STEPHEN A. RAINS[1]

Leveling the Organizational Playing Field—Virtually

A Meta-Analysis of Experimental Research Assessing the Impact of Group Support System Use on Member Influence Behaviors

One of the most heralded features of group support systems (GSSs) is their ability to democratize group processes. Through minimizing barriers to communication, GSSs are proposed to create greater opportunities for member influence than those created in groups meeting face-to-face. To test this notion, a meta-analysis was conducted examining the aggregate impact of GSS use on six influence variables across 48 experiments. Results indicate that groups using a GSS experience greater participation and influence equality, generate a larger amount of unique ideas, and experience less member dominance than do groups meeting face-to-face. The impact of GSS use on decision shifts is moderated by the national culture of participants. The implications of these findings for research on GSS use are examined, and directions for future research are offered.

Keywords: *computer-mediated communication; group support system; equalization hypothesis; teams; influence*

Since their introduction in the 1980s, group support systems (GSSs) and group decision support systems (GDSSs) have received considerable attention from practitioners and scholars alike.[2] As a "key resource" in more than 1,500 organizations, GSSs have been used by millions of organizational members (Briggs, Nunamaker, & Sprague, 1998, p. 8). Predictions of the amount of money spent by the end of 1998 for computer-based technologies to support group work ranged between 5.5 to 10 billion dollars (Scott, 1999a). The use of

COMMUNICATION RESEARCH, Vol. 32 No. 2, April 2005 193-234
DOI: 10.1177/0093650204273763
© 2005 Sage Publications

GSSs in organizations has been matched by scholarship on the topic. At least five meta-analyses assessing the effects of GSSs have been conducted involving a total of almost 175 experiments (Benbasat & Lim, 1993; Dennis & Wixom, 2002; Dennis, Wixom, & Vandenberg, 2001; McLeod, 1992; Postmes & Lea, 2000). Further, Fjermestad and Hiltz (1998) examine more than 200 studies in their comprehensive review of research on the topic.

One of the most heralded features noted throughout scholarship on GSSs is their potential to level the organizational playing field and to produce more democratic group processes. DeSanctis and Gallupe (1987) assert that "to the extent that GDSS [GSS] technology encourages equality of participation and discourages dominance by an individual member or subgroup, perceived member power and influence should become more distributed and decision quality should improve" (p. 605). This effect, which has been termed the equalization hypothesis (Dubrovsky, Kiesler, & Sethna, 1991; Hollingshead, 1996; Siegel, Dubrovsky, Kiesler, & McGuire, 1986), is rooted in the general notion that GSS use fosters greater member equality than that which is achieved in teams meeting face-to-face. GSSs minimize barriers to interaction and make it possible for all members to potentially influence group processes.

Given the prominent effects GSSs are proposed to have and the considerable amount of GSS use by organizational members, it is somewhat surprising that no attempt has been made to summarize this body of research empirically. Thus, the purpose of this study is to examine the aggregate impact of GSS use on member influence behaviors and ultimately, to determine whether or not GSS use fosters more democratic group processes than in teams meeting face-to-face. To this end, a meta-analysis was conducted focusing on six variables associated with member influence: participation equality, influence equality, dominance, number of unique ideas generated, normative influence, and decision shifts.

A meta-analysis of this body of research makes it possible to achieve three important goals. First, for outcomes in which research has been fairly consistent, such as participation equality, production of unique ideas, and dominance, it will be possible to draw general conclusions about the impact of GSS use on these factors. Second, for those outcomes in which research has been inconsistent, such as influence equality, normative influence, and decision shifts, it may be possible to identify moderating factors and to reconcile mixed findings. Finally, a meta-analysis of research on influence behaviors in GSSs provides a more definitive test of the equalization hypothesis than could be achieved in any single study.

To begin, an explanation of the impact of GSS use on member behavior is given, and research on the six influence variables is reviewed to develop

hypotheses and research questions. Next, the procedure used in the meta-analysis is explained, and the results are described. The implications of the findings from this study are then discussed, and directions for future research are suggested.

Review of Literature: GSS Use and Member Influence Behaviors

Explaining the Impact of GSS Use

The proposed impact of GSSs use on group member influence behaviors is relatively straightforward. The equalization hypothesis states that, in essence, GSS use minimizes inequalities between group members and leads to more equal levels of influence than those that occur in face-to-face teams (Dubrovsky et al., 1991; Kiesler, Siegel, & McGuire, 1984; Siegel et al., 1986; Sproull & Kiesler, 1986, 1991; Tan, Wei, Watson, Clapper, & McLean, 1998). For those lower in the organization's hierarchy, GSSs are particularly beneficial. GSS use is proposed to create a communication environment where low-status members have a greater opportunity to influence others than they do in face-to-face meetings.

Two primary explanations have been posited for the effects of GSS use. First, cues typically available in face-to-face interactions are dampened by GSSs (Dennis, Hilmer, & Taylor, 1998; Hollingshead, 1996; Nunamaker, Applegate, & Konsynski, 1988; Sproull & Kiesler, 1991). As a result, organizational members are less aware of status differences and feel less inhibited about contributing information and sharing ideas. Second, the opportunity for simultaneous input, or parallelism, makes it easier for all members to contribute (Dennis et al., 1998; Kelsey, 2000; Tan et al., 1998; Tan, Wei, & Watson, 1999). No single individual can dominate the virtual floor at one time.

Research on Influence in GSSs

Influence is broadly defined in this study as any "attempt to move, affect, or determine a course of action" in a group or team (Zigurs, Poole, & DeSanctis, 1988, p. 628). In the context of GSS use, six factors that assess member influence have been consistently examined: participation equality, influence equality, dominance, number of unique ideas generated, normative influence, and decision shifts. Each of these factors is an indicator of the equality of or the opportunity for member influence. Research on the six variables will be reviewed in the following sections to develop hypotheses and research questions.

Participation equality. Participation equality is one of the most widely examined variables in GSS research (Fulk & Collins-Jarvis, 2001; McLeod & Liker, 1992). In accordance with the equalization hypothesis, GSSs are proposed to reduce status cues and enable members to feel less inhibited about contributing to discussions (Dubrovsky et al., 1991; Hollingshead, 1996). As a result, levels of member participation become more equal than those that exist in teams meeting face-to-face.

The equalizing effects of GSS use have been demonstrated in previous research. To date, six studies in which objective raters were used to analyze meetings have reported significantly greater participation equality in GSS conditions in comparison with face-to-face groups (Easton, Vogel, & Nunamaker, 1992; George, Easton, Nunamaker, & Northcraft, 1990; Reinig & Mejias, 2003; Siegel et al., 1986; Weisband, 1992; Wood & Nosek, 1994). Using self-report measures, Lewis (1987) and Valacich, Sarker, Pratt, and Groomer (2002) also reported greater equality in GSS teams. These findings are tempered by research in which no differences were found in perceptions of participation equality (Jarvenpaa, Rao, & Huber, 1988; Mejias, Shepherd, Vogel, & Lazaneo, 1997; Smith & Vanecek, 1989) or in raters' observations of equality (Dubrovsky et al., 1991; Jarvenpaa et al., 1988). Nonetheless, the findings across this body of scholarship generally support the notion that GSS use allows more equal participation than that which occurs in face-to-face meetings.[3]

Influence equality. GSSs are also proposed to create greater equality in member influence (Tan et al., 1998; Watson, DeSanctis, & Poole, 1988). As Watson, DeSanctis, and Poole (1988) note, GSSs "provide a framework within which group members who are reluctant to contribute are encouraged to participate and potentially influence the group discussion" (p. 467). Through allowing for simultaneous contributions and dampening social cues, GSSs create an environment where all team members have the opportunity to influence a group's interactions and decisions.

To date, the results of research on influence equality have been inconsistent. Three studies using self-report measures (Scott & Easton, 1996;[4] Tan et al., 1998; Tan et al., 1999) and one study relying on rater observations (Huang & Wei, 2000) support the notion that GSS use leads to greater influence equality. Yet, a number of studies failed to detect differences between GSS and face-to-face groups (Ho & Raman, 1991; Lim, Raman, & Wei, 1994; Tan, Raman, & Wei, 1994; Tan, Wei, & Raman, 1991; Watson et al., 1988; Weisband, Schneider, & Connoly, 1995; Zigurs et al., 1988). One explanation for these inconsistent findings involves the nature of the task completed by

participants. This possibility will be further examined in the section addressing potential moderating variables.

Dominance. Definitions of dominance in GSS research range from "the degree that group members are active, talkative, and forceful in their style" (McLeod & Liker, 1992, p. 208) to "aris[ing] when higher-status individuals unproductively monopolize group communication time" (Tan et al., 1998, p. 121) to "efforts to control, command, and persuade others" (Walther, 1995, p. 192). At the foundation of these definitions is the notion that dominance occurs when an individual group member attempts to control the group's task or discussion. Similar to previous arguments about participation and influence equality, GSSs are proposed to reduce the dominance of a single group member and, as a result, to create greater equality among all team members. GSSs offer fewer cues for a member to convey his or her dominance and increase the ability of group members to actively resist a dominant individual.

In research to date, four studies have reported a significantly greater amount of dominance reduction in GSS groups in comparison with groups meeting face-to-face (Kwok, Ma, & Vogel, 2002; Lewis, 1987; Lim et al., 1994; Reinig & Mejias, 2003). Similarly, Walther (1995) reported that member dominance faded in computer-mediated teams over the final two measurement periods in his study. In two studies, however, McLeod and Liker (1992) found no difference in the dominance distance, which represents the absolute difference between the most- and least-dominant team member, between face-to-face and GSS groups. In summary, although there have been a few inconsistent findings, a majority of the studies suggest that GSS use reduces member dominance.

Unique information. Following McGuire, Kiesler, and Siegel (1987), Huang and Wei (2000) make a distinction between two types of influence in their study: informational influence and normative influence. Informational influence, they contend, "comes from information shared in group discussion that is novel or nonredundant . . . [and] whenever effective influence takes place, it is because one group member incorporates new information that is provided during the discussion" (p. 184). Accordingly, GSS use is proposed to reduce barriers to idea expression and to allow for greater informational influence. As one index of informational influence, the number of unique ideas generated has been examined in a number of studies. Unique ideas may influence others to think in new ways and, ultimately, may foster intellectual synergy (Roy, Gauvin, & Limayem, 1996).

A number of studies have demonstrated that GSS groups generate a greater amount of unique ideas than do face-to-face teams (Chidambaram & Jones, 1993; Dennis, 1996; Dennis et al., 1998; Easton, Easton, & Belch, 2003; Gallupe, Bastianutti, & Cooper, 1991; Gallupe, DeSanctis, & Dickson, 1988; Gallupe et al., 1992; Huang, Wei, Watson, & Tan, 2002; Murthy & Kerr, 2000; Sia, Tan, & Wei, 2002; Valacich & Schwenk, 1995; Wood & Nosek, 1994; Yellen, Winniford, & Sanford, 1995). In two meta-analyses, Benbasat and Lim (1993) and Dennis et al. (2001) report moderate effects consistent with the notion that GSS use fosters the production of unique ideas. To date, only El-Shinnawy and Vinze (1997) report a greater amount of novel ideas generated in face-to-face teams. A few scholars, however, have failed to find differences in the number of unique or novel ideas produced in GSS and face-to-face conditions (Dennis & Valacich, 1993; George et al., 1990; Massey & Clapper, 1995; Roy et al., 1996). Nonetheless, previous research generally supports the notion that GSSs are an effective tool for teams to generate unique ideas.

Normative influence. Normative influence, also termed social pressure, is influence to conform with group member expectations (Huang & Wei, 2000; Huang, Wei, & Tan, 1999). Huang and Wei (2000) explain that the restricted cues available in a GSS meeting, in comparison with a face-to-face meeting, may hinder the communication of personal preferences and values. As a result, GSS use may reduce perceptions of normative influence and pressure to conform. The structure of GSSs makes it easier to focus on ideas instead of on the sender or other team members.

Three studies demonstrate support for the notion that GSS use mitigates normative influence (Huang, Raman, & Wei, 1997; Huang & Wei, 2000; Tan et al., 1998). In each of these studies, the amount of normative influence, measured by statements addressing values or norms and personal preferences, was significantly reduced in GSS teams in comparison with teams meeting face-to-face. In contrast, Weisband (1992) failed to detect a difference in the number of social pressure remarks made in face-to-face and computer-mediated groups. Furthermore, Dennis et al. (1998) reported findings opposite those of the previous studies. Participants in GSS groups made significantly more normative influence statements than did those meeting face-to-face. Two explanations for the inconsistent results across research on normative influence involve the type of task completed during each experiment and the national culture of participants. These issues will be discussed further in the section addressing potential moderator variables.

Decision shifts. Decision shifts typically represent the discrepancy between an individual member's preference prior to a meeting and his or her preference once the meeting has been completed or once the group has reached consensus (El-Shinnawy & Vinze, 1998; Gallupe & McKeen, 1990; Mejias et al., 1997). Although decision shifts do not directly tap influence behavior, they do provide an indirect indicator of group influence processes. Decision shifts suggest that members were influenced by the group's discussion.

Drawing from persuasive arguments theory (Burnstein, 1982), El-Shinnawy and Vinze (1998) offer one potential explanation for the impact of GSS use on decision shifts. They contend that GSS use can impact the ability of organizational members to make persuasive arguments and, as a result, can influence the team's ultimate decision. Through allowing greater participation and reducing a member's fear of evaluation, GSSs create the opportunity for a greater number of arguments and more novel arguments. Yet, Shinnawy and Vinze (1998) also caution that the anonymity typically associated with GSSs may reduce perceptions of accountability and undermine the validity of the arguments made during meetings.

As El-Shinnawy and Vinze's (1998) argument demonstrates, specific a priori predictions about the influence of GSS use on decision shifts are difficult. This difficulty is also reflected in the mixed findings reported to date. A number of scholars have reported greater decision shifts in GSS teams than in face-to-face teams (Mejias et al., 1997; Murthy & Kerr, 2000; Sia et al., 2002; Siegel et al., 1986; Valacich et al., 2002). Others found greater decision shifts in groups meeting face-to-face (Anderson & Hiltz, 2001; Reinig & Mejias, 2003). El-Shinnawy and Vinze (1997, 1998) reported that both GSS and face-to-face teams experienced decision shifts. Face-to-face teams, however, made more risky shifts, whereas shifts in GSS teams were more conservative. Six studies failed to find differences in decision shifts between face-to-face and GSS groups (Dennis, 1996; Gallupe & McKeen, 1990; Karan, Kerr, Murphy, & Vinze, 1996; Scott, 1999b; Tan et al., 1994; Weisband et al., 1995).

In summary, although decision shifts have received a fair amount of attention in GSS research, the findings across these studies are largely inconsistent. One possible explanation for these results, addressed later, involves the role of anonymity as a potential moderating variable.

Hypotheses and Research Questions

The effect of GSS use on member influence behaviors. Given the role afforded GSSs as potentially mitigating status differences and allowing for more equal influence and participation, it is important to empirically examine the

cumulative findings across this body of literature. The results from research on participation equality, production of unique ideas, and dominance have been fairly consistent. GSS use appears to increase participation equality and the production of unique ideas and to reduce member dominance. Hypotheses 1a through 1c are proposed to formally test this notion:

> Hypothesis 1: Groups using a GSS will (a) experience greater participation equality, (b) produce a larger amount of unique ideas, and (c) experience less member dominance than will groups meeting face-to-face.

The results from studies of influence equality, normative influence, and decision shifts have been less consistent. As a result, Research Questions 1a through 1c are proposed to assess the impact of GSS use on these three influence behaviors:

> Research Question 1: In comparison with face-to-face groups, what impact does GSS use have on (a) influence equality, (b) normative influence, and (c) decision shifts?

Moderating variables. One of the key benefits of meta-analysis is the potential to explain inconsistent findings across a body of research through identifying moderating variables (Hunter & Schmidt, 1990). In the studies reviewed thus far, the results have been largely mixed for three of the six influence variables. Further, for those variables in which results have been more reliable, there are nonetheless some inconsistencies. Given the nature of influence behaviors in group settings, the type of task in which participants engage, the presence of anonymity in GSS conditions, and the national culture of participants may function as moderating factors in this body of studies.

The type of task in which participants engage has been identified as a key factor in research on teams (McGrath, 1984) and, more specifically, in research on GSSs (DeSanctis & Gallupe, 1987). Different types of tasks require different behaviors, and these behaviors can be facilitated or hindered by GSSs. Research on influence equality and normative influence underscores the importance of task type in studies of GSSs.

Huang and his associates (Huang et al., 1999; Huang & Wei, 2000) and Tan and his associates (Tan et al., 1998; Tan et al., 1999) reported an interaction between GSS use and task type for influence equality. For preference tasks that have no correct solution, GSS use mitigated the influence of higher status members and allowed for greater influence equality. Huang and his associates (Huang et al., 1997, 1999; Huang & Wei, 2000) also reported a sig-

nificant interaction between task type and GSS use for the number of normative influence statements made by study participants. Participants completing a preference task in face-to-face teams made significantly more normative influence statements than did those in GSS groups. For intellective tasks, however, the difference in the number of normative influence statements was nominal.

As the findings from these studies suggest, the type of task in which participants engage may impact the effect of GSS use on influence behaviors. To formally examine task type as a moderating variable, the following research question is proposed:

Research Question 2a: Does the type of task in which participants engage impact the effect of GSS use on the six influence behaviors?

A second potential moderating variable is anonymity. Like task type, anonymity has been identified as a key factor in GSS research (DeSanctis & Gallupe, 1987). Anonymity is "the degree to which a communicator perceives the message source as unknown or unspecified" (Anonymous, 1998, p. 387). Anonymous group members have been considered those whose names are unknown or who cannot be physically identified during a meeting. In terms of influence, anonymity is proposed to minimize status differences, liberate team members from a fear of retribution, and make it easier for members to resist group pressure (Hayne & Rice, 1997; Nunamaker et al., 1988; Postmes & Lea, 2000; Scott, 1999b).

Research to date demonstrates the impact of anonymity on the production of unique ideas (Valacich, George, Nunamaker, & Vogel, 1994), on participation equality (Siegel et al., 1986), on influence equality (Kelsey, 2000), and on decision shifts (Gallupe & McKeen, 1990; Scott, 1999b). Anonymous GSS groups generated more unique ideas and experienced greater participation equality, influence equality, and decision shifts than those that met face-to-face. Given its effect in these studies, it seems possible that anonymity may function as a moderating variable in the body of research assessing influence behaviors in GSSs. To address this issue, the following research question is posed:

Research Question 2b: Does the presence of anonymity impact the effect of GSS use on the six influence behaviors?

The national culture of participants is a final potential moderating variable. Watson, Ho, and Raman (1994) define culture as the "beliefs, value system, norms, mores, myths, and structural elements of a given organization,

tribe, or society" (p. 46). Individualism and power distance are two key dimensions of culture that may interact with GSS use to affect group processes (El-Shinnawy & Vinze, 1997; Reinig & Mejias, 2002; Robichaux & Cooper, 1998; Tan et al., 1998; Watson et al., 1988; Watson et al., 1994). As Reinig and Mejias (2002) explain, the reduced social cues and possibility for anonymity made available by GSSs support the behavioral norms of those in low power-distance and individualistic cultures. GSSs foster greater member equality and opportunities for individual members to express their unique opinions. In high power-distance cultures where the views of a few high-status members may dominate a group, and in collectivistic cultures where harmony is valued over individual achievement, GSS use may not have the same effects.

In research to date, an interaction between GSS use and the national culture of participants has been found for normative influence (Tan et al., 1998). Teams from a low power-distance and individualist culture using a GSS experienced significantly less normative influence than did teams meeting face-to-face. Among groups from a high power-distance and collectivistic culture, however, there was no difference between GSS and face-to-face teams in perceptions of normative influence. To assess the impact of culture as a moderating variable in the body of research on influence behaviors in GSSs, the following research question is proposed:

Research Questions 2c: Does the national culture of participants impact the effect of GSS use on the six influence behaviors?

Method

A meta-analysis was conducted to address the previous hypotheses and research questions. Meta-analysis is a statistical procedure used to examine the cumulative findings across a number of studies. This procedure makes it possible to draw general conclusions from a body of research and to help reconcile inconsistent findings (Hunter & Schmidt, 1990; Hunter, Schmidt, & Jackson, 1982; Lipsey & Wilson, 2001).

Literature Search

To identify studies to be included in the meta-analysis, literature reviews of GSS research (e.g., Fjermestad & Hiltz, 1998; McGrath & Hollingshead, 1994; Scott, 1999a) were first examined. Fjermestad and Hiltz's (1998) comprehensive review of GSS research, in which they examine more than 200 studies on the topic and include detailed information about the variables investigated and the findings of each study, was used as a primary resource.

To identify more recent research, *Academic Search Premiere*, *Business Source Premiere*, *ERIC*, *Psychology and Behavioral Science Collection*, and *Sociological Collection* were examined from the *EBSCO* database. In addition, *Communication Abstracts*, *PsychInfo*, and *Association for Computing Machinery* databases were examined. Finally, online search engines such as Google and Yahoo were used to identify any additional published works. The terms group support system, influence, and persuasion were used as search terms.

To be included in the sample, studies had to meet the following criteria. First, studies must be published in an academic journal. Studies from the *Proceedings of the Hawaii International Conference on System Sciences* and the *Proceedings of the International Conference on Information Systems* were also included in the sample.[5] Second, studies must compare teams using a GSS and groups meeting face-to-face. Studies using formal GSSs, such as *Vision Quest* (e.g., Yellen et al., 1995), *Software Aided Meeting Management* (e.g., Huang et al., 1999), and *The Meeting Room* (e.g., El-Shinnawy & Vinze, 1998) as well as studies that assessed computer-supported teams (e.g., Zigurs et al., 1988) were included in the meta-analysis. Third, studies must include a quantitative measure of one of the six influence variables. Studies relying on self-report measures and observer ratings were included. Finally, studies must report means, standard deviations, or $F[t]$ values for relevant influence variables.

An initial search resulted in approximately 75 studies assessing one or more of the six influence variables. However, studies were excluded for one or more of the following three reasons. First, they did not compare teams using a GSS with those meeting face-to-face (e.g., Connolly, Routhieaux, & Schneider, 1993; Davey & Olson, 1998; Dennis, Aronson, Heninger, & Walker, 1996; Easton et al., 1992; Hender, Rodgers, Dean, & Nunamaker, 2001; Roy et al., 1996; Scott, 1999b; Scott & Easton, 1996; Shirani, Tafti, & Affisco, 1999; Sia, Tan, & Wei, 1996; Silver, Cohen, & Crutchfield, 1994; Wilson & Jessup, 1995). Second, they assessed the total amount of participation, influence, or consensus and not participation or influence equality or decision shifts (e.g., Easton, George, Nunamaker, & Pendergast, 1990; Hiltz, Johnson, & Turoff, 1991; Olaniran, 1996; Straus, 1997).[6] Finally, they did not include enough information to calculate effects (e.g., Burke & Chidambaram, 1994; Hwang & Guynes, 1994; Mejias et al., 1996; Mejias et al., 1997; Samarah, Paul, Mykytyn, & Seetharaman, 2003). A total of 44 studies involving 48 different experiments were examined in the final analyses. Information about the sample, procedure, and GSS used in each study included in the meta-analysis is presented in Table 1.

(text continues on p. 214)

Table 1
Information About the Sample, Procedure, and System for all Studies Included in the Meta-Analysis

Study	Sample (Nationality)	Task	Anonymity	Experience	Time	System
Anderson and Hiltz (2001)	Undergraduates (from 39 countries)	Noble Industries task. Ranking the order in which fellow employees must be laid off due to corporate downsizing.	—	—	—	Web-EIES
Chidambaram and Jones (1993)	Undergraduates (United States)	Task 1: Act as a board of directors and recommend ways to improve the tainted image of a wine company. Task 2: Act as a board and suggest new products for international customers.	Manipulated	—	—	GroupSystems
Dennis (1996)	Undergraduates (United States)	Select 1 of 4 students for admission to the university.	Yes	—	30-minute time limit	GroupSystems
Dennis, Hilmer, and Taylor (1998)	Undergraduates (United States)	Task 1: Selecting 1 of 4 students for admission to the university. Task 2: Selecting 1 of 4 computers to be the standard computer for students in the college.	Yes	—	25-minute time limit	TCBWorks

Dubrovsky, Kiesler, and Sethna (1991)	Undergraduates and graduates (United States)	Four choice-dilemma tasks: attending a top graduate program versus a moderately good program; becoming a pianist versus a physician; requiring an introductory computer programming class for freshman or later in the program; whether to teach PASCAL or BASIC in introductory programming courses.	Yes	—	—	Email
Easton, Easton, and Belch (2003)	Undergraduates (United States)	Providing feedback to a camera manufacturer about new products and a commercial.	Yes	—	1.5-hour time limit	GroupSystems
El-Shinnawy and Vinze (1997)	Graduates (United States and Singapore)	Intel Pentium case.	Yes	—	1-hour time limit	—
Gallupe and McKeen (1990)	Undergraduates (Canada)	Determining the cause of a company's decreasing profits.	Manipulated	Training	—	Decision aid for groups—one
Gallupe, DeSanctis, and Dickson (1988)	Undergraduates (—)	Bonanza Business Forms case. Finding the cause of the company's decreasing profits.	—	—	1 hour and 17 minute average	Decision aid for groups

(continued)

Table 1 (continued)

Study	Sample (Nationality)	Task	Anonymity	Experience	Time	System
Gallupe, Dennis, Cooper, Valacich, Bastianutti, and Nunamaker (1992; Experiment 1)	Undergraduates (Canada)	Task 1: How can tourism be improved in Kingston? Task 2: How can campus security be improved at Queen's University?	—	Training	40 minutes total for both tasks	—
Gallupe, Dennis, Cooper, Valacich, Bastianutti, and Nunamaker (1992; Experiment 2)	Undergraduates (United States)	Task 1: How can tourism be improved in Tucson? Task 2: How can campus security be improved at the University of Arizona?	—	Training	—	—
George, Easton, Nunamaker, and Northcraft (1990)	Undergraduates (United States)	Parkway Drug Company case. Deciding who gets the sales territory left by a retiring salesperson.	Manipulated	Training	30-minute time limit	GroupSystems
Ho and Raman (1991)	Undergraduates (Singapore)	Allocating funds for a philanthropic foundation among 6 competing projects.	—	—	—	SAMM

Huang, Raman, and Wei (1997)	Undergraduates (—)	Task 1: International Studies Program task. Making acceptance decisions concerning applicants for an international studies program. Task 2: Personal Trust Foundation task. Allocating funds for competing philanthropic projects.	—	Warm-up task	—	SAMM
Huang, Wei, and Tan (1999)	Undergraduates (Singapore)	Task 1: International Studies Program task (see above). Task 2: Personal Trust Foundation task (see above).	Yes	Training and warm-up task	No limit	SAMM
Huang and Wei (2000)	Undergraduates (—)	Task 1: International Studies Program task (see above). Task 2: Personal Trust Foundation task (see above).	Yes	Training and warm-up task	—	SAMM
Huang, Wei, Watson, and Tan (2002)	Undergraduates (—)	Selecting a suitable country for the diversification efforts of a large corporation.	—	—	2.5 hours maximum	SAMM
Jarvenpaa, Rao, and Huber (1988)	Software designers and computer scientists (United States)	Three software design tasks.	—	Training	3 1-hour sessions	Electronic Blackboard
Karan, Kerr, Murphy, and Vinze (1996)	Undergraduates (United States)	Determining acceptable audit risk in an accounting scenario.	Yes	—	—	VisionQuest

(continued)

Table 1 (continued)

Study	Sample (Nationality)	Task	Anonymity	Experience	Time	System
Kelsey (2000)	Students (China and United States or Canada)	Acting as a manager and deciding on the correct sequence to complete a project.	Manipulated	—	30-minute time limit	GroupSystems
Kwok, Ma, and Vogel (2002)	Undergraduates (—)	Developing an evaluation scheme for a term project.	—	None	45 minutes	GroupSystems
Lewis (1987)	Undergraduates (United States)	Developing ways to increase revenue or decrease expenditures for the university.	—	—	—	Created by author.
Lim, Raman, and Wei (1994)	Undergraduates (Singapore)	Personal Trust Foundation task. Allocating funds among 6 competing projects on behalf of a philanthropic foundation.	—	—	No limit (most finished in 30 minutes)	SAMM
Massey and Clapper (1995)	Undergraduates (—)	Discussing differences between what students know and do in regards to sexual-health behavior.	Yes	—	2 1-hour sessions	VisionQuest
McLeod and Liker (1992; Experiment 1)	Undergraduates and graduates (United States)	Arranging 20 activities in the order most conducive for completing a project.	—	—	30-minute time limit	Capture Lab
Mcleod and Liker (1992; Experiment 2)	Undergraduates and graduates (United States)	Acting as manager and developing responses to a series of correspondences.	—	—	50-minute time limit	HyperCard

Murthy and Kerr (2000)	Undergraduates (United States)	Creating a list of control procedures to help a company developing an online order processing system.	—	Experience	30-minute time limit	WebBoard
Raman, Tan, and Wei (1993)	Undergraduates (Singapore)	Task 1: Personal Trust Foundation task. Allocating funds among 6 competing projects. Task 2: International Studies Program task. Scoring a group of applicants to the university.	—	Training	—	Software Aided Group Environment
Reinig and Mejias (2003)	Undergraduates (United States)	Allocating funds among 9 projects aimed at bettering the community.	Yes	—	—	GroupSystems
Sia, Tan, and Wei (2002)	Undergraduates (—)	Acting as the captain of a college football team and deciding on a strategy to compete against a rival school.	Yes	—	—	SAMM
Siegel, Dubrovsky, Kiesler, and McGuire (1986; Experiment 1)	Undergraduates (United States)	Choice-dilemma problem task.	Manipulated	—	20-minute time limit	Converse

(continued)

Table 1 (continued)

Study	Sample (Nationality)	Task	Anonymity	Experience	Time	System
Siegel, Dubrovsky, Kiesler, and McGuire (1986; Experiment 3)	Undergraduates (United States)	—	No	—	30-minute time limit	Email
Tan, Raman, and Wei (1994)	Undergraduates (Singapore)	Task 1: International Studies task. Scoring competing applicants for admittance to an international studies program. Task 2: Personal Trust Foundation task. Allocating funds to competing project proposals.	Yes	Training and warm-up task	—	SAMM
Tan, Wei, and Watson (1999)	Undergraduates (—)	Deciding on the damage award in a civil lawsuit.	Manipulated	None	—	—
Tan, Wei, Watson, Clapper, and McLean (1998)	Undergraduates (United States and Singapore)	Mock jury task deciding on damage awards.	No	—	—	—
Tan, Wei, and Watson (1999)	Undergraduates (United States and Singapore)	Mock jury task deciding on damage awards.	Manipulated	Training	—	—

Valacich, Sarker, Pratt, and Groomer (2002)	Undergraduates (United States)	Recommend a compensation contract for a company's chief executive officer.	—	—	—	Microsoft NetMeeting
Valacich and Schwenk (1995)	Undergraduates (United States)	Parkway Drug Company case. Deciding who gets the sales territory left by a retiring salesperson.	Yes	—	40 minutes	—
Walther (1995)	Undergraduates (United States)	Three decision-making tasks involving faculty hiring strategies, the use of writing-assistance programs for college papers, and mandatory student ownership of college papers.	No	Training	5 weeks for computer mediated communications. 3 fact to face meetings, each lasting up to 70 minutes.	COSY
Walther and Burgoon (1992)	Undergraduates (United States)	Three decision-making tasks.	No	Training	See Walther (1995)	COSY
Watson, DeSanctis, and Poole (1988)	Undergraduates and graduates (United States)	Personal Trust Foundation task. Allocating funds among 6 competing projects for a philanthropic foundation.	—	Training	—	SAMM

(continued)

Table 1 (continued)

Study	Sample (Nationality)	Task	Anonymity	Experience	Time	System
Watson, Ho, and Raman (1994)	Undergraduates and graduates (United States and Singapore)	Allocating funds to 1 of 6 projects.	Yes	Training	—	SAMM
Weisband (1992)	Undergraduates and graduates (United States)	Making a career choice among risky but attractive alternatives.	Yes	—	—	Email
Weisband, Schneider, and Connolly (1995; Experiment 1)	Undergraduates and graduates (United States)	Two ethical decision-making tasks. Task 1: Marketing computer software known to have bugs. Task 2: The development and sale of marketing profiles from public information.	No	Some	—	Computer Conferencing System
Weisband, Schneider, and Connolly (1995; Experiment 3)	Undergraduates and graduates (United States)	Three ethical decision-making tasks about the conduct of a computer professional. Task 1: Offering access to pornographic material. Task 2: Monitoring others' electronic mail. Task 3: Development and sale of marketing profiles from public information.	Manipulated	—	—	Computer Conferencing System

Wood and Nosek (1994)	Undergraduates and graduates (United States)	Task 1: Examining stakeholder assumptions in regards to pricing issues at a pharmaceutical company. Task 2: Determining the basis for and characteristics of a policy for adjusting procedures used to compute the U.S. Census.	No	—	2.5 hours	VisionQuest
Yellen, Winniford, and Sanford (1995)	Undergraduates (United States)	Two ethical decision-making tasks. Task 1: The foreman in a bind task. Task 2: I never make big mistakes task.	—	Training	—	VisionQuest
Zigurs, Poole, and DeSanctis (1988)	Undergraduates (United States)	International Studies Program task. Making acceptance decisions concerning applicants for an international studies program.	Yes	Training and warm-up task	—	SAMM

Note: A dash indicates that the information was not available. Experience is the participants' experience with the group support system prior to the task. Time is the task-completion time.

Calculating Effect Sizes and Testing for Moderating Variables

The computer program DSTAT (Johnson, 1989) was used to conduct the meta-analysis. Effects, in the form of d, were calculated using means and standard deviations for each dependent variable of interest. The d coefficient represents the standardized difference between the experimental (i.e., GSS) and control (i.e., face-to-face) groups.[7] Johnson recommends using d as an effect measure for studies with small sample sizes. In cases where means or standard deviations were not available, the sample size and $F[t]$ values were used. In a majority of the studies, influence-related variables were analyzed at the group level; thus, the number of teams in the study was used as the sample size.

For each of the six dependent variables, a separate meta-analysis was conducted. Each analysis produced an average effect size in the form of d and a confidence interval (CI). In addition, homogeneity of effects tests were conducted. A significant Q-value indicates that the effects in the sample are not homogenous and suggests the possibility of a moderating variable.

To test for moderating factors, studies were coded for the presence or absence of anonymity in the GSS condition, the type of task performed, and the national culture of participants. Studies in which participants could not see one another or could make contributions during the GSS meeting without revealing their name were considered anonymous (Postmes & Lea, 2000). Inconsistencies in reporting made it impossible to make further distinctions between these two types of anonymity. Studies were also coded for the type of task(s) in which participants engaged based on two commonly studied categories from McGrath's (1984) task circumplex. Preference tasks have no definitive solution and lack guidelines for arriving at a solution (Huang & Wei, 2000). Intellective tasks have an ideal solution and include guidelines. Studies involving features of both types of tasks (e.g., Dennis & Valacich, 1993; George et al., 1990) were excluded from the analyses. Finally, following previous research (El-Shinnawy & Vinze, 1997; Reinig & Mejias, 2003; Tan et al., 1998; Tan et al., 1999; Watson et al., 1994), national culture was operationalized as the nation in which participants resided at the time of the study. A substantial majority of participants in the studies analyzed in this data set were from the United States or Singapore. Watson et al. (1994) explain that these two nations represent distinct cultural groups: The United States ranks high on individualism and low on power distance, whereas Singapore ranks low on individualism and high on power distance. Unless otherwise noted, these two nationalities will be used to test the impact of culture as a moderating variable.

Table 2
Overview of the Impact of Group Support System (GSS) Use on Influence Behaviors

Influence Behavior	*n*	Average *d*	95%	CI
Participation equality	10	0.80	0.57	1.03
Unique idea production	13	1.12	0.88	1.36
Dominance	8	–0.52	–0.77	–0.27
Influence equality	10	0.23	0.05	0.42
Normative influence	4	–0.01	–0.28	0.26
Decision shifts	11	0.12	–0.07	0.32

Note: n is the number of experiments used in estimation of average effect size. Positive *d* values indicate increased amounts of the behavior in GSS groups.

Results

The Impact of GSS Use on Member Influence Behaviors

Hypotheses 1a through 1c propose that groups using a GSS will experience greater participation equality, produce a greater amount of unique ideas, and experience less member dominance than will groups meeting face-to-face. Research Questions 1a through 1c inquire about the impact of GSS use, in comparison with face-to-face meetings, on influence equality, normative influence, and decision shifts. To address these hypotheses and research questions, 48 different experiments and approximately 1,500 groups were examined. The results of the analyses for the six influence variables are summarized in Table 2.

Participation equality. Eleven experiments, involving 287 groups, have been conducted examining the impact of GSS use on participation equality. The effect for one study (Reinig & Mejias, 2003), however, deviated significantly from the average effect size for the sample. Following Lipsey and Wilson's (2001) recommendation, this study was excluded from the analysis.[8] The results of the meta-analysis of the remaining studies support Hypothesis 1a and indicate that GSS use results in significantly greater equality of participation, $d = .80$, $p < .05$. This effect is consistent across the studies in the sample, $Q(9, n = 247) = 14.23$, $p = .11$. Table 3 includes information about each of the studies examined in this analysis.

Unique idea production. Fifteen experiments, involving 342 teams, have been conducted to evaluate the influence of GSS use on the production of

Table 3
The Impact of Group Support System (GSS) Use on Participation Equality

Study	*n*	*d*	95%	CI
Dubrovsky, Kiesler, and Sethna (1991)	24	0.72	–0.10	1.55
George, Easton, Nunamaker, and Northcraft (1990)	30	1.95	1.08	2.81
Jarvenpaa, Rao, and Huber (1988)[a]	21[b]	0.31	–0.30	0.92
Kelsey (2000)	30	1.23	0.55	1.90
Lewis (1987)	30	0.46	–0.31	1.23
Reinig and Mejias (2003)[c]	40	3.16	2.23	4.09
Siegel, Dubrovsky, Kiesler, and McGuire (1986; Experiment 1)	18[b]	1.18	0.47	1.88
Siegel, Dubrovsky, Kiesler, and McGuire (1986; Experiment 3)	18[b]	0.76	0.08	1.43
Valacich, Sarker, Pratt, and Groomer (2002)	36	0.46	–0.20	1.13
Weisband (1992)	24[b]	1.10	0.50	1.71
Wood and Nosek (1994)	16	1.51	0.09	2.21
Overall	247	0.80	0.57	1.03

Note: Positive *d* values indicate increased member equality in GSS groups. The within-subgroup test for homogeneity is not significant, $Q(9, n = 247) = 14.23, p = .11$.
a. The effect for this study was determined by averaging rater observations of participation equality and participant perceptions of equality.
b. *n* refers to the number of groups in the repeated measures design.
c. Statistical outlier excluded from estimate of overall effect size.

unique ideas. The effects for two studies (El-Shinnawy & Vinze, 1997; Huang et al., 2002) deviated significantly from the average effect size for the sample and were excluded from the analysis. Consistent with Hypothesis 1b, GSS groups produced significantly more unique ideas than did face-to-face teams, $d = 1.12, p < .05$. Yet, this effect is not consistent across the sample, $Q(12, n = 270) = 25.90, p = .01$. Table 4 includes information about each of the studies examined in this analysis.

Dominance. Eight experiments, involving 270 groups, have evaluated the influence of GSS use on dominance. Consistent with Hypothesis 1c, teams using GSSs reported significantly less member dominance than did face-to-face groups, $d = –.52, p < .05$. This effect is consistent across the studies in the sample, $Q(7, n = 270) = 9.70, p = .21$. Table 5 includes information about each of the studies examined in this analysis.

Influence equality. Eleven experiments, involving 461 teams, were examined to answer Research Question 1a. The effect for one study (Huang et al., 1999) deviated significantly from the average effect size for the sample and was excluded from the analysis. The average effect across the remaining studies is statistically significant, $d = .23, p < .05$, indicating greater influence

Table 4
The Impact of Group Support System (GSS) Use on Production of Unique Ideas

Study	*n*	*d*	95%	CI
Chidambaram and Jones (1993)	12	1.75	0.42	3.08
Dennis (1996)	14	1.44	0.27	2.62
Easton, Easton, and Belch (2003)	12	1.09	–0.12	2.31
El-Shinnawy and Vinze (1997)[a]	24[b]	–0.44	–1.01	0.14
Gallupe, DeSanctis, and Dickson (1988)	24	1.24	0.37	2.11
Gallupe, Dennis, Cooper, Valacich, Bastianutti, and Nunamaker (1992; Experiment 1)	30[b]	1.19	0.64	1.73
Gallupe, Dennis, Cooper, Valacich, Bastianutti, and Nunamaker (1992; Experiment 2)	16[b]	2.53	1.60	3.46
George, Easton, Nunamaker, and Northcraft (1990)	30	0.46	–0.27	1.18
Huang, Wei, Watson, and Tan (2002)[a]	48	2.53	1.78	3.29
Massey and Clapper (1995)	18	0.56	–0.39	1.50
Murthy and Kerr (2000)	18	0.39	–0.54	1.32
Sia, Tan, and Wei (2002)	26	2.58	1.54	3.62
Valacich and Schwenk (1995)	42	0.88	0.25	1.52
Wood and Nosek (1994)	16	1.01	–0.03	2.05
Yellen, Winniford, and Sanford (1995)	12[b]	0.76	–0.06	1.59
Overall	270	1.12	0.88	1.36

Note: Positive *d* values indicate increased production of unique ideas in GSS teams. The within-subgroup test for homogeneity is statistically significant, $Q(12, n = 270) = 25.90$, $p = .01$.
a. Statistical outlier excluded from estimate of overall effect size.
b. *n* refers to the number of groups in the repeated measures design.

Table 5
The Impact of Group Support System (GSS) Use on Member Dominance

Study	*n*	*d*	95%	CI
Kwok, Ma, and Vogel (2002)	8	–0.84	–1.43	–0.25
Lewis (1987)	30	–0.87	–1.67	–0.08
Lim, Raman, and Wei (1994)	20	–1.63	–2.64	–0.62
McLeod and Liker (1992; Experiment 1)	34	–0.38	–1.06	0.30
McLeod and Liker (1992; Experiment 2)	34	–0.25	–0.92	0.42
Reinig and Mejias (2003)	40	–0.49	–1.12	0.14
Walther (1995)[a]	32	–0.13	–0.82	0.57
Walther and Burgoon (1992)[a]	32	–0.14	–0.84	0.55
Overall	270	–0.52	–0.77	–0.27

Note: Negative *d* values indicate decreased member dominance in GSS teams. The within-subgroup test for homogeneity is not statistically significant, $Q(7, n = 270) = 9.69$, $p = .21$.
a. The effect for this study was determined by averaging the effects from each of the three measurement periods.

equality in teams using a GSS than in those meeting face-to-face. This effect is not consistent across the sample, $Q(9, n = 429) = 17.44$, $p = .04$. Table 6 includes information about each of the studies examined in this analysis.

Table 6
The Impact of Group Support System (GSS) Use on Influence Equality

Study	*n*	*d*	95%	CI
Ho and Raman (1991)	31	–0.50	–1.21	0.22
Huang and Wei (2000)	28	1.49	0.65	2.33
Huang, Wei, and Tan (1999)[a]	32	1.98	1.14	2.83
Lim, Raman, and Wei (1994)	32	0.70	–0.02	1.41
Tan, Raman, and Wei (1994)	46	0.00	–0.58	0.58
Tan, Wei, Watson, Clapper, and McLean (1998)	93	0.26	–0.14	0.67
Tan, Wei, and Watson (1999)	72	0.32	–0.17	0.82
Watson, DeSanctis, and Poole (1988)	54	–0.12	–0.65	0.42
Weisband, Schneider, and Connolly (1995; Experiment 1)	18[b]	0.21	–0.44	0.87
Weisband, Schneider, and Connolly (1995; Experiment 3)	27[b]	0.39	–0.15	0.93
Zigurs, Poole, and DeSanctis (1988)	28	0.00	–0.74	0.74
Overall	429	0.23	0.05	0.42

Note: Positive *d* values indicate increased influence equality in GSS groups. The within-subgroup test for homogeneity is statistically significant, $Q(9, n = 429) = 17.44$, $p = .04$.
a. Statistical outlier excluded from estimate of overall effect size.
b. *n* refers to the number of groups in the repeated measures design.

Table 7
The Impact of Group Support System (GSS) Use on Normative Influence

Study	*n*	*d*	95%	CI
Dennis, Hilmer, and Taylor (1998)	17[a]	0.90	0.19	1.60
Huang, Raman, and Wei (1997)	32	–0.57	–1.28	0.14
Huang, Wei, and Tan (1999)[b]	32	–6.68	–8.46	–4.91
Huang and Wei (2000)[b]	28	–7.75	–9.91	–5.59
Tan, Wei, Watson, Clapper, and McLean (1998)	119	–0.28	–0.66	0.10
Weisband (1992)	24[a]	0.35	–0.22	0.92
Overall	192	–0.01	–0.28	0.26

Note: Negative *d* values indicate decreased normative influence in GSS groups. The within-subgroup test for homogeneity is statistically significant, $Q(3, n = 192) = 12.25$, $p < .01$.
a. *n* refers to the number of groups in the repeated measures design.
b. Statistical outlier excluded from estimate of overall effect size.

Normative influence. Six studies, involving 252 teams, were examined to address Research Question 1b. The effects for two of these studies (Huang et al., 1999; Huang & Wei, 2000) deviated significantly from the average effect size for the sample and were excluded from the analysis. Of the remaining studies, the average effect of GSS use on normative influence is not statistically significant, $d = –.01$, $p > .05$. This effect is not consistent across the sample, $Q(3, n = 192) = 12.25$, $p < .01$, indicating the potential presence of a moderating variable. Table 7 includes information about each of the studies examined in this analysis.

Table 8
The Impact of Group Support System (GSS) Use on Decision Shifts

Study	*n*	*d*	95%	CI
Anderson and Hiltz (2001)[a]	46	–1.10	–1.73	–0.48
Dennis (1996)	14	0.73	–0.36	1.80
Gallupe and McKeen (1990)	14	–0.92	–2.13	0.29
Karan, Kerr, Murphy, and Vinze (1996)	20	0.67	–0.23	1.57
Raman, Tan, and Wei (1993)	45	–0.77	–1.37	–0.16
Reinig and Mejias (2003)[a]	40	–1.76	–2.49	–1.03
Sia, Tan, and Wei (2002)[a]	26	2.68	1.62	3.73
Siegel, Dubrovsky, Kiesler, and McGuire (1986; Experiment 1)	18	0.65	–0.02	1.32
Siegel, Dubrovsky, Kiesler, and McGuire (1986; Experiment 3)	18	1.05	0.35	1.74
Tan, Raman, and Wei (1994)	46	–0.30	–0.88	0.28
Valacich, Sarker, Pratt, and Groomer (2002)	36	0.28	–0.28	0.93
Watson, Ho, and Raman (1994)	85	0.22	–0.20	0.65
Weisband, Schneider, and Connolly (1995; Experiment 1)	18[b]	–0.13	–0.79	0.52
Weisband, Schneider, and Connolly (1995; Experiment 3)	27[b]	0.08	–0.46	0.61
Overall	341	.12	–.07	.32

Note: Positive *d* values indicate increased decision shifts in GSS groups. The within-subgroup test for homogeneity is statistically significant, $Q(10, n = 341) = 25.94, p < .01$.
a. Statistical outlier excluded from estimate of overall effect size.
b. *n* refers to the number of groups in the repeated measures design.

Decision shifts. Fourteen experiments, involving 453 teams, were analyzed to answer Research Question 1c. The effects from three studies (Anderson & Hiltz, 2001; Reinig & Mejias, 2003; Sia et al., 2002) deviated significantly from the average effect for the sample and were excluded from the analysis. The average effect of GSS use in the remaining studies is not statistically significant, $d = .12, p > .05$. This effect is not consistent across the sample, $Q(10, n = 341) = 25.94, p < .01$. Table 8 includes information about each of the studies examined in this analysis.

Moderating Factors

Research Questions 2a through 2c inquire about the impact of task type, anonymity, and national culture as moderating factors in the relationship between GSS use and the influence behaviors. The previous analyses indicate that potential moderators exist in the body of studies addressing influence equality, production of unique ideas, normative influence, and decision shifts. Although a lack of information about the presence or absence of anonymity, task type, and the national culture of participants restricted compari-

sons to among only four studies for some of these factors, Hunter et al. (1982) acknowledge that such comparisons are appropriate.[9]

Task type. Task type is not a significant moderator for any of the four influence variables. For influence equality, four studies incorporated an intellective task, and seven studies used a preference task. Although influence equality was greater in preference tasks (d = .29) than in intellective tasks (d = .06), this difference is not statistically significant, $Q_B(1) = 1.07, p = .30$.[10] Similarly, the amount of unique ideas produced in preference tasks across five studies (d = 1.33) was greater than the amount produced in intellective tasks across three studies (d = 1.07), but this difference is not statistically significant, $Q_B(1) = .72, p = .40$. Normative influence was greater in intellective tasks across three studies (d = .23) than in preference tasks across three studies (d = –.13). This difference, however, is not statistically significant, $Q_B(1) = 1.72, p = .19$. The difference in decision shifts during the three studies that relied on intellective tasks (d = .34) and five studies that used preference tasks (d = –.07) is not statistically significant, $Q_B(1) = 1.89, p = .17$.

Anonymity. Anonymity is not a significant moderator for any of the four influence variables. For influence equality, participants were identified in four experiments and were anonymous in seven experiments. Anonymous groups (d = .31) reported greater influence equality than did identified groups (d = .23), but this difference is not statistically significant, $Q_B(1) = .20$, $p = .65$. There is also no difference in the production of unique ideas between the single experiment in which participants were identified (d = 1.73) and the seven in which participants were anonymous (d = 1.20), $Q_B(1) = .56, p = .45$. Normative influence was reduced in the single study where participants were identified (d = –.17) in comparison with the three studies in which participants were anonymous (d = .09), but this difference is not statistically significant, $Q_B(1) = .84, p = .36$. Finally, the difference in decision shifts in the five studies involving identified participants (d = .28) and the seven studies in which participants were anonymous (d = .18) is not statistically significant, $Q_B(1) = .22, p = .64$.

National culture. The difference in influence equality between the four studies with participants from Singapore (d = .13) and the five studies with participants from the United States (d = .15) is not statistically significant, $Q_B(1) = .004, p = .95$. Similarly, the difference in normative influence between the three studies with participants from the United States (d = .08) and the two studies with participants from Singapore (d = –.06) is not statistically

significant, $Q_B(1) = .28$, $p = .60$. The difference in decision shifts between the ten studies with participants from the United States and Canada ($d = .16$) and the four studies with participants from Singapore and Hong Kong ($d = -.42$) is statistically significant, $Q_B(1) = 7.83$, $p < .01$. However, the within-subgroup test of homogeneity for studies with participants from the United States and Canada, $Q_W = 27.29$, $p < .01$, and Singapore and Hong Kong, $Q_W = 15.34$, $p < .01$, are also significant. A significant Q_W value indicates that variation remains within the subgroup.[11] Finally, all participants in the sample of studies examining unique ideas were from the United States; thus, it is not possible to test for the impact of national culture as a moderating variable.

Discussion

One of the most heralded features of GSSs is their ability to level the organizational playing field and to produce more democratic group processes (DeSanctis & Gallupe, 1987; Dubrovsky et al., 1991; McGrath & Hollingshead, 1994; Siegel et al., 1986). GSS use is posited to reduce inequalities between group members, thus minimizing barriers to communication. As a result, GSS use leads to more equal levels of member influence than that which occurs in teams meeting face-to-face. The purpose of this study has been to examine the aggregate impact of GSS use on member influence behaviors across the body of research on this topic. In this section, the findings from the meta-analysis are discussed, study limitations are identified, and directions for future research are offered.

Among the 48 experiments examined, GSS use affected four of the influence variables. GSS use resulted in increased participation equality, influence equality, and production of unique ideas. GSS use also reduced member dominance in comparison with face-to-face teams. The absolute values of the average effect sizes for these four factors range from $d = .23$ to $d = 1.12$. Cohen (1977) suggests that, for the d coefficient, effect sizes of .20 are small, .50 are moderate, and .80 are large. In general, these findings indicate that GSS use leads to greater equality in member communication than that which occurs in face-to-face meetings.

The findings from this study help clarify inconsistencies in previous GSS research. To date, the results of individual studies of influence equality, normative influence, and decision shifts have been mixed. Although some studies demonstrate the positive impact of GSS use on these variables, others fail to provide support or, in some cases, report opposite findings. The average effects across this body of research indicate that, in comparison with teams meeting face-to-face, GSS use leads to a small but statistically significant

increase in influence equality. GSS use alone, however, does not reduce normative influence nor impact decision shifts.

At a broader level, the results of this study provide qualified support for the equalization hypothesis. In the past, the notion that GSS use leads to greater member equality in group decision making has been questioned (Hollingshead, 1996; McGrath & Hollingshead, 1994; Weisband, 1992; Weisband et al., 1995). McGrath and Hollingshead (1994), for example, contend that findings consistent with the equalization hypothesis are an artifact of the "reduction in the total number of acts in computer-mediated as compared with face-to-face interactions" (p. 89). GSS use, they argue, "does not simply reduce the participation of loquacious group members, nor does it simply increase the participation of quiet group members" (p. 89). The results of previous research are a result of less total communication in GSS teams in comparison with those meeting face-to-face.

Yet, this study focused on influence *equality* and participation *equality*. Only those experiments assessing the impact of GSS use on an individual's behavior, in proportion to the behavior of the rest of the team, were included in the meta-analysis. Thus, any changes in an individual's influence or participation behaviors were assessed in relation to the entire team's behavior. In addition, perceptual measures of both influence and participation equality were included among the studies examined. Although GSS use only led to a small increase in influence equality and did not affect normative influence, the increase in participation equality and production of unique ideas coupled with the decrease in member dominance underscore the benefits of GSS use. As a whole, the results of this study provide some support for the equalization hypothesis and the utility of GSSs to democratize group processes.

This study was less successful, however, in identifying moderating variables. Although the effects for influence equality, production of unique ideas, normative influence, and decision shifts varied significantly across each respective sample, national culture only explained the variance for studies of decision shifts. Participants from Singapore and Hong Kong, which are high power-distance and collectivistic cultures, experienced less decision shifts when using a GSS. There are two possible explanations for this finding. The reduced social cues available during GSS meetings may have made it possible for members to resist conforming to others in the group. Participants may have perceived less pressure from other, potentially higher status, members and may have felt a greater sense of efficacy to maintain their initial position. An alternative explanation is that the reduced social cues created uncertainty among participants from Singapore and Hong Kong. These participants may have had difficulty identifying the position of dominant members

and, as a result, may have maintained their initial opinion in an attempt to avoid contradicting higher status members or disrupting group harmony.

Task type was not a significant moderating factor for any of the four influence variables. This result, however, may be partially attributed to the relatively small number of studies compared in each analysis. Examining the average effects for both types of tasks across the four influence variables reveals fairly consistent results. Groups using a GSS and completing a preference task had greater influence quality, generated a slightly larger amount of unique ideas, experienced reduced normative influence, and had fewer decisions shifts in comparison with those completing intellective tasks. The democratizing effects of GSSs seem to be more prominent during preference tasks where there is no single, correct solution. Although these findings are not statistically significant, their consistency suggests that task type may be a useful avenue for future GSS research.

It is somewhat surprising that anonymity was not a moderating factor for any of the influence variables examined in this study. Throughout the body of research on GSSs, anonymity is considered an integral component of these systems. One explanation for the lack of findings involves the way anonymity was operationalized (Postmes & Lea, 2000). In some studies, participants who were prevented from seeing one another were considered anonymous (e.g., Dubrovsky et al., 1991; Weisband et al., 1995). In others, participants were considered anonymous if their name was not attached to their comments (e.g., Massey & Clapper, 1995; Valacich & Schwenk, 1995). As Anonymous (1998) notes and as others have demonstrated (Gallupe & McKeen, 1990; Jessup & Tansik, 1991; Scott, 1999b), there are considerable differences in these types of anonymity. Scott (1999b), for example, found a greater number and magnitude of effects for discursive anonymity than for physical anonymity across a range of group outcomes. A test of the effects of these two types anonymity, however, was not possible with this data set. In most studies, it was not clear whether participants had physical anonymity, discursive anonymity, or both. Future research should better articulate the type of anonymity afforded participants to better understand the extent of anonymity's impact, if any.

Limitations

A limitation of this study, as with any meta-analysis, is the so-called file-drawer problem. Because only published studies were examined, it is possible that other, unpublished, research may exist with inconsistent findings. The partiality in academic scholarship toward studies with statistically significant findings may have created a biased sample. This problem is ex-

acerbated by the relatively small sample of experiments included in each analysis.

One approach to address a potential file-drawer problem is to determine the fail-safe *n* for each influence variable. The fail-safe *n* is an estimate of the number of unpublished experiments with null results necessary to reduce an average effect size to nonsignificance (Lipsey & Wilson, 2001). To reduce the effect for unique ideas to the value of $d = .01$, 1,443 experiments must exist with an effect size of 0. To nullify the effects for participation equality, dominance, and influence equality, 790, 408, and 220 experiments with effect sizes of 0, respectively, must exist for each variable. Thus, although the file-drawer problem is always a possibility, the fail-safe *n*s indicate that it is fairly unlikely for these four influence variables.

Directions and Recommendations for Future Research

The findings from this study suggest two directions and a methodological recommendation for future research. First, given that the equalization hypothesis was supported in this study, scholars need to examine its underlying mechanisms. That is, *why* does GSS use promote greater influence equality, participation equality, production of unique ideas, and reduced dominance? Are the reduced social cues or opportunity for simultaneous interaction key to producing these effects? Are there particular technical features of some systems, such as SAMM or GroupSystems, that enhance or mitigate the impact of GSSs on these factors? Although there has been a great deal of speculation, little research has focused on isolating a cause for this phenomenon (Weisband, 1992; Wiesband et al., 1995). Identifying the critical features associated with GSSs will help establish a solid foundation to develop more effective theories for predicting and explaining the impact of GSS use on group processes.

Second, although the findings from this study generally support the equalization hypothesis, the impact of GSS use may be limited to initial uses of the technology. A majority of the experiments included in the analyses examined a single interaction among college students. Yet, scholars have repeatedly claimed that the democratizing effects of GSSs may not persist across repeated group interactions (Dubrovsky et al., 1991; McGrath & Hollingshead, 1994; Scott, 1999a; Scott & Easton, 1996). As groups using a GSS become more familiar with one another in the new meeting environment, influence patterns from traditional meetings may reemerge. Given the important practical implications associated with the repeated use of GSSs in

organizations, future research should examine the impact of GSS use over time.

Finally, research on GSSs presents a number of methodological challenges. Because participants in a team are not statistically independent, the unit of analysis in this body of research is groups (Postmes & Lea, 2000).[12] For researchers, this creates logistical difficulties in filling an adequate number of teams and running each of them through the study. Yet, without a sizable number of groups, the power of statistical tests is reduced, and the possibility of Type II error is increased. To detect a moderate-sized effect ($\omega^2 = .2$) between GSS and face-to-face conditions, for example, 20 groups per condition are necessary to achieve adequate statistical power (power = .89; Hays, 1994). Assuming that each group is composed of 3 individuals, 120 total participants would be necessary for the study.

One solution to this problem is the use of multilevel modeling (see Raudenbush & Bryk, 2002). Multilevel modeling (also called hierarchical linear modeling) is a statistical technique that facilitates the analysis of data with a hierarchical structure, such as individuals clustered in teams (Reis & Duan, 1999). In the context of research on GSSs, multilevel modeling makes it possible to account for the influence of the team in which a participant is placed. Through statistically accounting for the variance created by being placed in a particular team, the impact of a treatment—such as GSS use—can be examined at the individual level. The practical value of using multilevel modeling is that some of the logistical problems associated with recruiting and running participants can be overcome. From the prior example, only 20 participants per condition would be necessary to attain the same .89 power level for the statistical analyses. Multilevel modeling makes it possible to detect a moderate effect with as few as 7 groups (assuming 3 members per group) in each condition.

Conclusion

Given the widespread use of GSSs and the prominent effects proposed to result from their use, a meta-analysis of the aggregate impact of GSS use on group member influence behaviors was conducted in this study. The results of the analyses underscore the utility of GSSs as tools for organizational communication and decision making. Through increasing participation equality and influence equality and reducing member dominance, GSSs can help foster a more egalitarian communication environment. Yet, for scholars, questions remain about the effectiveness of GSS use over time and the mechanisms driving member behavior in GSS teams. Through continued research,

it will be possible to address these issues and, ultimately, to develop more effective communication tools for organizational members.

Notes

1. The author would like to thank Craig Scott and two anonymous reviewers for their insightful feedback on previous drafts of this manuscript. Correspondence concerning this article should be addressed to Stephen A. Rains, Department of Communication Studies—A1105, University of Texas at Austin, Austin, TX 78712; phone: (512) 471-7044; fax: (512) 471-3504l; e-mail: srains@mail.utexas.edu

2. Throughout this study, GSS will be used to refer to group support systems as well as group decision support systems. The term GSS is broader and more inclusive than is GDSS, encapsulating electronic meeting systems designed to support a range of communicative activities that include, but are not limited to, group decision making (McLeod, 1992; Scott, 1999a). GSSs are defined in this study as "suites of tools designed to focus the deliberation and enhance the communication of teams working under high cognitive loads" (Briggs et al., 1998, p. 5). That is, GSSs are composed of software designed to facilitate group work such as decision making, problem solving, and idea generation.

3. It is also noteworthy that McLeod (1992) and Benbasat and Lim (1993) reported medium-sized effects for the impact of GSS use on participation equality in their meta-analyses of group processes and outcomes. Yet, in both meta-analyses, studies assessing influence equality and participation were combined into a single measure of participation equality.

4. Despite the decrease in the level of influence of higher status group members, Scott and Easton (1996) report that a difference remained in the influence level of lower and higher status members. GSS use did not completely eliminate status differences between participants.

5. Studies reported in the proceedings from these two conferences were included in the analysis for two reasons. First, submissions to both of these conferences are subject to a peer review process. Second, including studies from these two conferences makes it possible to gather a larger sample and may help mitigate so-called file-drawer problems within this body of research (discussed further in the limitations section). Six of the studies included in the meta-analysis are from one of these two conferences.

6. Measures of participation and influence focus solely on the frequency of each individual group member's contributions. Measures of participation or influence equality, in contrast, examine an individual member's participation or influence in proportion to all of the other members' participation or influence. Thus, measures of participation or influence equality reflect a member's behavior relative to all other group members. Measuring equality makes it possible to account for differences in absolute rates of participation or influence stemming from an individual's ability to speak (in face-to-face conditions) more quickly than he or she can type (in GSS conditions).

7. In the DSTAT program, d is converted from g using the following formula given by Hedges and Olkin (1985): $d = (1 - (3 / 4N - 9))g$. The g coefficient represents the difference between the experimental and control group divided by the pooled standard deviation.

8. The standard deviation of each effect was computed to indicate the degree to which it deviates from the average effect size for the variable. Experiments resulting in effect sizes +/– 3.29 standard deviations from the average effect, or outside the 99.9% confidence interval, were considered statistical outliers and were excluded from the

analysis. This approach is advocated by Lipsey and Wilson (2001) who argue that the purpose of meta-analysis "is not usually served well by the inclusion of extreme effect size values that are notably discrepant from the preponderance of those found in the research of interest and, hence, unrepresentative of the results of that research and possibly even spurious" (p. 107).

9. Also, some of the studies included in the meta-analysis manipulated task type (e.g., Huang & Wei, 2000; Huang et al., 1999; Tan et al., 1998; Tan et al., 1999), anonymity (e.g., Gallupe & McKeen, 1990; Tan et al., 1999), and/or national culture (e.g., Tan et al., 1998; Tan et al., 1999; Watson et al., 1994) as independent variables. In these cases, the main effects were examined in each of the manipulated conditions for moderator analyses. For example, to test the impact of the presence or absence of anonymity as a moderating variable, separate effects were calculated for those in the anonymity and the identified conditions and used in the analysis.

10. Q_B is calculated in DSTAT using the following formula given by Hedges and Olkin (1985): $\sum_{i=1}^{p} (d_{i+} - d_{++})^2 / \sigma^2(d_{i+})$

11. Q_W is calculated in DSTAT using the following formula given by Hedges and Olkin (1985): $\sum_{i=1}^{p} \sum_{j=1}^{mi} (d_{ij} - d_{i+})^2 / \sigma^2(d_{ij})$

12. Failing to consider the effect of the group in which participants are placed violates the assumption of independence for analysis of variance and regression techniques. The implication of this violation is that the amount of sampling variance, and the commensurate standard error used in statistical tests, is underestimated. Consequently, Type I error rate may be inflated.

References

Anderson, W. N., & Hiltz, S. R. (2001). *Culturally heterogeneous vs. culturally homogeneous groups in distributed group support systems: Effects on group process and consensus*. Retrieved June 24, 2004, from http://www.computer.org/proceedings/cps_dl.htm

Anonymous. (1998). To reveal or not to reveal: A theoretical model of anonymous communication. *Communication Theory*, *8*, 381-407.

Benbasat, I., & Lim, L. H. (1993). The effects of group, task, context, and technology variables on the usefulness of group support systems: A meta-analysis of experimental studies. *Small Group Research*, *24*, 430-462.

Briggs, R. O., Nunamaker, J., & Sprague, R. (1998). 1001 unanswered research questions in GSS. *Journal of Management Information Systems*, *14*, 3-22.

Burke, K., & Chidambaram, L. (1994). Development in electronically-supported groups: A preliminary longitudinal study of distributed and face-to-face meetings. *Proceedings of the Twenty-Seventh Hawaii International Conference on System Sciences*, *4*, 104-113.

Burnstein, E. (1982). Persuasion as argument processing. In J. H. Davis & G. Stocker-Kreichgauer (Eds.), *Group decision processes* (pp. 381-395). London: Academic Press.

Chidambaram, L., & Jones, B. (1993). Impact of communication medium and computer support on group perceptions and performance: A comparison of face-to-face and dispersed meetings. *MIS Quarterly*, *17*, 465-491.

Cohen, J. (1977). *Statistical power analysis for the behavioral sciences*. New York: Academic Press.

Connolly, T., Routhieaux, R. L., & Schneider, S. K. (1993). On the effectiveness of group brainstorming: Test of one underlying cognitive mechanism. *Small Group Research*, *24*, 490-503.

Davey, A., & Olson, D. (1998). Multiple criteria decision making models in group decision support. *Group Decision and Negotiation*, *7*, 55-75.

Dennis, A., Aronson, J., Heninger, B., & Walker, E. (1996). A task and time decomposition in electronic brainstorming. *Proceedings of the Twenty-Ninth Hawaii International Conference on System Sciences*, *3*, 51-59.

Dennis, A. R. (1996). Information exchange and use in group decision making: You can lead a group to information, but you can't make it think. *MIS Quarterly*, *20*, 433-457.

Dennis, A. R., Hilmer, K. M., & Taylor, N. J. (1998). Information exchange and use in GSS and verbal group decision making: Effects of minority influence. *Journal of Management Information Systems*, *14*, 61-88.

Dennis, A. R., & Valacich, J. S. (1993). Computer brainstorms: More heads are better than one. *Journal of Applied Psychology*, *78*, 531-537.

Dennis, A. R., & Wixom, B. H. (2002). Investigating the moderators of the group support systems use with meta-analysis. *Journal of Management Information Systems*, *18*, 235-257.

Dennis, A. R., Wixom, B. H., & Vandenberg, R. J. (2001). Understanding fit and appropriation effects in group support systems via meta-analysis. *MIS Quarterly*, *25*, 169-173.

DeSanctis, G., & Gallupe, R. B. (1987). A foundation for the study of group decision support systems. *Management Sciences*, *33*, 589-609.

Dubrovsky, V. J., Kiesler, S., & Sethna, B. N. (1991). The equalization phenomenon: Status effects in computer-mediated and face-to-face decision-making groups. *Human-Computer Interaction*, *6*, 119-146.

Easton, G., Easton, A., & Belch, M. (2003). An experimental investigation of electronic focus groups. *Information & Management*, *40*, 717-727.

Easton, G. K., George, J. F., Nunamaker, J. F., & Pendergast, M. O. (1990). Using two different electronic meeting system tools for the same task: An experimental comparison. *Journal of Management Information Systems*, *7*, 85-100.

Easton, A. C., Vogel, D. R., & Nunamaker, J. F. (1992). Interactive versus stand-alone group decision support systems for stakeholder identification and assumption surfacing in small groups. *Decision Support Systems*, *8*, 159-168.

El-Shinnawy, M., & Vinze, A. S. (1997). Technology, culture, and persuasiveness: A study of choice-shifts in group settings. *International Journal of Human-Computer Studies*, *47*, 473-496.

El-Shinnawy, M., & Vinze, A. S. (1998). Polarization and persuasive argumentation: A study of decision making in group settings. *MIS Quarterly*, *22*, 165-198.

Fjermestad, J., & Hiltz, S. R. (1998). An assessment of group support systems experimental research: Methodology and results. *Journal of Management Information Systems*, *15*, 7-149.

Fulk, J., & Collins-Jarvis, L. (2001). Wired meetings: Technological mediation of organizational gatherings. In F. Jablin & L. Putnam (Eds.), *New handbook of organizational communication* (pp. 624-663). Thousand Oaks, CA: Sage.

Gallupe, R. B., Bastianutti, L. M., & Cooper, W. H. (1991). Unblocking brainstorms. *Journal of Applied Psychology*, *76*, 137-142.

Gallupe, R. B., Dennis, A. R., Cooper, W. H., Valacich, J. S., Bastianutti, L. M., & Nunamaker, J. F. (1992). Electronic brainstorming and group size. *Academy of Management Journal*, *35*, 350-369.

Gallupe, R. B., DeSanctis, G., & Dickson, G. W. (1988). Computer-based support for problem-finding: An experimental investigation. *MIS Quarterly*, *12*, 277-296.

Gallupe, R. B., & McKeen, J. D. (1990). Enhancing computer-mediated communication: An experimental investigation into the use of a group decision support system for face-to-face versus remote meetings. *Information and Management*, *18*, 1-13.

George, J. F., Easton, G. K., Nunamaker, J. F., & Northcraft, G. B. (1990). A study of collaborative group work with and without computer-based support. *Information Systems Research*, *1*, 394-415.

Hayne, S. C., & Rice, R. E. (1997). Attribution accuracy when using anonymity in group support systems. *International Journal of Human Computer Studies*, *47*, 429-452.

Hays, W. L. (1994). *Statistics*. Orlando, FL: Harcourt Brace.

Hedges, L. V., & Olkin, I. (1985). *Statistical methods for meta-analysis*. Orlando, FL: Academic Press.

Hender, J. M., Rodgers, T. L., Dean, D. L., & Nunamaker, J. F. (2001). *Improving group creativity: Brainstorming versus non-brainstorming techniques in a GSS environment*. Retrieved June 24, 2004, from http://www.computer.org/proceedings/cps_dl.htm

Hiltz, S. R., Johnson, K., & Turoff, M. (1991). Group decision support: The effects of designated human leaders and statistical feedback in computerized conferences. *Journal of Management Information Systems*, *8*, 81-108.

Ho, T. H., & Raman, K. S. (1991). The effect of GDSS and elected leadership on small group meetings. *Journal of Management Information Systems*, *8*, 19-133.

Hollingshead, A. B. (1996). Information suppression and status persistence in group decision making: The effects of communication media. *Human Communication Research*, *23*, 193-219.

Huang, W., Raman, K. S., & Wei, K. K. (1997). Effects of group support system and task type on social influences in small groups. *IEEE Transactions on Systems, Man, and Cybernetics—Part A: Systems and Humans*, *27*, 578-587.

Huang, W. W., & Wei, K. K. (2000). An empirical investigation of the effects of group support systems (GSS) and task type on group interactions from an

influence perspective. *Journal of Management Information Systems*, *17*, 181-206.
Huang, W., Wei, K. K., & Tan, B. C. (1999). Compensating effects of GSS on group performance. *Information and Management*, *35*, 195-202.
Huang, W. W., Wei, K. K., Watson, R. T., & Tan, B. C. (2002). Supporting virtual team-building in GSS: An empirical investigation. *Decision Support Systems*, *34*, 359-367.
Hunter, J., & Schmidt, F. (1990). *Methods of meta-analysis.* Newbury Park, CA: Sage.
Hunter, J. E., Schmidt, F. L., & Jackson, G. B. (1982). *Meta-analysis: Cumulating research findings across studies*. Beverly Hills, CA: Sage.
Hwang, H. G., & Guynes, J. (1994). The effect of group size on group performance in computer-supported decision making. *Information and Management*, *26*, 189-198.
Jarvenpaa, S. L., Rao, V. S., & Huber, G. P. (1988). Computer support for meetings of groups working on unstructured problems: A field experiment. *MIS Quarterly*, *12*, 645-666.
Jessup, L. M., & Tansik, D. A. (1991). Decision making in an automated environment: The effects of anonymity and proximity with a group decision support system. *Decision Sciences*, *22*, 266-279.
Johnson, B. T. (1989). *DSTAT: Software for the meta-analytic review of research literatures*. Hillsdale, NJ: Lawrence Erlbaum.
Karan, V., Kerr, D. S., Murphy, U. S., & Vinze, A. S. (1996). Information technology support for collaborative decision making in auditing: An experimental investigation. *Decision Support Systems*, *16*, 181-194.
Kelsey, B. L. (2000). Increasing minority group participation and influence using a group support system. *Canadian Journal of Administrative Sciences*, *17*, 63-75.
Kiesler, S., Siegel, J., & McGuire, T. W. (1984). Some psychological aspects of computer-mediated communication. *American Psychologists*, *39*, 1123-1134.
Kwok, R. C., Ma, J., & Vogel, D. R. (2002). Effects of group support systems and content facilitation on knowledge acquisition. *Journal of Management Information Systems*, *19*, 185-229.
Lewis, L. F. (1987). A decision support system for face-to-face groups. *Journal of Information Sciences*, *13*, 211-219.
Lim, L. H., Raman, K. S., & Wei, K. K. (1994). Interacting effects of GDSS and leadership. *Decision Support Systems*, *12*, 199-211.
Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis.* Thousand Oaks, CA: Sage.
Massey, A. P., & Clapper, D. L. (1995). Element finding: The impact of a group support system on a crucial phase of sense making. *Journal of Management Information Systems*, *11*, 149-176.
McGrath, J. E. (1984). *Groups: Interaction and performance.* Englewood Cliffs, NJ: Prentice Hall.
McGrath, J. E., & Hollingshead, A. B. (1994). *Groups interacting with technology.* Thousand Oaks, CA: Sage.

McGuire, T. W., Kiesler, S., & Siegel, J. (1987). Group and computer-mediated discussion effects in risk decision making. *Journal of Personality and Social Psychology*, *32*, 917-930.

McLeod, P. L. (1992). An assessment of the experimental literature on electronic support of group work: Results of a meta-analysis. *Human-Computer Interaction*, *7*, 257-280.

McLeod, P. L., & Liker, J. K. (1992). Electronic meeting systems: Evidence from a low structure environment. *Information Systems Research*, *3*, 195-223.

Mejias, R., Lazeno, L., Rico, A., Torres, A., Vogel, D., & Shepherd, M. (1996). A cross-cultural comparison of GSS and non-GSS consensus and satisfaction level within and between the U.S. and Mexico. *Proceedings of the Twenty-Ninth Hawaii International Conference on System Sciences*, *3*, 408-417.

Mejias, R. J., Shepherd, M. M., Vogel, D. R., & Lazaneo, L. (1997). Consensus and perceived satisfaction levels: A cross-cultural comparison of GSS and non-GSS outcomes within and between the United States and Mexico. *Journal of Management Information Systems*, *13*, 137-161.

Murthy, U. S., & Kerr, D. S. (2000). *Task/technology fit and the effectiveness of group support systems: Evidence in the context of tasks requiring domain specific knowledge*. Retrieved June 24, 2004, from http://www.computer.org/proceedings/cps_dl.htm

Nunamaker, J. F., Applegate, L. M., & Konsynski, B. R. (1988). Computer-aided deliberation: Model management and group decision support. *Operations Research*, *36*, 826-848.

Olaniran, B. A. (1996). A model of group satisfaction in computer-mediated communication and face-to-face meetings. *Behaviour and Information Technology*, *15*, 24-36.

Postmes, T., & Lea, M. (2000). Social processes and group decision making: Anonymity in group decision support systems. *Ergonomics*, *43*, 1252-1274.

Raman, K., Tan, B., & Wei, K. (1993). An empirical study of task type and communication medium in GDSS. *Proceedings of the Twenty-Sixth Hawaii International Conference on System Sciences*, *4*, 161-168.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks, CA: Sage.

Reinig, B. A., & Mejias, R. J., (2003). *An investigation of the influence of national culture and group support systems on group processes and outcomes*. Retrieved June 24, 2004, from http://www.computer.org/proceedings/cps_dl.htm

Reis, S. P., & Duan, N. (1999). Multilevel modeling and its application in counseling psychology research. *The Counseling Psychologist*, *27*, 528-551.

Robichaux, B. P., & Cooper, R. B. (1998). GSS participation: A cultural examination. *Information & Management*, *33*, 287-300.

Roy, M. C., Gauvin, S., & Limayem, M. (1996). Electronic group brainstorming: The role of feedback on productivity. *Small Group Research*, *27*, 215-247.

Samarah, I., Paul, S., Mykytyn, P., & Seetharaman, P. (2003). *The collaborative conflict management style and cultural diversity in DGSS supported*

fuzzy tasks: An experimental investigation. Retrieved June 24, 2004, from http://www.computer.org/proceedings/cps_dl.htm

Scott, C. R. (1999a). Communication technology and group communication. In L. R. Frey, D. Gouran, & M. S. Poole (Eds.), *The handbook of group communication theory and research* (pp. 432-472). Thousand Oaks, CA: Sage.

Scott, C. R. (1999b). The impact of physical and discursive anonymity on group members' multiple identifications during computer-supported decision making. *Western Journal of Communication*, *63*, 456-487.

Scott, C. R., & Easton, A. C. (1996). Examining equality of influence in group decision support system interaction. *Small Group Research*, *27*, 360-382.

Shirani, A. I., Tafti, M. H., & Affisco, J. F. (1999). Task and technology fit: A comparison of two technologies for synchronous and asynchronous group communication. *Information & Management*, *36*, 139-150.

Sia, C., Tan, B., & Wei, K. (1996, December). *Will distributed GSS groups make more extreme decisions? An empirical study*. Paper presented at the Proceedings of the 17th International Conference on Information Systems, Cleveland, OH.

Sia, C., Tan, B., & Wei, K. (2002). Group polarization and computer-mediated communication: Effects of communication cues, social presence, and anonymity. *Information Systems Research*, *13*, 70-90.

Siegel, J., Dubrovsky, V., Kiesler, S., & McGuire, T. W. (1986). Group processes in computer-mediated communication. *Organizational Behavior and Human Decision Processes*, *37*, 157-187.

Silver, S. D., Cohen, B. P., & Crutchfield, J. H. (1994). Status differentiation and information exchange in face-to-face and computer-mediated idea generation. *Social Psychology Quarterly*, *57*, 108-123.

Smith, J. Y., & Vanecek, M. (1989). A nonsimultaneous computer conference as a component of group decision support systems. *Proceedings of the Twenty-Second Hawaii International Conference on System Sciences*, *4*, 370-377.

Sproull, L., & Kiesler, S. (1986). Reducing social context cues: Electronic mail in organizational communication. *Management Science*, *32*, 1492-1512.

Sproull, L., & Kiesler, S. (1991). *Connections: New ways of working in the networked organization*. Cambridge, MA: Massachusetts Institute of Technology Press.

Straus, S. G. (1997). Technology, group process, and group outcomes: Testing the connections in computer-mediated and face-to-face communication. *Human-Computer Interaction*, *12*, 227-266.

Tan, B., Raman, K., & Wei, K. (1994). An empirical study of task dimension of group support systems. *IEEE Transactions on Systems, Man, and Cybernetics*, *24*, 1054-1060.

Tan, B., Wei, K., & Raman, K. (1991). Effects of support and task type on group decision outcomes: A study using SAMM. *Proceedings of the Twenty-Fourth Hawaii International Conference on System Sciences*, *4*, 537-546.

Tan, B. C., Wei, K. K., & Watson, R. T. (1999). The equalizing impact of a group support system on status differential. *ACM Transactions on Information Systems*, *17*, 77-100.

Tan, B. C., Wei, K. K., Watson, R. T., Clapper, D. L., & McLean, E. R. (1998). Computer-mediated communication and majority influence: Assessing the impact in an individualistic and collectivistic culture. *Management Science*, *44*, 1263-1278.

Tan, B. C., Wei, K. K., Watson, R. T., & Walczuch, R. M. (1998). Reducing status effects with computer-mediated communication: Evidence from two distinct national cultures. *Journal of Management Information Systems*, *15*, 119-141.

Valacich, J. S., George, J. F., Nunamaker, J. F., & Vogel, D. R. (1994). Physical proximity effects on computer-mediated group idea generation. *Small Group Research*, *25*, 83-104.

Valacich, J. S., Sarker, S., Pratt, J., & Groomer, M. (2002). *Computer-mediated and face-to-face groups: Who makes riskier decisions?* Retrieved June 24, 2004, from http://www.computer.org/proceedings/cps_dl.htm

Valacich, J. S., & Schwenk, C. (1995). Devil's advocacy and dialectical inquiry effects on face-to-face and computer-mediated group decision making. *Organizational Behavior and Human Decision Processes*, *63*, 158-173.

Walther, J. B. (1995). Relational aspects of computer-mediated communication: Experimental observations over time. *Organization Science*, *6*, 186-203.

Walther, J. B., & Burgoon, J. K. (1992). Relational communication in computer-mediated interaction. *Human Communication Research*, *19*, 50-88.

Watson, R. T., DeSanctis, G., & Poole, M. S. (1988). Using a GDSS to facilitate group consensus: Some intended and unintended consequences. *MIS Quarterly*, *12*, 463-477.

Watson, R. T., Ho, T. S., & Raman, K. S. (1994). Culture: A fourth dimension of group support systems. *Communications of the ACM*, *37*, 44-55.

Weisband, S. P. (1992). Group discussion and first advocacy effects in computer-mediated and face-to-face decision making groups. *Organizational Behavior and Human Decision Processes*, *53*, 352-380.

Weisband, S. P., Schneider, S. K., & Connolly, T. (1995). Computer-mediated communication and social information: Status salience and status differences. *Academy of Management Journal*, *38*, 1124-1151.

Wilson, J., & Jessup, L. M. (1995). A field experiment on GSS anonymity and group member status. *Proceedings of the Twenty-Eighth Hawaii International Conference on System Sciences*, *4*, 212-221.

Wood, J. G., & Nosek, J. T. (1994). Discrimination of structure and technology in a group support system: The role of process complexity. *Proceedings of the International Conference on Information Systems*, *3*, 187-199.

Yellen, R. E., Winniford, M. A., & Sanford, C. C. (1995). Extraversion and introversion in electronically-supported meetings. *Information and Management*, *28*, 63-74.

Zigurs, I., Poole, M. S., & DeSanctis, G. L. (1988). A study of influence in computer-mediated group decision making. *MIS Quarterly*, *12*, 625-644.

***Stephen A. Rains**, M.S., Illinois State University, is a doctoral candidate at the University of Texas at Austin. His research focuses on issues at the intersection of new communication technologies and social influence.*