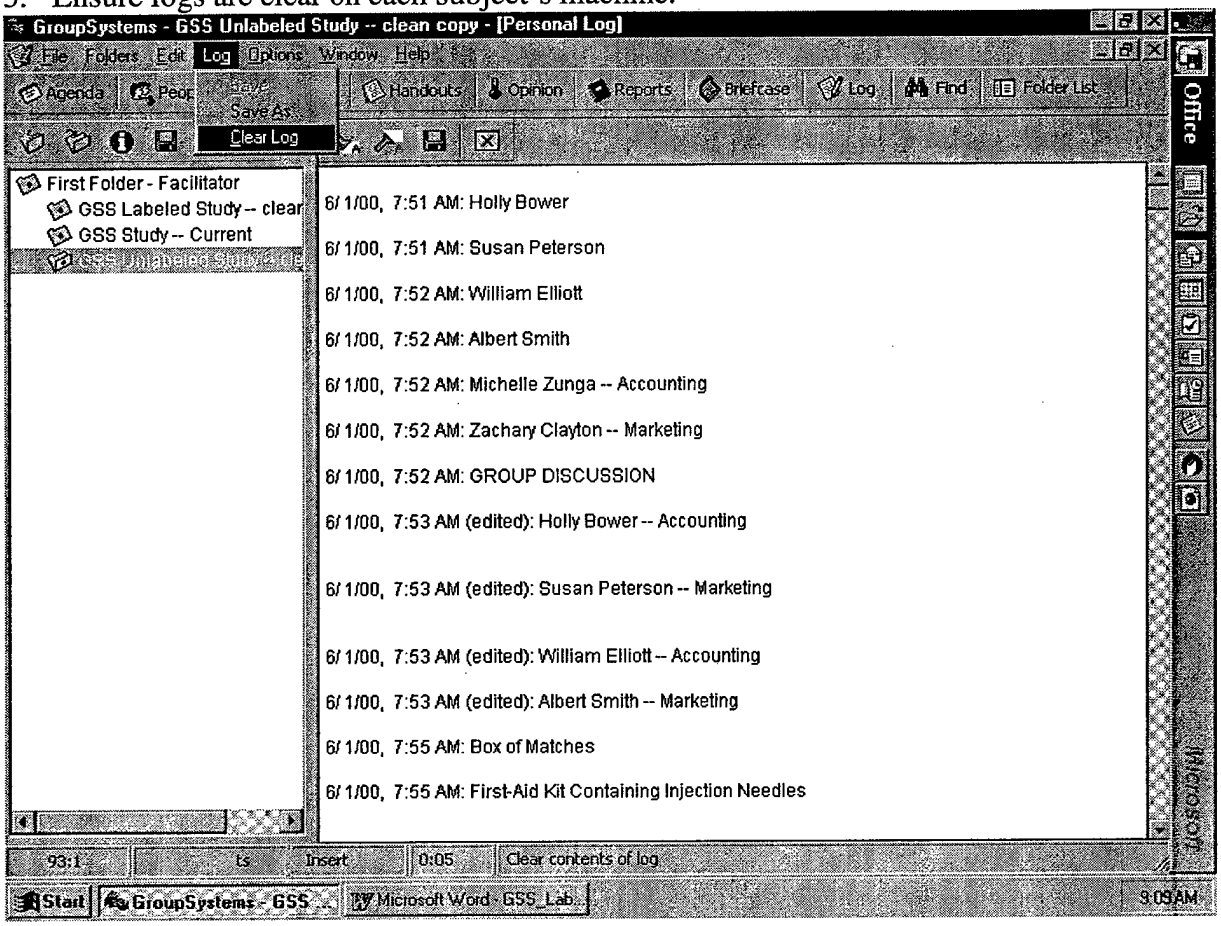
Ensure following items are available:
Big folder labeled consent forms
4 Manila folders
Attached via paper clip are
Consent form
Demographic/Personality Questionnaire
1 copy of Moon Scenario
Check out Projector and printer with paper
In Group System Admin, click on Clear, then open roster, edit user terminal, set to full-access user



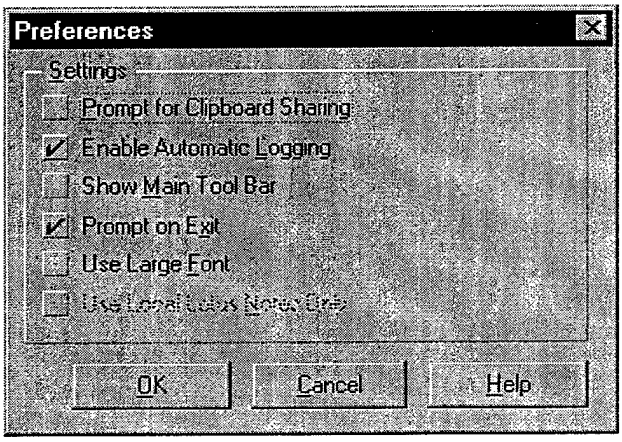


Start Group Systems WGE at Facilitator station and all user stations

5. Ensure logs are clear on each subject's machine.



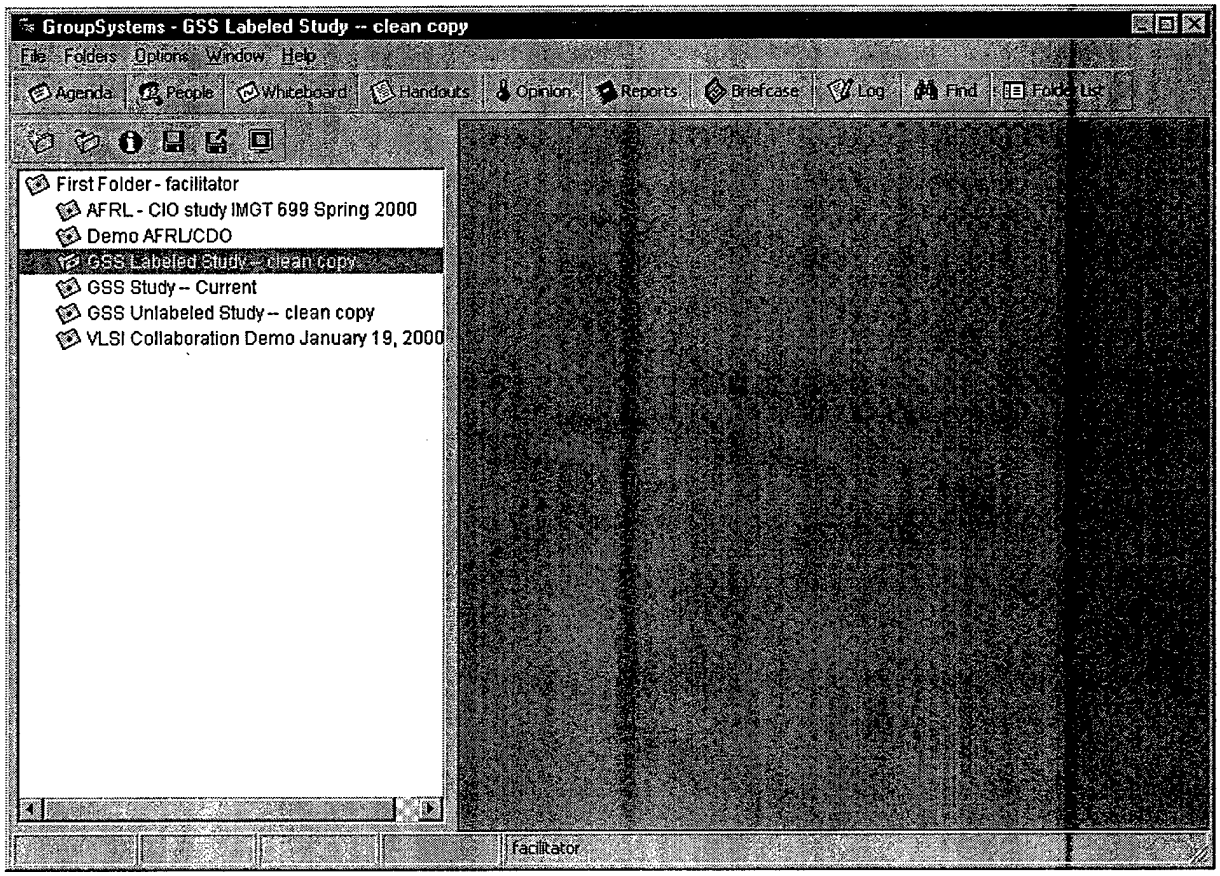
6. At each user station Under Options – Preferences check the following boxes



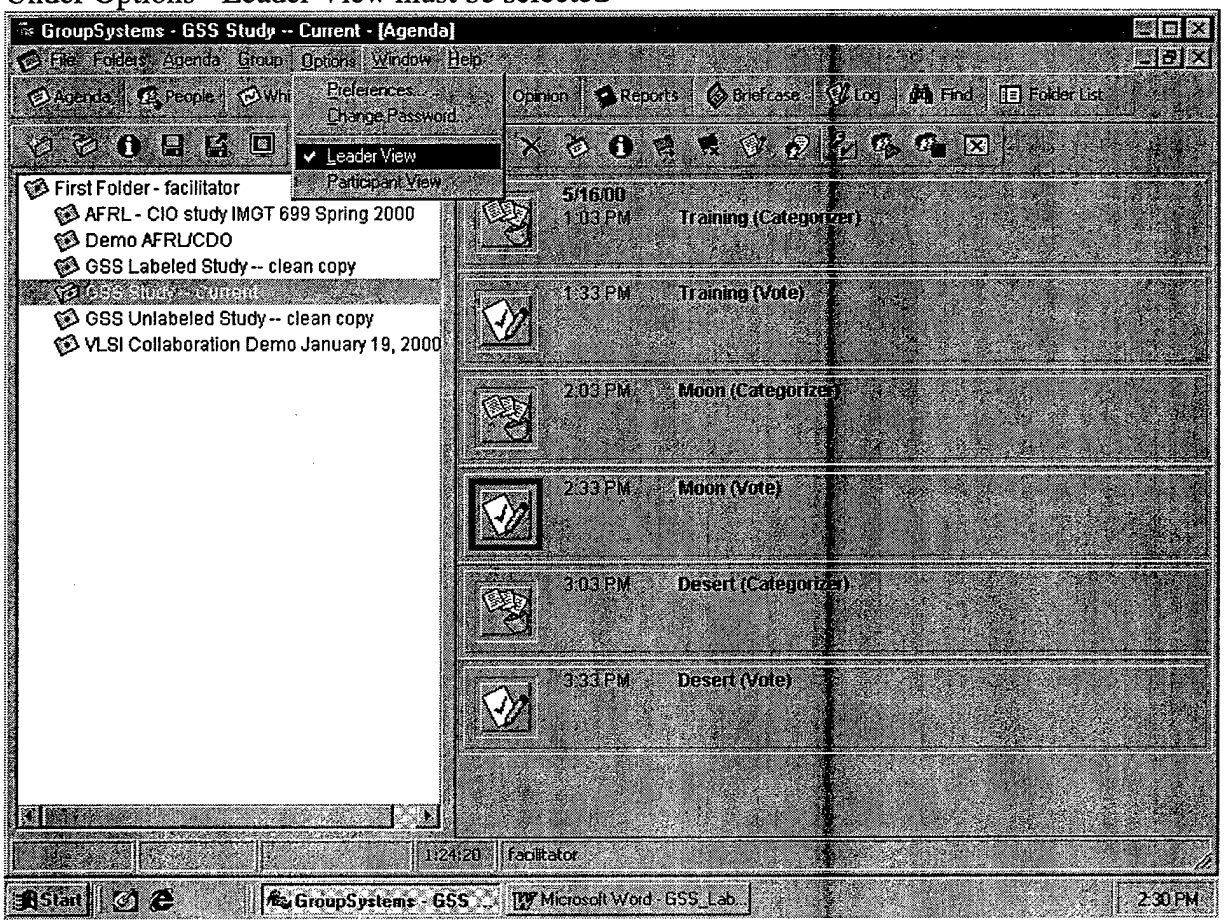
Ensure each participant station has a 3.5" floppy inserted in the drive

Copy all activities for session from:
For a labeled session: GSS Labeled Study – clean copy
For an unlabeled session: GSS Unlabeled Study – clean copy

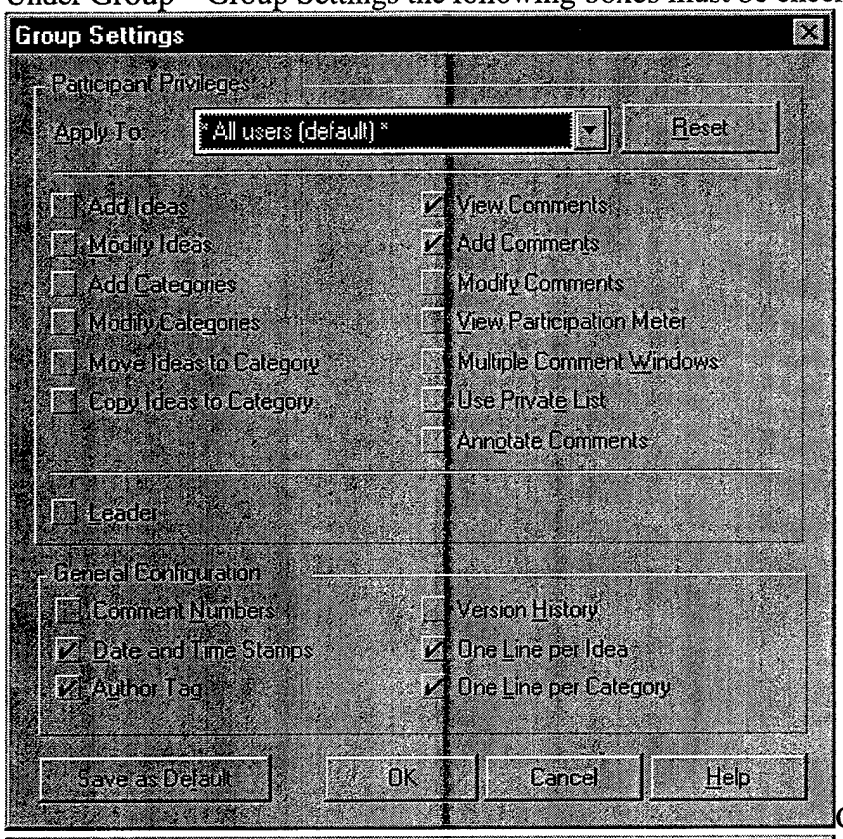
Paste to GSS Study – Current



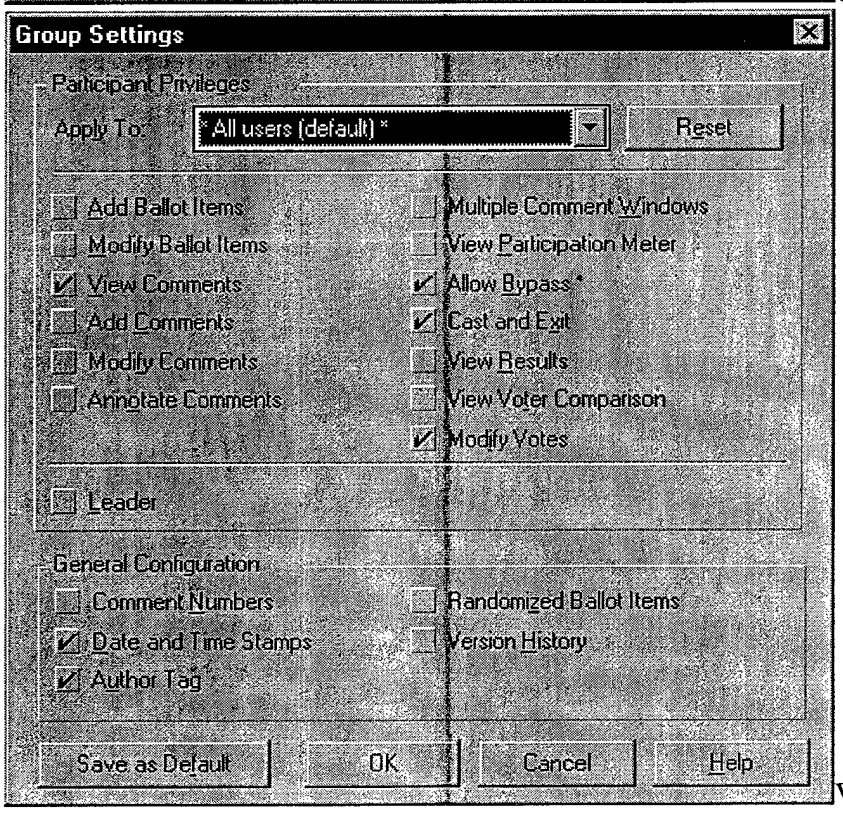
Configure each GSS station for **EACH ACTIVITY on facilitator station**
Under Options - Leader View must be selected



Under Group – Group Settings the following boxes must be checked



Categorizer



Vote

Researchers Label Subjects Monitors with placard **(if applicable)**
Ensure four placards (blue, green, red and yellow) are available

Prep Room: Introduction

When subjects arrive, introduce yourself. Have subjects wait in the prep room. Tell subjects *"The task will begin when all participants have arrived."*

Once all participants have arrived, have all subjects sit down in the prep room.

Facilitator says: *"Welcome to the study. I'm XX and this is XX. We are AFIT students conducting an experiment for our Masters degree. We will be asking you some questions about yourself. Our study looks at how different types of groups interact to solve a problem. During the course of this experiment you will be asked to complete three questionnaires, receive some group interaction training, and conduct tasks individually and as a group. About half way through this two hour experiment you will be given a short break."*

Facilitator says: *"My assistant will now hand out a manila folder with some attached information. Please don't look at the attached information until asked."*

Assistant provides participants with manila folder.

Facilitator says: *"To begin, please remove the consent-form from the manila folder. This form indicates your rights as a participant in the study. Please read the consent form and print and sign your name at the bottom of the page. Your participation is voluntary. If at any time you want to stop please let the facilitator know."*

Subjects read and sign (if applicable) Consent Form

Assistant collects consent forms

Facilitator says, *"This is the only place your name will be recorded during this experiment."*

Assistant puts consent forms in big folder labeled consent forms.

Facilitator says: *"We would now like you to fill out the individual characteristics questionnaire attached to the manila folder. All responses to this questionnaire are completely confidential and will not be associated with you as an individual. Use the rating scale provided to indicate how accurately each statement describes you. Think about yourself as you generally are now and not as you wish to be in the future. Please read each statement carefully. Does anyone have any questions?"*

Subjects complete questionnaire.

Facilitator says: *"Please place the questionnaire in the manila folder."*

Facilitator says: *"Now lets complete a problem solving task individually. Please read the scenario and complete the exercise. It will take you approximately 5 minutes to complete the*

exercise. If you finish early, please remain quiet until everyone completes the exercise. Please remove the scenario from your manila folder."

Facilitator says: *"Please begin."*

Subjects individually complete Moon Scenario

Facilitator says: *"Please place the Moon Scenario in the manila folder."*

Facilitator says: *"Before we move to another room let's discuss group decision making and problem solving in general. The first step is for the group to discuss the problem and all pertinent issues related to the problem. One method often used to do this is "brainstorming" during which ideas are freely generated and not judged on quality or feasibility. Once the brainstorming session is complete, the group then attempts to reach consensus on a solution. This does not necessarily mean all individuals completely agree with the groups' decision, but the decision is one that all can endorse. There are different methods groups use to reach consensus, one of which is voting. If the results of the group vote indicate agreement, then consensus is reached. If the group does not have agreement, further discussion may be required to reach consensus. Remember the purpose of this study is to look at how different types of groups interact to solve a problem. Does anyone have any questions before we move to the next phase of the study."*

Facilitator says: *"Please pick up your manila folder and follow me."*

Assistant moves subjects to Task Room (GSS Room)

GSS Room: Training

Assistant says: *"Please take a seat at one of the computers."*

Subjects sit at one of the GSS stations

Training Script

Facilitator flips **UP** projector

As you introduce options in GSS point to them on the screen.

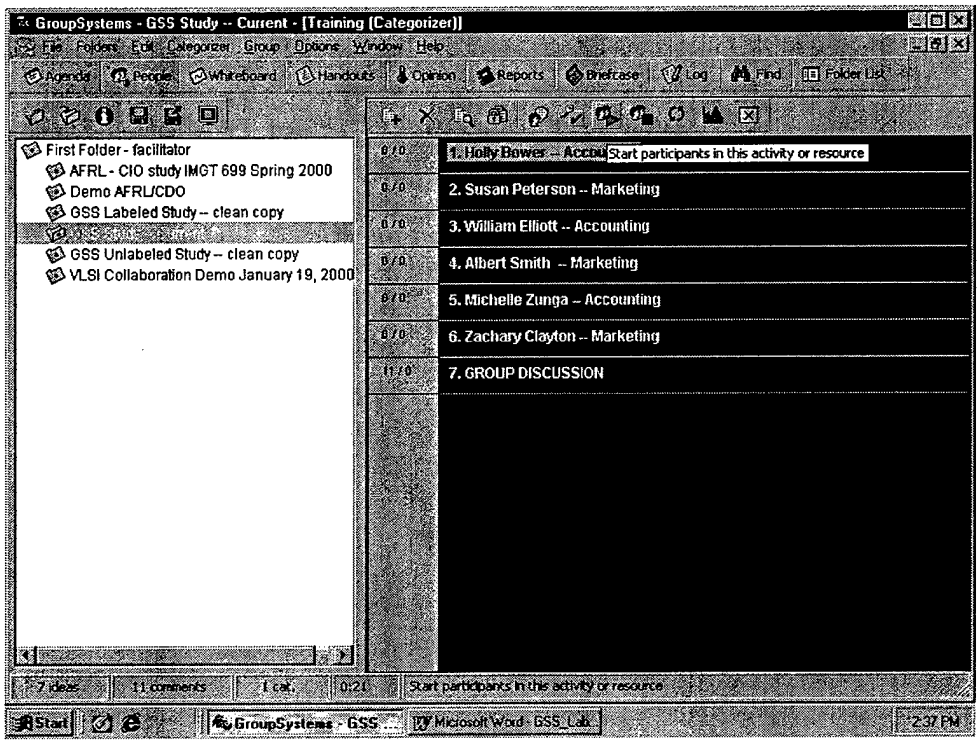
Facilitator says: *"A group support system is made up of software, computers and a facilitator. Each of your computers has* <u>*Group System*</u> software (point to screen) *loaded on it. This software and hardware is often used in the Air Force to increase the effectiveness of decision-making groups."*

Facilitator says: *"We will only be introducing you to a small set of the capabilities of a GSS because of our limited time. As you use this software, please only use the capabilities we introduce to you so we can minimize the impact on your time and ours. For the purposes of this study we will be using two GSS tools: Categorizer and Vote."*

PAUSE

Facilitator says: *"Before we begin the actual group problem-solving scenario, we will first guide you through a brief training session. You will be introduced and allowed to practice with GSS Categorizer and Vote tools. Let's begin."*

Facilitator starts participants in Training (Categorizer)



Facilitator says: *"At this point, you should have been invited to join an activity. Please click on **Yes**."* **(Note to Researcher: In some cases this field will be blank.)**

Facilitator says: *"You may receive another log-in prompt. Please click on **OK**."*

Facilitator says: *"You should now see a list of six names and a category called "Group Discussion". Double Click on **Group Discussion."***

Facilitator says: *"A new window should appear on your screen. This is a discussion area where you will provide comments for the group problem-solving task. At this point your cursor should be in the large field at the bottom of the window. This is the box where you enter your comments. Please type in one method you would use to rank order the list of names."*

PAUSE

Facilitator says: *"Click on the **Submit** key at the bottom of the window on the left. The comment you entered should appear in the notepad above the large field. Everyone in the GSS session will be able to see all comments submitted. Does anyone not see other's comments?"*

For a Labeled Session the facilitator says: *"If you look at the end of each comment you will see that the GSS software labels the person who entered the comment. You should see our choice of labels (blue, green, red or yellow) at the end of each comment."*

Facilitator says: *"As your group brainstorms and you enter your individual comments, all of you will be able to see the inputs of the entire group. Reading others' thoughts and ideas allows you to "piggyback" off each other which should improve your group brainstorming process."*

Facilitator says: *"Now that we've shown you how to enter comments, we will now have you perform a practice session before we move into the problem-solving task. Your group's task is to discuss possible ways your group could rank order the names. Any and all comments are valuable, including ideas on how to rank the names, and your thoughts/opinions of each other's ideas. You will have a couple of minutes to discuss the task as a group. At the end of the session we will measure group consensus on how you ranked the list by introducing you to the GSS Vote tool."*

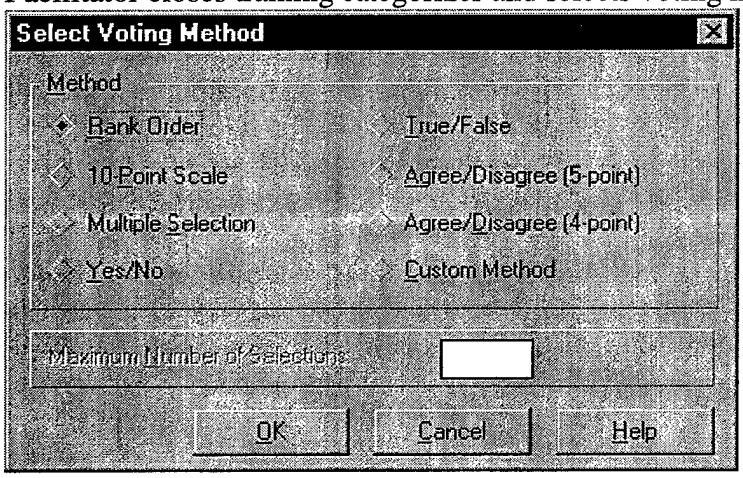
Facilitator says: *"Please begin discussing the task."*

Assistant notifies facilitator when time reaches 5 minutes.

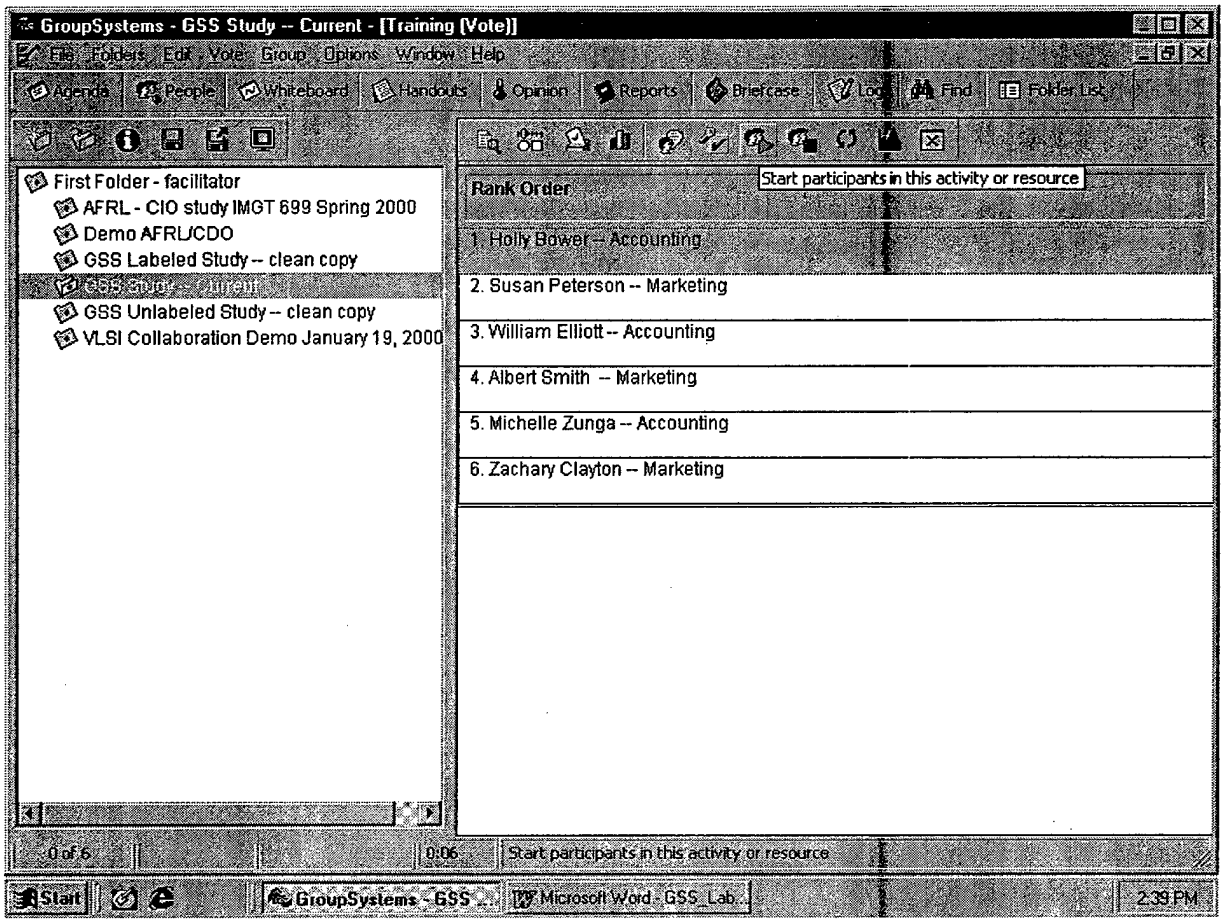
Facilitator says: *"Please stop discussing the task at this time."*

Facilitator says: *"You've had plenty of time to discuss possible ways to rank order the list of names. Now it's time to actually rank the names. Hopefully, during the discussion period, your group decided how to rank the list. We will now introduce you to the GSS Vote tool where each of you will individually rank the list of names. Please close the Group Discussion window."*

Facilitator closes training categorizer and selects voting method for ballot and clicks OK.



Facilitator: Start participants in Training (Vote).

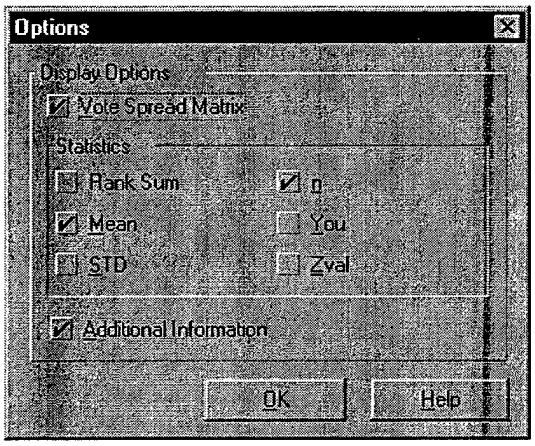


Facilitator says: *"You have been invited to join the Voting activity. Please click yes. Now you should see the original list of names. You change the sequence of the list by clicking and dragging an item to the position in the list you wish to move it. Please begin voting by re-ordering the list now."*

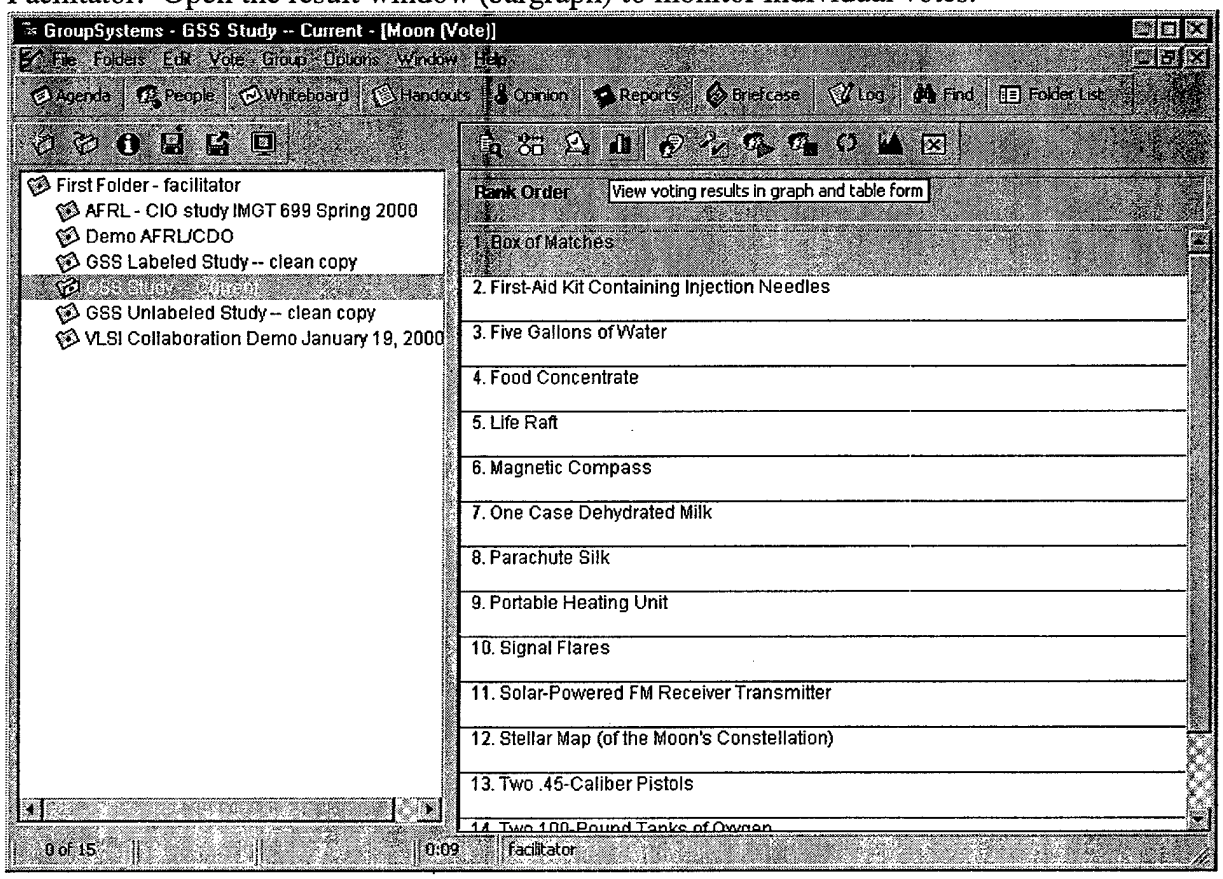
PAUSE

Facilitator says: *"Once you are satisfied with your list order, cast your ballot by clicking on the "cast ballot" icon, which is the 2nd from the left. You will receive a dialogue box asking you to confirm your ballot. Please click yes and wait for further instructions.*

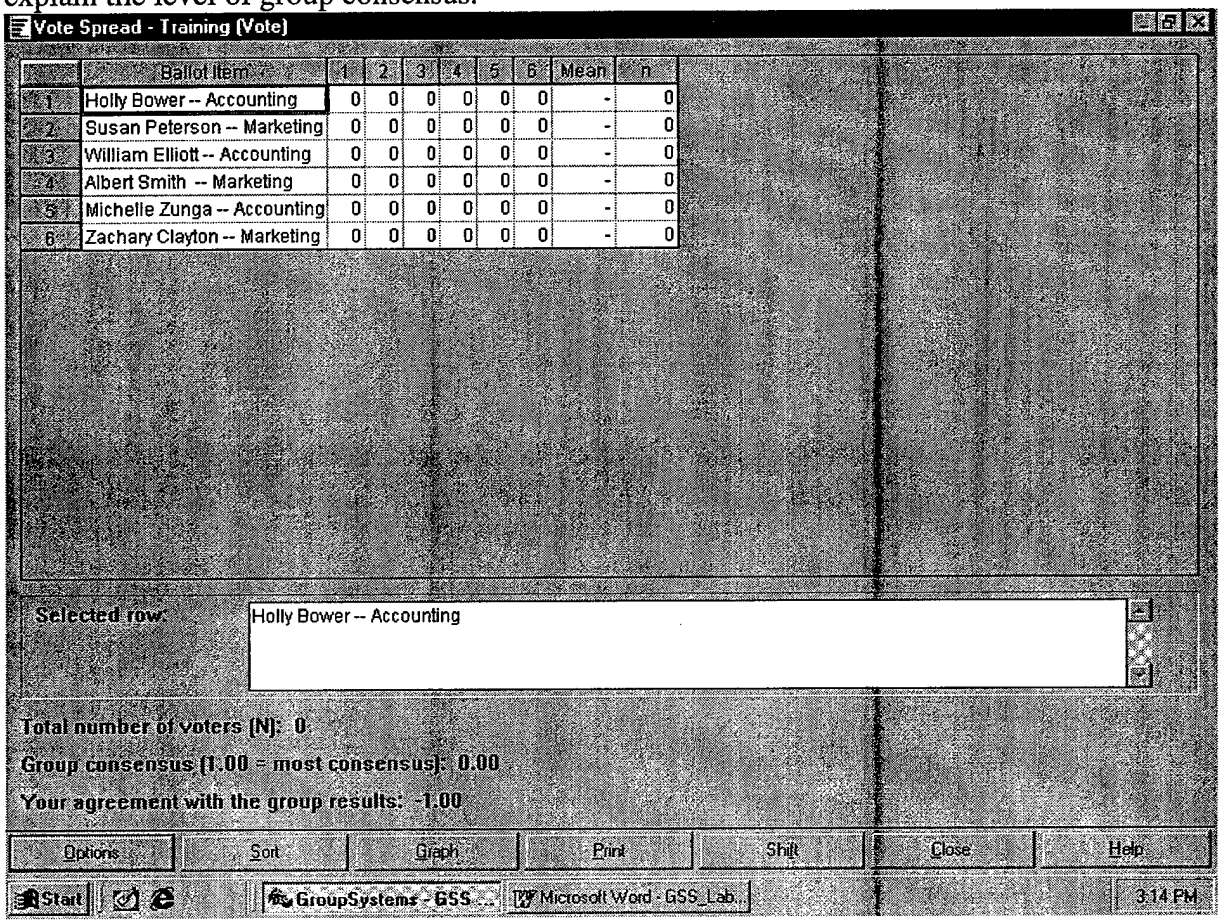
Ensure voting graph tool is set as follows:



Facilitator: Open the result window (bargraph) to monitor individual votes.



When n=number of participants, the group is done. Display the results with the projector and explain the level of group consensus.



Facilitator says: *"During the actual problem-solving tasks following this training, your group will be given 5 minutes after the initial vote to allow your group to determine if everyone is satisfied with the final solution, or if further discussion is needed."*

Training exercise complete.

Facilitator says: *"I will now be closing the training session and beginning the first exercise. Please do not enter any information until instructed."*

Facilitator stops participants in Training (Categorizer).

Facilitator stops participants in Training (Vote).

Facilitator flips **DOWN** projector

GSS Room: Experiment One

Moon Scenario Script

Facilitator says: *"You will have 15 minutes to discuss the scenario as a group. The scenario you will be discussing is the same one you did previously as individuals. At the end of the 15 minutes you will each rank order the list individually. The ranking results will be consolidated as a group to indicate how well the group reached consensus. At this time the group will have another 5 minutes to determine if you have reached consensus. If the group did not reach consensus you should try to resolve any differences. The group will then individually rank the items again."*

Facilitator says: *"During the 15-minute discussion period, focus on discussing each item's merits, not on where each item should be ranked. You will be able to rank order the list at the end of the 15 minutes. It is important to focus on discussion not on how to rank order since this could shut down conversation. It is normal to experience a lull during conversation, but this is part of group dynamics."*

Facilitator says: *"Researchers will not answer questions dealing with the scenario during this session, but will assist with GSS questions. We will let you know when there are 5 and 2 minutes left in the session."*

Facilitators start participants in Moon Scenario -- Categorizer.

Facilitator says: *"At this point, you should have been invited to join an activity. Please click on **Yes**."* **(Note to Researcher: In some cases this field will be blank.)**

Facilitator says: *"Now you should be prompted to enter an author tag. Please click on **OK**."*

Facilitator says: *"You have a list of 15 items and a category called "Group Discussion". Double Click on **Group Discussion.**"*

Facilitator says: *"Are there any questions?"*

Facilitator says: *"You may begin group discussion on the Moon Scenario."*

Time (min/sec)	Facilitator Entry
10:00	FACILITATOR INPUT: YOU HAVE 5 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.
13:00	FACILITATOR INPUT: YOU HAVE 2 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.

Subjects finish initial discussion.
Facilitator says: *"Please close your Group Discussion Window."*

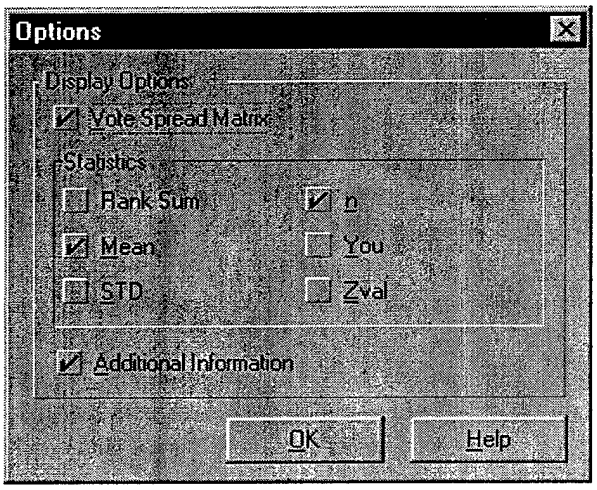
Facilitator says: *"We will now open a voting tool for your use."*
Facilitator starts Moon (Vote).

Facilitator says: *"You have been invited to join the Voting activity. Please click yes. Now you should see the original list of items. Please begin voting by re-ordering the list now just as you did in the training session."*

PAUSE (1 minute)

Facilitator says: *"Once you are satisfied with your list order, cast your ballot by clicking on the "cast ballot" icon, which is the 2nd from the left. You will receive a dialogue box asking you to confirm your ballot. Please click yes and wait for further instructions."*

Ensure voting graph tool is set as follows:



Facilitator: Open the result window to monitor individual votes. When n=number of participants, the group is done. Display the results with the projector and explain the level of group consensus.

Vote Spread - Moon (Vote)

	Ballot Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Mean	n
1	Two 100-Pound Tanks of Oxy	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
2	Five Gallons of Water	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2.00	3
3	Stellar Map (of the Moon's Co	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3.00	3
4	Food Concentrate	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	4.33	3
5	Solar-Powered FM Receiver T	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	4.67	3
6	Parachute Silk	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	6.00	3
7	50 ft. of Nylon Rope	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	7.00	3
8	Life Raft	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	8.00	3
9	First-Aid Kit Containing Inject	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	9.67	3
10	Two .45-Caliber Pistols	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	10.33	3
11	One Case Dehydrated Milk	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	11.00	3
12	Portable Heating Unit	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	11.33	3
13	Signal Flares	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	12.67	3
14	Magnetic Compass	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	14.33	3
15	Box of Matches	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	14.67	3

Selected row: Two 100-Pound Tanks of Oxygen

Total number of voters (N): 3

Group consensus (1.00 = most consensus): 0.98

Your agreement with the group results: -1.00

Options | Sort | Graph | Print | Shift | Close | Help

Start | GroupSystems - GSS | Microsoft Word - GSS_Lab | 3:15 PM

Facilitator says: *"You have the next five minutes to discuss the results further using the GSS. If you are satisfied with the results let the facilitator know. If not you will be given the chance to vote again at the end of the five minutes."*

If group is satisfied with original outcome then go to STEP 2 else do the following:
Facilitator says: *"Go ahead and vote again."*
Facilitator: Open the result window to monitor individual votes. Assistant lets Facilitator know when the group is done. Display the results with the projector and explain the level of group consensus.
Facilitator says: *"These are your final results. "*

Facilitator stops Moon (Vote).

Facilitator flips **DOWN** projector

Facilitator says: *"Feel free to take a quick 5-minute break in the prep room. Please don't discuss what color you are."*

Assistant counts number of comments per subject and creates appropriate feedback and goal charts.

Facilitator stops Subjects in Moon Scenario -- Categorizer

Prep Room: Feedback

Subjects come back from break

Assistant says: *"We would now like to give you a short questionnaire concerning your groups ranking on the task you just completed."*

Assistant provides subjects with 5 item commitment to ranking Questionnaire

Goal and No Feedback or Goal Feedback Script

Assistant says: ***"During the group exercise just completed, your group worked together to solve a problem. Studies have shown that when individual members of the group participate fairly equally, the meeting will produce better results. For example, as you can see in the graph (show graph of equal proportion) the participation rates were almost equal among the group participants. The next graph shows participation rates where participants did not participate equally. What problem can result from the unequal levels of participation?"***

(Wait for group to respond... Look for an answer such as subject 4 did not participate as much and he may have had the best answer while subject 2 dominated the meeting with his ideas. If group does not submit the answer looked for, provide an explanation.

Assistant says: *"Studies have also shown that the more comments input during a meeting, the greater the chances to reach a high quality decision. In other words, the more ideas that are generated the better the chance the optimum solution will be found in those comments."*

Assistant says: **GOAL STATEMENT:** *"In the next task, try to participate equally while maximizing your number of comments."*

IF GIVING FEEDBACK READ THE NEXT SECTION, IF NOT STOP AND PROCEED TO NEXT TASK

Assistant says: *"I will now show each of you a graph showing your participation level in the previous task."*

Assistant provides an explanation of the feedback.

Assistant says: *"Next to the bar graph of each individual show their score. Once all subjects have looked at the paper give them the paper to start the desert scenario."*

Assistant says: *"You will now be given 5 minutes to complete the desert scenario. Please follow the directions on the page."*

Subjects individually complete Desert Scenario

Assistant says: *"We will now move to the Task room to continue the task. Remember the goal to participate equally while maximizing your number of comments. Please take your desert scenario and questionnaire with you and place it in your manila folder."*

Researchers move subjects to Task Room (GSS Room)

GSS Room: Experiment Two

Desert Scenario Script

Facilitator says: *"You will have 15 minutes to discuss the scenario as a group. The scenario you will be discussing is the same one you did previously as individuals. At the end of the 15 minutes you will each rank order the list individually. The ranking results will be consolidated as a group to indicate how well the group reached consensus. At this time the group will have another 5 minutes to determine if you have reached consensus. If the group did not reach consensus you should try to resolve any differences. The group will then individually rank the items again."*

Facilitator says: *"During the 15-minute discussion period, focus on discussing each item's merits, not on where each item should be ranked. You will be able to rank order the list at the end of the 15 minutes. It is important to focus on discussion not on how to rank order since this could shut down conversation. It is normal to experience a lull during conversation, but this is part of group dynamics."*

Facilitator says: *"Researchers will not answer questions dealing with the scenario during this session, but will assist with GSS questions. We will let you know when there are 5 and 2 minutes left in the session."*

Facilitators start participants in Desert (Categorizer).

Facilitator says: *"At this point, you should have been invited to join an activity. Please click on **Yes**."* **(Note to Researcher: In some cases this field will be blank.)**

Facilitator says: *"Now you should be prompted to enter an author tag. Please click on **OK**."*

Facilitator says: *"You have a list of 15 items and a category called "Group Discussion". Double Click on **Group Discussion.**"*

Facilitator says: *"Are there any questions?"*

Facilitator says: *"You may begin group discussion on the Desert Scenario."*

Time (min/sec)	Facilitator Entry
10:00	FACILITATOR INPUT: YOU HAVE 5 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.
13:00	FACILITATOR INPUT: YOU HAVE 2 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.

Subjects finish initial discussion.
Facilitator says: *"Please close your Group Discussion Window."*

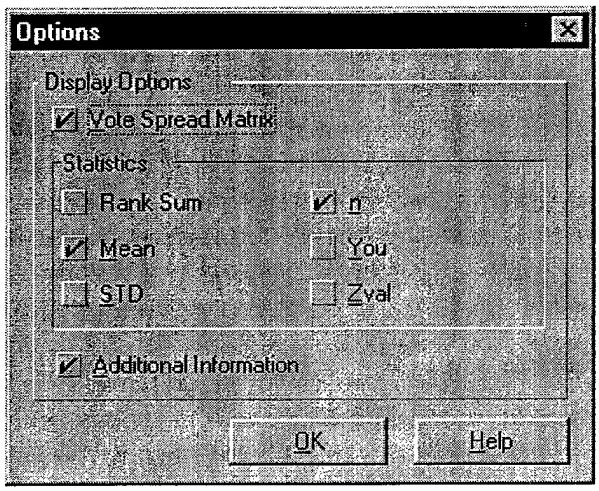
Facilitator says: *"We will now open a voting tool for your use."*
Facilitator starts Desert (Vote).

Facilitator says: *"You have been invited to join the Voting activity. Please click yes. Now you should see the original list of items. Please begin voting by re-ordering the list now."*

PAUSE (1 minute)

Facilitator says: *"Once you are satisfied with your list order, cast your ballot by clicking on the "cast ballot" icon, which is the 2nd from the left. You will receive a dialogue box asking you to confirm your ballot. Please click yes and wait for further instructions."*

Ensure voting graph tool is set as follows:



Facilitator: Open the result window to monitor individual votes. When n=number of participants, the group is done. Display the results with the projector and explain the level of group consensus.
Facilitator flips **UP** projector

Vote Spread - Desert (Vote)

	Ballot Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Mean	n
1	One Liter of Water per Perso	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	3
2	Bottle of Salt Tablets (1000 T	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2.00	3
3	Parachute (Red and White)	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3.33	3
4	Cosmetic Mirror	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	3.67	3
5	Plastic Raincoat (Large Size)	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	5.00	3
6	.45-Caliber Pistol	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	6.33	3
7	Compress Kit and Gauze	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	6.67	3
8	2 Liters of 100% Proof Vodka	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	8.33	3
9	One Top Coat per Person	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	8.67	3
10	Penknife	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	10.33	3
11	Flashlight	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	10.67	3
12	Book Entitled "Edible Animals	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	12.00	3
13	A Pair of Sunglasses per Per	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	13.00	3
14	Magnetic Compass	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	14.00	3
15	Sectional Air Map of the Area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	15.00	3

Selected row: One Liter of Water per Person

Total number of voters [N]: 3

Group consensus [1.00 = most consensus]: 0.99

Your agreement with the group results: -1.00

Options | Sort | Graph | Print | Shift | Close | Help

Start | GroupSystems - GSS ... | Microsoft Word - GSS_Lab... | 3:18 PM

Facilitator says: *"You have the next five minutes to discuss the results further using the GSS. If you are satisfied with the results let the facilitator know. If not you will be given the chance to vote again at the end of the five minutes."*

If group is satisfied with original outcome then go to STEP 2 else do the following:
Facilitator says: *"Go ahead and vote again."*
Facilitator: Open the result window to monitor individual votes. Assistant lets Facilitator know when the group is done. Display the results with the projector and explain the level of group consensus.
Facilitator says: *"These are your final results. "*

Researcher stops Desert (Vote).

Facilitator flips **DOWN** projector

Facilitator says: *"Lets go back to the prep room to finish up."*

Prep Room: Wrap-Up

Assistant provides subjects with Post-Session Questionnaire

Subjects complete Post-Session Questionnaire

Assistant debriefs subjects
"The experiment you just participated in was designed to measure the effect of feedback and goal setting on group performance, compare different levels of anonymity in a meeting on group performance, study ideation over time, and evaluate the influence of personality types on groups."

"The experiment collected data on the quantity of comments provided, the quality of group decision, the timing of ideas generated, and participation rates from various personality groups."

"I would like to thank you for your participation in this experiment. Do you have any other questions about the experiment you participated in today or on Group Support Systems?"

[Pause for questions.]

"Please, if you know others who are likely to participate in this experiment, please keep the details of the experiment to yourself in order to avoid biasing our final results and jeopardizing the continuation of this study."

Researchers collect all handouts, data, disks, etc. and ensures all are labeled

Face-to-Face: Pre-Experiment Steps

1. Ensure following items are available:
   Big folder labeled consent forms
   4 Manila folders
   Attached via paper clip are
   Consent form
   Demographic/Personality Questionnaire
   1 copy of Moon Scenario
   2 Comment Tally Sheets (includes Moon and Desert Scenario)
   4 copies of Training Scenario
   12 Paper copies of both scenarios (Moon and Desert)
   8 Pencils
   Flip Chart or Whiteboard or Chalk Board with appropriate marking device
   Check out Projector, Laptop and Printer with paper
   Room configuration standardized

Prep Room: Introduction

1. When subjects arrive, introduce yourself. Have subjects wait in the prep room. Tell subjects *"The task will begin when all participants have arrived."*

2. Once all participants have arrived, have all subjects sit down in the prep room.

3. Facilitator says: *"Welcome to the study. I'm XX and this is XX. We are AFIT students conducting an experiment for our Masters degree. We will be asking you some questions about yourself. Our study looks at how different types of groups interact to solve a problem. During the course of this experiment you will be asked to complete three questionnaires, receive some group interaction training, and conduct tasks individually and as a group. About half way through this two hour experiment you will be given a short break."*

4. Facilitator says: *"My assistant will now hand out a manila folder with some attached information. Please don't look at the attached information until asked."*

5. Assistant provides participants with manila folder.

6. Facilitator says: *"To begin, please remove the consent-form from the manila folder. This form indicates your rights as a participant in the study. Please read the consent form and print and sign your name at the bottom of the page. Your participation is voluntary. If at any time you want to stop please let the facilitator know."*

7. Subjects read and sign (if applicable) Consent Form

8. Assistant collects consent forms

9. Facilitator says, *"This is the only place your name will be recorded during this experiment."*

10. Assistant puts consent forms in big folder labeled consent forms.

11. Facilitator says: *"We would now like you to fill out the individual characteristics questionnaire attached to the manila folder. All responses to this questionnaire are completely confidential and will not be associated with you as an individual. Use the rating scale provided to indicate how accurately each statement describes you. Think about yourself as you generally are now and not as you wish to be in the future. Please read each statement carefully. Does anyone have any questions?"*

12. Subjects complete questionnaire.

13. Facilitator says: *"Please place the questionnaire in the manila folder."*

14. Facilitator says: *"Now lets complete a problem solving task individually. Please read the scenario and complete the exercise. It will take you approximately 5 minutes to complete the exercise. If you finish early, please remain quiet until everyone completes the exercise. Please remove the scenario from your manila folder."*

15. Facilitator says: *"Please begin."*

16. Subjects individually complete Moon Scenario

17. Facilitator says: *"Please place the Moon Scenario in the manila folder."*

18. Facilitator says: *"Before we move to another room let's discuss group decision making and problem solving in general. The first step is for the group to discuss the problem and all pertinent issues related to the problem. One method often used to do this is "brainstorming" during which ideas are freely generated and not judged on quality or feasibility. Once the brainstorming session is complete, the group then attempts to reach consensus on a solution. This does not necessarily mean all individuals completely agree with the groups' decision, but the decision is one that all can endorse. There are different methods groups use to reach consensus, one of which is voting. If the results of the group vote indicate agreement, then consensus is reached. If the group does not have agreement, further discussion may be required to reach consensus. Remember the purpose of this study is to look at how different types of groups interact to solve a problem. Does anyone have any questions before we move to the next phase of the study."*

19. Facilitator says: *"Please pick up your manila folder and follow me."*

Assistant moves subjects to Task Room (Face-to-Face Room)

Face-to-Face Room: Training

Training Script

Facilitator says: *"Before we begin the actual group problem-solving scenario, we will first guide you through a brief training session. Let's begin."*

Assistants hand out training scenario.

Facilitator says: *"Your group's task is to come to consensus on how to rank order the list of names. Your goal is to discuss possible ways your group could rank order the names. Any and all comments are valuable, including ideas on how to rank the names, and your thoughts/opinions of each other's ideas. It will take about 5 minutes to discuss the task. At the end of the session you will each individually rank order the list based on the groups chosen method. Individual results will be combined to determine group consensus. Any questions?"*

Facilitator says: *"Don't worry if you see the facilitators taking notes during the study we are writing notes to on how your group interacts. Please begin discussing the task."*

Assistant: Time hack for 5 minutes.

Assistant notifies facilitator when time reaches 5 minutes.

Facilitator says: *"Please stop discussing the task at this time."*

Facilitator says: *"You've had enough time to discuss possible ways to rank order the list of names. Now it's time to actually rank the names. Hopefully, during the discussion period, your group was able to come to consensus on how to rank the list."*

Facilitator says: *"Go ahead and rank the list of names individually using the method chosen by the group. When done hand your list to the facilitator."*

Assistant collects training scenarios.

Facilitator reviews list with group discussing group consensus.

Facilitator says: *"During the actual problem-solving tasks following this training, your group will be given 5 minutes after the initial vote to allow your group to determine if everyone is satisfied with the final solution, or if further discussion is needed."*

Training exercise complete.

Facilitator says: *"We will now start the first exercise. Please do not discuss the scenario until instructed."*

Face-to-Face Room: Experiment One

Moon Scenario Script

Facilitator says: *"You will have 15 minutes to discuss the scenario as a group. The scenario you will be discussing is the same one you did previously as individuals. At the end of the 15 minutes you will each rank order the list individually. The ranking results will be consolidated as a group to indicate how well the group reached consensus. At this time the group will have another 5 minutes to determine if they have reached consensus. If your group does not reach consensus, you should try to resolve any differences. The group will then individually rank the items again."*

Facilitator says: *"During the 15-minute discussion period, focus on discussing each item's merits, not on where each item should be ranked. You will be able to rank order the list at the end of the 15 minutes. It is important to focus on discussion not on how to rank order since this could shut down conversation. It is normal to experience a lull during conversation, but this is part of group dynamics."*

Facilitator says: *"Researchers will not answer questions dealing with the scenario during this session. We will let you know when there are 5 and 2 minutes left in the session."*

Facilitator says: *"Are there any questions?"*

Facilitator says: *"You may begin Group Discussion on the Moon Scenario."*

Facilitator and Assistant keep track of comments on comment tally sheet.

Time (min/sec)	Facilitator Entry
10:00	YOU HAVE 5 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.
13:00	YOU HAVE 2 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.

Subjects finish initial discussion.

Facilitator says: "Now lets vote."

Assistant hands out another copy of Moon Scenario.

Facilitator says: *"Please fill the scenario out individually. When finished give your copy to the facilitator."*

Subjects individually rank Moon Scenario items and give to assistant.

When the group is done:

Assistant calculates means on laptop in Excel, sorts the list by mean, and projects the mean and each subject's rankings on the wall.
Facilitator explains the level of group consensus.

Facilitator says: *"You have the next five minutes to discuss the results further. If you are satisfied with the results let the facilitator know. If not you will be given the chance to vote again at the end of the five minutes."*
If group is satisfied with original outcome then go to STEP 2 else do following:
Assistant hands out another copy of Moon Scenario.
Facilitator says: *"Go ahead and vote again."*
When the group is done:
Assistant calculates means on laptop in Excel, sorts the list by mean, and projects the mean and each subject's rankings on the wall.
Facilitator explains the level of group consensus.
Facilitator says: *"These are your final results. "*

Facilitator says: *"Feel free to take a quick 5-minute break in the prep room."*

Assistant counts number of comments per subject comment tally sheet and create appropriate feedback and goal charts.

Assistant prints the spreadsheet.

Prep Room: Feedback

Subjects come back from break

Assistant says: *"We would now like to give you a short questionnaire concerning your groups ranking on the task you just completed."*

Assistant provides subjects with 5 item commitment to ranking Questionnaire

Goal and No Feedback or Goal Feedback Script

Assistant says: ***"During the group exercise just completed, your group worked together to solve a problem. Studies have shown that when individual members of the group participate fairly equally, the meeting will produce better results. For example, as you can see in the graph (show graph of equal proportion) the participation rates were almost equal among the group participants. The next graph shows participation rates where participants did not participate equally. What problem can result from the unequal levels of participation?"***

(Wait for group to respond... Look for an answer such as subject 4 did not participate as much and he may have had the best answer while subject 2 dominated the meeting with his ideas. If group does not submit the answer looked for, provide an explanation.

Assistant says: *"Studies have also shown that the more comments input during a meeting, the greater the chances to reach a high quality decision. In other words, the more ideas that are generated the better the chance the optimum solution will be found in those comments."*

Assistant says: **GOAL STATEMENT:** *"In the next task, try to participate equally while maximizing your number of comments."*

IF GIVING FEEDBACK READ THE NEXT SECTION, IF NOT STOP AND PROCEED TO NEXT TASK

Assistant says: *"I will now show each of you a graph showing your participation level in the previous task."*

Assistant provides an explanation of the feedback.

Assistant says: *"Next to the bar graph of each individual show their score. Once all subjects have looked at the paper give them the paper to start the desert scenario."*

Assistant says: *"You will now be given 5 minutes to complete the desert scenario. Please follow the directions on the page."*

Subjects individually complete Desert Scenario

Assistant says: *"We will now move to the Task room to continue the task. Remember the goal to participate equally while maximizing your number of comments. Please take your desert scenario and questionnaire with you and place it in your manila folder."*

15. Researchers move subjects to Task Room (Non-GSS Room)

Face-to-Face Room: Experiment Two

Desert Scenario Script

Facilitator says: *"You will have 15 minutes to discuss the scenario as a group. The scenario you will be discussing is the same one you did previously as individuals. At the end of the 15 minutes you will each rank order the list individually. The ranking results will be consolidated as a group to indicate how well the group reached consensus. At this time the group will have another 5 minutes to determine if they have reached consensus. If your group does not reach consensus, you should try to resolve any differences. The group will then individually rank the items again."*

Facilitator says: *"During the 15-minute discussion period, focus on discussing each item's merits, not on where each item should be ranked. You will be able to rank order the list at the end of the 15 minutes. It is important to focus on discussion not on how to rank order since this could shut down conversation. It is normal to experience a lull during conversation, but this is part of group dynamics."*

Facilitator says: *"Researchers will not answer questions dealing with the scenario during this session. We will let you know when there are 5 and 2 minutes left in the session."*

Facilitator says: *"Are there any questions?"*

Facilitator says: *"You may begin Group Discussion."*

Facilitator and Assistant keep track of comments on comment tally sheet.

Time (min/sec)	Facilitator Entry
10:00	YOU HAVE 5 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.
13:00	YOU HAVE 2 MINUTES LEFT TO DISCUSS THE SCENARIO IF NEEDED.

Subjects finish initial discussion.

Facilitator says: "Now lets vote."

Assistant hands out another copy of Desert Scenario.

Facilitator says: *"Please fill the scenario out individually. When finished give your copy to the facilitator."*

Subjects individually rank Desert Scenario items and give to assistant.

When the group is done:
Assistant calculates means on laptop in Excel, sorts the list by mean, and projects the mean and each subject's rankings on the wall.
Facilitator explains the level of group consensus.

Facilitator says: *"You have the next five minutes to discuss the results further. If you are satisfied with the results let the facilitator know. If not you will be given the chance to vote again at the end of the five minutes."*

If group is satisfied with original outcome then go to STEP 2 else do following:
Assistant hands out another copy of Desert Scenario.
Facilitator says: *"Go ahead and vote again."*
When the group is done:
Assistant calculates means on laptop in Excel, sorts the list by mean, and projects the mean and each subject's rankings on the wall.
Facilitator explains the level of group consensus.
Facilitator says: *"These are your final results. "*

Assistant counts number of comments per subject comment tally sheet.

Prep Room: Wrap-Up

Assistant provides subjects with Post-Session Questionnaire

Subjects complete Post-Session Questionnaire

Assistant debriefs subjects
"The experiment you just participated in was designed to measure the effect of feedback and goal setting on group performance, compare different levels of anonymity in a meeting on group performance, study ideation over time, and evaluate the influence of personality types on groups."

"The experiment collected data on the quantity of comments provided, the quality of group decision, the timing of ideas generated, and participation rates from various personality groups."

"I would like to thank you for your participation in this experiment. Do you have any other questions about the experiment you participated in today or on Group Support Systems?"

[Pause for questions.]

"Please, if you know others who are likely to participate in this experiment, please keep the details of the experiment to yourself in order to avoid biasing our final results and jeopardizing the continuation of this study."

Researchers collect all handouts, data, etc. and ensures all are labeled

Appendix F: Consent Form

Study Overview

Welcome to the experiment. The following is a general description of the study and a reminder of your rights as a potential subject. As in any study, your participation is completely voluntary. If now, or at any point during the study, you decide that you do not want to continue participating, please let the experimenter know and you will be dismissed without penalty. Also, please remember that your name will not be associated with any of the information that you provide during the study. All of the information you provide is absolutely anonymous and confidential.

In this study, you will be working as part of a group to complete two group tasks. You will also be asked to complete two questionnaires during the study. You will first be given a questionnaire to complete, then you will complete the first task as a group, after a short break you will be given the second task to complete as a group, and finally, you will be given a second questionnaire to complete. The experimenter will give you more specific instructions later in the study. If you have any questions or concerns at this time, please inform the experimenter.

For further information

The Air Force Institute of Technology faculty members responsible for conducting this research are Maj. Michael Morris and Maj. Paul Thurston. They would be happy to address any of your questions or concerns regarding this study. Maj. Morris can be reached at 255-3636 ext 4578 and Maj. Thurston can be reached at 255-6565 ext 4315.

If you would like to participate in this study, please sign in the space provided. Your signature indicates that you are aware of each of the following: 1) the general procedure to be used in this study, 2) your right to discontinue participation at any time, and 3) you and your name will not be associated with any of the information you provide.

Printed Name: _____

Signature:_____ Date:_____

Answer the questions using the following scale.

1. Very Inaccurate
2. Moderately Inaccurate
3. Neither Accurate Nor Inaccurate
4. Moderately Accurate
5. Very Accurate

____1. I trust others.

____2. I complete tasks successfully.

____3. I would never cheat on my taxes.

____4. I like order.

____5. I am easy to satisfy.

____6. I avoid mistakes.

____7. I believe that people are essentially evil.

____8. I don't see the consequences of things.

____9. I obstruct others' plans.

____10. I am not bothered by disorder.

____11. I hold a grudge.

____12. I often make last-minute plans.

____13. I believe that others have good intentions.

____14. I excel in what I do.

____15. I stick to the rules.

____16. I like to tidy up.

____17. I can't stand confrontations.

____18. I choose my words with care.

1. Very Inaccurate
2. Moderately Inaccurate
3. Neither Accurate Nor Inaccurate
4. Moderately Accurate
5. Very Accurate

____19. I am aware of others.

____20. I have little to contribute.

____21. I take advantage of others.

____22. I am not bothered by messy people.

____23. I get back at others.

____24. I act without thinking.

____25. I trust what people say.

____26. I handle tasks smoothly.

____27. I use flattery to get ahead.

____28. I want everything to be "just right".

____29. I hate to seem pushy.

____30. I stick to my chosen path.

____31. I suspect hidden motives in others.

____32. I don't understand things.

____33. I pretend to be concerned for others.

____34. I leave my belongings around.

____35. I insult people.

____36. I do crazy things.

____37. I believe that people are basically moral.

____38. I am sure of my ground.

1. Very Inaccurate
2. Moderately Inaccurate
3. Neither Accurate Nor Inaccurate
4. Moderately Accurate
5. Very Accurate

____39. I use others for my own ends.

____40. I love order and regularity.

____41. I have a sharp tongue.

____42. I jump into things without thinking.

____43. I distrust people.

____44. I misjudge situations.

____45. I put people under pressure.

____46. I do things according to a plan.

____47. I yell at people.

____48. I rush into things.

____49. I believe in human goodness.

____50. I come up with good solutions.

____51. I know how to get around the rules.

____52. I leave a mess in my room.

____53. I contradict others.

____54. I make rash decisions.

____55. I think that all will be well.

____56. I know how to get things done.

____57. I cheat to get ahead.

____58. I often forget to put things back in their proper place.

____59. I love a good fight.

____60. I like to act on a whim.

___ Male ___ Female ___ Married ___ Single Age:_____

Highest Education Level Completed (please choose one):
___ High School ___ Bachelor's Degree ___ Graduate Degree
___ Some College ___ Some Graduate Studies ___ Post Graduate Degree

For Bachelor's, Graduate, and Post Graduate Degree recipients, please enter the type of degree conferred (e.g., BS Computer Science, MBA, BA MIS, etc.):
Bachelor's:_____
Graduate:_____
Post Graduate:_____

If active duty military, enter the number of years you've spent on active duty:_____

If civilian with prior military service, enter the number of years spent on active duty:_____, **and** the number of years of paid employment not including prior military service:_____

If civilian with no prior military service, enter the number of years of paid employment:_____

Current occupational specialty or occupation:_____
(e.g., Communications & Information, Logistics, Management, Teacher, etc.)

Number of years supervisory experience:_____

Approximately how many years have you used a computer?
___ Less than 1 ___ 1-5 ___ 6-10 ___ 10 or more

Approximately how many hours per week do you currently use a computer (work and home)?

___ 0-10 ___ 11-20 ___ 21-30 ___ 31 or more

Answer the remaining questions using the following scale.
1 – Very Inaccurate
2 – Moderately Inaccurate
3 – Neither Accurate Nor Inaccurate
4 – Moderately Accurate
5 – Very Accurate

___ I feel comfortable using e-mail
___ I feel comfortable programming a computer
___ I feel comfortable using MS Word and other desktop software tools
___ I am a proficient typist
___ I feel comfortable navigating around the Internet
___ I am knowledgeable about computer networks
___ I am comfortable learning how to use new computer software
___ Overall, I am proficient at using personal computers (PCs)

Appendix H: Moon Scenario

You are a member of a space crew originally scheduled to rendezvous with a mother ship on the lighted surface of the moon. Due to mechanical difficulties, however, your ship was forced to land at a spot some 200 miles from the rendezvous point. During re-entry and landing, much of the equipment aboard was damaged and, since survival depends on reaching the mother ship, the most critical items available must be chosen for the 200-mile trip.

The 15 items left intact and undamaged after landing are listed below. Your task is to rank them in terms of their necessity to your crew in reaching the rendezvous point. Place the number 1 by the most crucial item, the number 2 by the second most crucial, and so on through number 15, the least important.

____ Box of matches
____ First-aid kit containing injection needles
____ Five gallons water
____ Food concentrate
____ Life raft
____ Magnetic compass
____ One case dehydrated milk
____ Parachute silk
____ Portable heating unit
____ Signal flares
____ Solar-powered FM receiver transmitter
____ Stellar map (of the moon's constellation)
____ Two .45-caliber pistols
____ Two 100-pound tanks of oxygen
____ 50 ft. of nylon rope

Appendix I: Commitment to Group Ranking Questionnaire

Answer the questions using the following scale

1. Strongly Disagree
2. Disagree
3. Disagree Somewhat
4. Neither Agree Nor Disagree
5. Agree Somewhat
6. Agree
7. Strongly Agree

_____ I believe my group's solution is better than the ranking I developed myself.

_____ I would be willing to make other decisions based on my group's ranking because it is so accurate.

_____ I would be willing to argue my group's solution to another group.

_____ I understand the reasons why we ranked items in their particular order.

_____ I agree with the reasons why we ranked items in their particular order.

Appendix J: Desert Scenario

It is approximately 10:00 AM in mid August and you have just crash-landed in the Sonora Desert in southwestern United States. The twin engine plane, containing the bodies of the pilot and the co-pilot, has completely burned. Only the airframe remains. None of the rest of you have been injured. The pilot was unable to notify anyone of your position before the crash. However, he had indicated before impact that you were 70 miles south - southwest from a mining camp which is the nearest known habitation and that you were approximately 65 miles off the course that was filed in your Flight Plan.

Before the plane caught fire your Patrol was able to salvage the 15 items listed on the attached sheet. Your task is to rank these items according to their importance to your survival. Place the number 1 by the most crucial item, the number 2 by the second most crucial, and so on through number 15, the least important.

____ A pair of sunglasses per person
____ Book entitled "Edible Animals of the Desert"
____ Bottle of salt tablets (1000 tablets)
_____ Compress kit and gauze
____ Cosmetic Mirror
____ Flashlight
____ Magnetic compass
____ One liter of water per person
____ One top coat per person
_____ Parachute (red and white)
____ Penknife
____ Plastic Raincoat (large size)
____ Sectional Air Map of the Area
____ 2 liters of 100% proof vodka
____ .45 caliber pistol

Appendix K: Box and Whiskers Defined

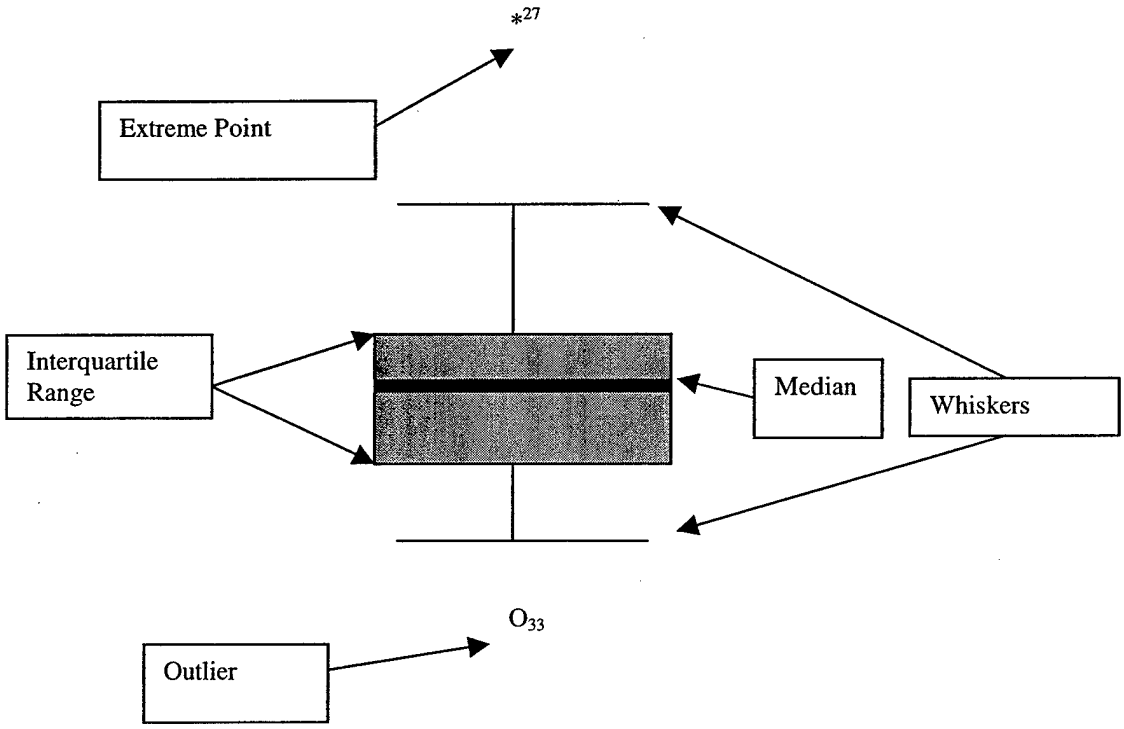
Box plots

Summary plot based on the median, quartiles, and extreme values. The box represents the interquartile range, which contains the 50% of values. The whiskers are lines that extend from the box to the highest and lowest values, excluding outliers and extreme points. A line across the box indicates the median. (SPSS 10.0.7 documentation, 2000)

Outliers – Cases where a value is between 1.5 and 3 box lengths from the upper or lower edge of the box. These points are signified on the boxplot with an "O" and the session number.

Extreme Points -- Cases where a value is greater than 3 box lengths from the upper or lower edge of the box. These points are signified on the boxplot with an "*" and the session number.

NOTE: Both Outliers and Extreme point values are used in calculating the mean.



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Vita

Captain Robert A. Sylvester was born on [redacted] in Lowell, Massachusetts. He graduated from Wentzville High School in Wentzville, Missouri in 1983. He enlisted in the Air Force in 1986. His first assignment was at the 2148th Communications Squadron, Ellsworth Air Force Base, South Dakota in December 1986, where he served as a communications operator. While assigned to the 2148th CS, he was selected as the Ellsworth Air Force Base Airman of the Year. In 1990, he was reassigned to 1500 Computer Systems Group where he served as the lead programmer for Ada- Commercial Operations Integrated Systems (COINS). He completed his undergraduate studies at McKendree University in Lebanon, Illinois in 1993. He was commissioned through the Officer Training School (OTS), Maxwell Air Force Base, Alabama, on 22 June 1994.

Captain Sylvester's first assignment after his commissioning was to the Air Force Global Weather Center (AFGWC), Offutt Air Force Base, Nebraska in July 1994, where he served as the Metrics Officer and the Lead Programmer of the Scientific Transition Branch. In July 1997, he was reassigned to the Air Force Operational Test and Evaluation Center (AFOTEC), Operating Location VC, Vandenberg Air Force Base, California where he served as the Deputy Test Director for the Evolved Expendable Launch Vehicle (EELV). In July 1999, he entered the Graduate Information Resource Management program, School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be assigned to Air Force Communications Agency, Scott Air Force Base, Illinois.

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14. ABSTRACT

A group support system (GSS) uses a combination of networked personal computers, software that collects, manipulates, and aggregates member's individual input, and human facilitation to improve the group decision-making process. Prior GSS research has found that content and process anonymity influence problem solving groups. However, previous studies report mixed results on which levels of anonymity positively influence group performance.
This thesis looked at content and process anonymity using four treatments to explore possible explanations for the mixed results found in previous GSS research. The study examined numerous theories including anonymity, identification, social loafing, and social comparison. An experiment was developed to assess how content and process anonymity influence participation rates, quality of the group decision, consensus levels, user attitudes, and user satisfaction with the group outcome. Groups participated in conditions of total anonymity, process anonymity, and no anonymity. The no anonymity condition included face-to-face discussion and use of a GSS in which comments were labeled and stations were labeled with placards. The results of the study were underwhelming. In general, it was found that face-to-face groups participated at higher levels, achieved a higher group decision quality, reached higher consensus and were more satisfied with the group outcome. These findings cannot be attributed to the lack of process and content anonymity however, because the GSS labeled with placard treatment did not achieve the same results.

15. SUBJECT TERMS

Group Support System (GSS), Anonymity, Content Anonymity, Process Anonymity, Problem-Solving Group, Social Loafing, Social Comparison, User Participation, Decision Quality, Consensus, User Attitudes, User Satisfaction

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