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Computer-Mediated Group Work: The Interaction of Member Sex and Anonymity

This research invokes two theoretical perspectives — the equalization hypothesis and the SIDE model — to examine the impact of individuals' sex on group members' use of anonymous, computer-mediated collaborative technologies. Data from 127 individuals in 22 enduring task groups indicate that the strategies employed differentially by men and women correspond with inferred motivations: men are more likely to seek ways to make computer-mediated interactions more like a face-to-face interaction with women, whereas women are more likely to employ strategies that maintain the reduced social cues of computer-mediated communication and afford them greater potential influence in mixed-sex interactions. The integration of theories previously regarded as oppositional, and the empirical support of hypotheses derived from these perspectives, suggest a richer, more complex view of technological support of group work at a time when collaborative technologies are increasingly important, given shifts toward more dispersed, global, and virtual organizational work groups.

Electronic means of communication have been credited with extending the number and variety of people involved in work group decisions (Sproull & Kiesler, 1991), diminishing temporal and physical interaction constraints (Eveland & Bikson, 1988), and increasing horizontal and vertical communication in organizations (Hinds & Kiesler, 1995). Pinsonneault and Kraemer (1990) reported that technological advancements affect group processes in organizations by increasing the potential for consensus, confidence in group decisions, and members' satisfaction with group process and group decisions

COMMUNICATION RESEARCH, Vol. 29 No. 1, February 2002 66-93

while also decreasing decision time. Moreover, as these tools become more prevalent, organizations are increasingly relying on dispersed groups of workers to achieve organizational goals (Fulk & Collins-Jarvis, 2001). Accordingly, the study of electronic communication tools designed to aid group collaboration has become an important area of research during the past decade or so (DeSanctis & Gallupe, 1987; Scott, 1999; Sosik, Avolio, & Kahai, 1997; Valacich, Dennis, & Nunamaker, 1992).

One specific outcome proposed to derive from the use of computer-mediated communication (CMC)[2] is the "equalization phenomenon" (Dubrovsky, Kiesler, & Sethna, 1991; Kiesler, Siegel, & McGuire, 1984; Siegel, Dubrovsky, Kiesler, & McGuire, 1986). From this perspective, CMC provides group members a means by which to escape traditional social constraints that occur in face-to-face interaction. By reducing or eliminating static cues (e.g., cues such as appearance, gesticulation, and facial expression), CMC ostensibly enables individuals to interact more fully and equally. A reduction in social cues presumably leads to reduced social constraints and, hence, the reduced impact of social norms. Such disinhibition, in turn, also reduces status differentials (Dubrovsky et al., 1991) and encourages a greater equality of participation (Siegel et al., 1986).

However, the likelihood, level, and nature of equalization that may occur in a CMC environment are not agreed upon or clear. "Liberation" claims characteristic of the equalization perspective have been challenged on several fronts (Lea, O'Shea, Fung, & Spears, 1992; Walther, Anderson, & Park, 1994; Weldon & Mustari, 1988), and recent research points to the important influence of group norms in determining salient identity in anonymous CMC environments (Postmes, Spears, & Lea, 1998, 2000; Spears & Lea, 1994). Furthermore, such factors as the anticipation of future interaction (Walther, 1992) and extended personal interaction (Walther et al., 1994) have been demonstrated to play key roles in the development of group dynamics and individual behaviors.

The research reported here examines these liberation claims by focusing on the group-related effects of members' sex—an important cue that may be masked or unavailable in CMC—during groups' use of anonymous, computer-mediated collaborative technologies. Although the issue of how males and females interact in groups has long been an area of study in a variety of disciplines (see, for instance, Andrews, 1992; Hawkins, 1995; Mabry, 1985; Wheelan & Verdi, 1992), research directly examining sex within a collaborative technology environment is sparse, particularly research on enduring work groups focusing on meaningful tasks over extended periods of time. However, with the current widespread use of CMC for collaborative group work (Scott, 1999), the consideration of sex has reemerged as a potentially

important factor in the study of contemporary organizational groups interacting via technologies. With this reemergence, a number of crucial questions arise: Do any benefits derived from the use of collaborative computer-mediated technologies accrue equally to all group members? Does the equalization phenomenon, a subject of some debate, play a role in considering sex differences in a computer-mediated, anonymous collaborative environment? Are there differences in how males and females strategically use collaborative technologies for personal and group aims?

To address these questions, we proceed by first reviewing research on the effects of CMC on groups of people working collaboratively. In so doing, we examine the nature of communication in CMC, the role of anonymity in collaborative electronic environments, sex roles in face-to-face and mediated communication, and competing theories of technological effects on group work. Second, to test a number of hypotheses developed from these theoretical bases, we report data from two studies of collaborative group work over extended periods of time in a computer-mediated, anonymous, collaborative environment. Results of the studies illuminate our understanding of the role of technologies and group member sex in contemporary work groups. Third, in light of the results, we identify theoretical extensions to extant literature and a number of applied directions for current technological systems designed for the support of collaborative work.

The Interaction of Sex and Anonymity in Computer-Mediated Group Environments

Sex, Anonymity, and Group Technology Use

According to Lockheed and Hall (1976), as a result of power and prestige ordering, women in face-to-face groups are often at a disadvantage in relation to men, and are therefore less positive about communicating. Gopal, Mirana, Robichaux, and Bostrom (1997) note that this could lead to greater communication apprehension and reticence for females because of their perceived "lower status." Indeed, research reveals that males do exhibit less communication apprehension in groups than do their female counterparts (Heinssen, Glass, & Knight, 1987).

Extending this notion to CMC environments, Scott (1999) suggests that member status is an important input variable when considering group processes supported by collaborative technologies. He posits that status cues, such as sex, may be of particular importance in groups interacting via technology because of a reduction in the social cues and social presence that are

typically part of group interaction in face-to-face communication. Such differences may explain why computer-mediated environments are often perceived by women as more hostile and less hospitable than by men (Herring, 1996). Accordingly, Gopal et al. (1997) found that females preferred interacting anonymously through collaborative group technologies because they were able to communicate to others without being judged on the basis of their sex. Similarly, others suggest that group support technologies can (e.g., by facilitating anonymity) provide members with a means to communicate that minimizes the potential disadvantages associated with a person's sex (Herschel, Cooper, Smith, & Arrington, 1994).

Consistent with this argument and with the equalization phenomenon, Connolly, Jessup, and Valacich (1990) found that the positive effect of anonymity inheres in the comfort of putting forth ideas that otherwise may have been suppressed. Specifically, in an investigation of small groups that employed computer-mediated systems to generate ideas, Connolly et al. (1990) discovered that anonymity led to increased idea generation. Similarly, Valacich et al. (1992) noted that "anonymity may promote interaction because it offers a low-threat communicative environment" (p. 54). Group members also can be assured that ideas set forth to others will be evaluated in terms of merit and worth, not on the reputations or rank of the members themselves (Jessup, Connolly, & Tansik, 1990). Therefore, group members who traditionally participate less in face-to-face contexts (e.g., females) may be likely to express themselves more in anonymous CMC environments. In this equalization view, women may find that anonymous, computer-mediated environments hold significant advantages for them in group interactions.

However, an alternative perspective—the SIDE model—proposes that the bases of the "liberation" afforded by CMC technology use may reside as much in females' and males' strategic use of the technology as in the equalization characteristics of the technology itself. This perspective suggests that CMC technologies are not deterministic, but rather that individuals may be technologically opportunistic and that men and women might respond to the opportunity of anonymity in different ways given their different experiences in face-to-face interactions. Although the SIDE model has typically been treated as oppositional to the equalization perspective, we view the two as complementary with regard to differences in males' and females' behavior in CMC groups.

SIDE effects of anonymous, computer-mediated communication. The social identity model of deindividuation (SIDE model; Spears & Lea, 1992, 1994) posits two central elements related to situated self-categorization—a *cognitive*

element corresponding to the salient identity or self-category, and a *strategic* element corresponding to the potential expression of behavior consistent with that self-category (Spears & Lea, 1994). The SIDE model thus draws from social-identity and self-categorization theories that present individuals as having multiple layers of self that can be accessed depending on which identity is salient in a given social context (Postmes et al., 1998). Spears and Lea (1994) argue that prevailing claims of equalization present a rather optimistic view and they contend that technical features, such as anonymity, do not produce a loss of identity as much as an increase in the salience of social identity in group contexts. They caution against viewing CMC as a sort of virtual reality where the individual can escape the constraints of ordinary identity and interaction and argue that interaction in CMC instead will often be grounded in the same social relations that exist beyond CMC. Although Spears and Lea (1994) do not dispute that social information is eliminated or reduced by CMC, they do suggest that the social cues that remain, typically cues to role, status, and category membership that are often implied in the social context, can become more important and influential rather than less so and cannot be divorced from their underlying social context.

In addition, we maintain that users recognize their status prior to entering a CMC environment (a cognitive element) and may make decisions when using CMC channels that either dampen the equalization prospects of anonymity (in the case of those with higher status) or take advantage of the benefits of anonymity by expressing a neutral or alternative identity to equalize or even heighten status (a strategic element). Therefore, it is crucial to recognize that the identity cloak provided by CMC can imply a freedom to "exploit or explore" (Spears & Lea, 1994). With respect to sex, women and men may "exploit" CMC in different manners to transcend or to perpetuate status differentials in ways that might either be typical or impossible in face-to-face conversation, given the inability in such conversations to mask identifying cues. In spite of its relevance to understanding group behavior and its particular richness for examining status and power differences (Postmes et al., 1998; Spears & Lea, 1994), this strategic element of the SIDE model has remained largely unexplored.

Anonymity in CMC may thus enable resistance to some groups' dynamics (e.g., sex stereotyping) that, if groups were not anonymous, would not be as easy to resist. This is the key distinction of the strategic (as opposed to cognitive) SIDE model. In strategic models, the use of the technology can be liberating in ways similar to equalization phenomenon perspectives. However, the sources of influence are quite different. From an equalization perspective, the

technological tools are the root of status reduction. By contrast, the SIDE model stipulates that group members define themselves strategically in contrast to others. Although technological capabilities such as anonymity do matter, they are not the primary cause of equalization phenomena. Instead, equalization occurs when individuals actively and strategically process socially relevant information (e.g., sex stereotypes) to further their own goals. Thus, considering both the equalization perspective and the SIDE model, we hypothesize the following:

> *Hypothesis 1*$_{a\text{-}b}$: Females (a) will perceive their group contributions to be more readily accepted when working in an anonymous, computer-mediated group environment and (b) will enjoy this anonymity more than males will.

Although the SIDE model emphasizes that anonymity reinforces boundaries between groups, it is also the case that individuals are simultaneously guided by group and individual identities. Ellemers (1993) reports that unstable group status seems to elicit a desire for collective action toward status improvement such that ingroup identification is heightened; at the same time, permeable group boundaries seem to elicit "a desire to upgrade one's status position individually, as a result of which people resist identification with their group" (p. 45). Consequently, particularly salient individual identities (e.g., sex) might mitigate the effects of even the strongest group identities, such that individual motivations guide behaviors as well.

This is particularly likely in the strategic dimension of the SIDE model and when a salient category might work to one's disadvantage. For example, there is evidence that individuals in CMC environments adapt their communicative cues to relational management and that people are resilient when it comes to finding ways to exchange and process social information (Walther, 1992). Moreover, CMC partners engage in selective self-presentation by taking advantage of the limitations of the medium to mask undesirable cues while intentionally presenting preferred cues (Walther, 1996). As evidence of status protection, Ellemers (1993) found that high status minority subjects felt most proud of their group membership and sought to maintain its exclusiveness when boundaries were permeable. Inside anonymous CMC, the boundary of sex becomes permeable, which makes individual identity salient and may prompt men to protect the status advantage they enjoy in face-to-face interaction. Consequently, Hypothesis 2 addresses males' desire to recapture advantages that may occur in group communication that is not anonymous:

Hypothesis 2: Males will have a greater desire to disclose identifying, personal information than will females when working in an anonymous, computer-mediated group environment.

Consistent with the strategic element of the SIDE model, Myers (1987) found that those with a distinct social advantage in the group tended to disclose personal information voluntarily, whereas those who lacked such advantage were completely unwilling to disclose personal information. Similarly, when given the opportunity, women tended to mask their sex with their choice of pseudonyms in CMC, whereas men did not (Jaffe, Lee, Huang, & Oshagan, 1999). This suggests that within CMC members at a disadvantage recognize their lower status and, therefore, may prefer their online identity to their actual identity because it enables them to exert a higher degree of influence. It therefore seems reasonable to expect that with a permeable sex boundary, women will be motivated to heighten their status, whereas men will attempt to maintain any advantages that may accrue to them as a result of their sex (Ellemers, 1993). Therefore, in CMC men may be more likely than women to behave in ways that signal their actual sex. In addition, because research has shown that women sometimes suppress their sex to avoid unwanted attention and experience the freedoms of neutral or male identities (Myers, 1987), Hypothesis 3 addresses sex deception that may occur in anonymous, computer-mediated groups:

Hypothesis $3_{a\text{-}b}$: When working in an anonymous, computer-mediated group environment, for those who report representing their sex to other group members, (a) males will be more likely than females to give the impression of their actual sex and (b) females will be more likely than males to give the impression of the opposite sex.

Sex Differences in Mediated Groups

Hawkins (1995) investigated the role of sex as a factor in understanding leadership emergence in task-oriented small groups and observed that the bulk of group communication content focused on task-relevant communication—a style used primarily by males—which was the significant predictor of leadership emergence. However, Andrews (1992) suggested that in organizational settings the focus on task-oriented behavior may not be desirable or appropriate. For instance, Baird and Bradley (1979) determined that in an actual organizational context, females exceeded males in being receptive to ideas, stressing interpersonal relations, showing concern, and being attentive to

others, whereas males exceeded females in dominance, being quick to challenge others, and directing the course of the conversation. They also found that the female behavioral style led to greater subordinate satisfaction. Similar findings surfaced in Eagly and Johnson's (1990) meta-analysis of studies on sex and leadership styles. They concluded that women tended to adopt a more democratic style and were more "kind, helpful, understanding, warm, sympathetic, [and] aware of others' feelings" than men, who adopted a more autocratic style and were more "aggressive, independent, self-sufficient, forceful, [and] dominant" (p. 236). Face-to-face groups thus seem to be characterized by sex differences in task and relational communication.

Despite research focusing on the effects of sex on roles and communication styles in face-to-face contexts (Hawkins, 1995; Herschel, 1994; Mabry, 1985), few studies have examined the effects of sex in CMC settings. For instance, Postmes and Spears (in press) found that characteristics of the social context interact to produce sex differences in CMC. Specifically, with sex stereotypes activated, and individuation not possible, males dominated masculine-oriented discussions, whereas women under the same conditions were more assertive in feminine-oriented discussions. Similarly, women have demonstrated greater social interdependence in CMC groups (Jaffe et al., 1999). Another notable exception is Hardy, Hodgson, and McConnell (1994), who investigated turn-taking behavior, duration of speech, and types of messages produced by males and females in CMC settings. Females took more turns than males during group computer conferences but showed no difference in length of "talk time." When asked to describe their relational computer communication experiences, however, females consistently spoke of being " 'more holistic,' being themselves or using their own language, and the ease of feeling connected to and responding to other women" as opposed to feeling "heavy and cerebral . . . [and] intimidated" when referring to conversations with men (p. 410). This suggests that men engage in task-oriented "report talk," whereas women engage in relationship-oriented "rapport talk." Combined with Walther's (1997) finding that long-term CMC interactions are more socially oriented than short-term interactions, as well as sex research indicating that men are more outcome-oriented whereas women are more process-oriented (Van Hiel & Schittekatte, 1998), we propose the following:

Hypothesis $4_{a\text{-}d}$: Compared to males, females will have higher levels of social or process-oriented behavior reflective of (a) group cohesion, (b) group trust, (c) task interdependence, and (d) satisfaction with group process when working in an anonymous, computer-mediated group environment.

Sustained Group Interaction

Social Information Processing theory (SIP) (Walther, 1992, 1994) echoes SIDE theory in its contention that rather than eliminating social information, or blinding participants to it, CMC's limited bandwidth might simply delay normal impression development and relational communication. The source of this delay is that CMC compresses both task-related and social information into a single channel such that it takes longer to exchange the same number of messages in CMC than it does in face-to-face interaction. Like SIDE theory, SIP is based on the belief that users adapt their remaining communicative cues to the process of relational management, which suggests that people are resilient when it comes to finding ways to exchange and process social information (Walther, 1992).

Similarly, interactions restricted by time have been shown to be associated with task-oriented communication, whereas both truly unrestricted and apparently unrestricted time frames result in more socioemotionally positive behavior (Walther et al., 1994). Asynchronous CMC, given the additional time to contemplate and compose messages, heightens the opportunity for selective self-presentation and may explain why environments with reduced cues have led to higher ratings of partners' attitude similarity, social attractiveness, and physical attractiveness, a phenomenon called the "hyperpersonal" perspective (Walther, 1996). Walther (1997) notes that when no future interactions were anticipated, communication was more impersonal when compared to more long-term interactions, which were characterized as more social and personal. Given these findings, coupled with the findings on sex differences in computer-mediated groups, we predict the following:

Hypothesis 5$_{a\text{-}d}$: Over time, females working in an anonymous, computer--mediated group environment will increase their levels of social or process-oriented group behaviors reflective of (a) group cohesion, (b) group trust, (c) task interdependence, and (d) satisfaction with group process.

Sex Composition of Groups

The relative proportion of members of each sex comprising a group is a critical determinant of that group's behavior (Kanter, 1977). The sex composition of groups may mediate interaction patterns, communicative behavior, leadership emergence, and satisfaction outcomes (Andrews, 1992). Comparing all-female groups to mixed-sex groups, Piliavin and Martin (1978) found that

females interacting in groups with males performed in somewhat more task-oriented and less socioemotional ways than did women in all-female groups. Dose (1996) reported that individuals in mixed-sex groups made more statements classified as giving informational influence than did those in all-female groups. Propp (1996) noted that women in mixed-sex groups asked significantly more questions as a form of information evaluation than did women in all-female groups, which Propp interpreted as a coping mechanism brought on by low status. In addition, Courter (1999) observed that all-female groups offered more resistance to female leadership than did mixed-sex groups. Taken together, these findings suggest that all-female groups are distinguishable from mixed-sex groups by the emphasis placed on socioemotional behaviors. Moreover, the presence or absence of males appears to alter female responses. With males present, females tend to act in ways that offset traditional differences between the sexes. Without men in the group, women appear to place a premium on socioemotive processes that promote equality, even if it means resisting a woman in authority in an all-female group.

Such findings raise the issue of whether sex-based communication differences will endure under conditions of anonymity—when the group's composition is unknown to its members. Herschel (1994) found that sex composition did not affect brainstorming performance for groups working in anonymity within computerized group support systems (GSS). Klein and Dologie (2000) reported no difference in the innovativeness of ideas generated by all-male, all-female, and mixed-sex groups in an anonymous GSS setting. However, the innovativeness of an idea and brainstorming performance are both measures of task outcomes and not evaluative of the process, per se. Indeed, when examining socioemotional behaviors in GSS, Herschel et al. (1994) discovered that same-sex groups expressed more positive socioemotional behaviors (i.e., relational communication acts showing solidarity, tension release, and agreement) than did mixed-sex groups. Given that a group's sex composition explains communicative differences, even under conditions of anonymity, and coupled with previous research that has consistently found all-female groups to be more socioemotive than mixed-sex groups, we predict the following:

Hypothesis 6$_{a\text{-}d}$: All-female groups will have higher levels of social or process-oriented group behaviors reflective of (a) group cohesion, (b) group trust, (c) task interdependence, and (d) satisfaction with group process than will mixed-sex groups working in an anonymous, computer-mediated group environment.

Method

Collaborative Technology and Participants

Participants were advanced college students (juniors and seniors) enrolled in an undergraduate course focusing on collaborative technologies in contemporary organizations. Data were collected from two distinct sets of participants ($N = 58$ and $N = 69$) in late 1998 and late 1999 (hereafter dataset A and dataset B, respectively). Because some measures were common to the two datasets, a degree of replicability was achieved in the testing of Hypotheses 1 and 2.

Participants in this research used a custom-designed, computer-based software application that was delivered via the Internet. This technology was modeled after group support systems used in contemporary organizations and was designed to support members working together in online groups. The system provided a range of options to support group teamwork: Users were able to access self-generated reference material and to work together by way of asynchronous, text-based communication and information sharing features. More specifically, users could assemble information to complete tasks and then share it with members of their group either by sending electronic messages to any combination of members or by placing information in a common database. In addition to these communication and information-sharing functions, the technology enabled group members to work on jointly authored documents to fulfill group work requirements. Tasks completed by group members required widescale participation across several group members over extended periods of time and were the sole basis for evaluation in the course. Thus, tasks were interdependent, purposeful, the basis for meaningful rewards, and substantially resembled organizational work tasks. Prior to using the system for group work, all users attended a mandatory training session and were allotted time to experiment with the technology.

Procedure

For both datasets, participants were randomly assigned to groups of between 5 and 7 members, with whom they worked for 10 weeks using the collaborative technology already described. Group membership remained the same for the duration of the 10-week period, except for the early attrition of a few members (which occurred prior to data collection). Group members were identified to one another only by non sex-specific pseudonyms, which were selected after pretests of the sex neutrality of these names.[3] Participants thus did not know the actual identity of the other members of their own

group, nor did they know the user IDs of members from groups other than their own. In this manner, participants worked with a stable group of people who remained anonymous in terms of identity and attendant cues (sex, appearance, etc.) for the duration of their working relationship.[4]

For dataset A, 10 groups of 5 to 7 members were formed (N = 58). There were 41 females (71%) and 17 males (29%). Due to the low number of males in this population, all groups were mixed-sex, although the majority membership of each group was female. For dataset B, 12 groups were formed, ranging from 5 to 6 members each (N = 69). There were 42 females (61%) and 27 males (39%). From this more balanced population, groups were stratified by sex, and members were randomly assigned, which resulted in three all-female groups and nine mixed-sex groups of fairly equal proportion.

Measures

Unless otherwise noted, measures in this study were identical across datasets A and B and were gathered at multiple points in time by means of an online survey, completed by group members at the conclusion of each of 7 group tasks (the same survey was administered at each point in time). Data from multiple time periods were collapsed to mean values across the 7 measurement periods (with the exception of data for Hypothesis 5, which explicitly examined over-time phenomena).

Data for some measures were gathered across the 7 time periods for dataset B but only at one point in time (after the completion of the final group task) for dataset A: The *perceived acceptance of group contributions* was assessed by subjects' responses to the statement, "I feel as though my contributions are accepted more readily using [the group support technology] than they would be if we met face-to face." Users indicated their *enjoyment of anonymity* by responding to the statement "I enjoyed the anonymity that [the group support technology] provides." Each of these items was assessed on a 7-point scale for dataset A and a 5-point scale for dataset B (from *strongly disagree* to *strongly agree*). *Desire for information disclosure* items probed users' desire to reveal or disclose personal information that would violate the condition of anonymity (5-point scale for both datasets). *Sex representation* was indicated by responses to the statement, "If you tried to give the impression that you were a specific gender/sex, which did you try to be?" This particular measure was gathered only for dataset A. *Sex* was derived from course enrollment information.

Data for the following measures were collected only as part of dataset B on a 5-point scale ranging from *strongly disagree* to *strongly agree*: *Group*

cohesiveness was composed of items adapted from Seashore (1954) and Warkentin, Sayeed, and Hightower (1997) that reflected group members' sense of belonging, inclusiveness, helpfulness, and ability to work together. *Group task interdependence* items assessed beliefs about the extent to which successful task completion required widescale input from team members. *Satisfaction with group process* was composed of items from Green and Taber (1980) and Warkentin et al. (1997). *Group trust* scale items were derived from measures by Mayer, Davis, and Schoorman (1995) and Pearce, Sommer, Morris, and Frideger (1992; as cited in Jarvenpaa & Leidner, 1998).

For multiple-item measures, Cronbach's alpha was calculated to assess reliability. Due to autocorrelation among responses, the final alpha reliability measure was determined by the mean of 7 reliability measures, one calculated for each time period. Appendix A contains a list of each multi-item variable, the survey items included in it, and its Cronbach's alpha value. In view of the differences in measures between datasets A and B, Hypotheses 1 and 2 were tested with data from datasets A and B, Hypothesis 3 was tested with data only from dataset A, and Hypotheses 4, 5, and 6 were tested with data from dataset B only.

Results

Hypothesis 1 proposed that females would perceive their contributions to the group to be accepted more readily when working with the computer-mediated, anonymous group than they would be if meeting face-to-face (Hypothesis 1a) and would enjoy this anonymity more than would males (Hypothesis 1b). Because the data most likely exhibit interdependence among observations by virtue of the "groupness" shared by participants, intraclass correlation (ICC) measures were employed to determine the degree of this interdependence and its effect on the findings.[5] According to Kenny (1995), "if p_x [ICC] is small (less than .3 in absolute value), it is relatively safe to use person as the unit" of analysis and to conclude that the shared group identity does not significantly influence results of the analysis (p. 72).[6]

In dataset A, a MANOVA indicated a significant effect for sex ($F[2,54] = 3.06, p \leq .05, \eta^2 = .10$).[7] Although females ($M = 4.32, SD = 1.47$) felt that their contributions were accepted more readily than did men when using the anonymous, collaborative group technology (men's $M = 4.12, SD = 1.09$), this difference was not statistically significant. For Hypothesis 1a, the ICC value was –.019, indicating that it is reasonable to treat each group member as separate from his or her respective group. In support of Hypothesis 1b, females ($M =$

5.10, SD = 1.20) enjoyed the collaborative group technology's anonymity significantly more than men did (M = 4.19, SD = 1.38; F[1,55] = 6.09, $p \leq .05$, η^2 = .10). In this instance, the ICC value = .055, again suggesting that each participant can be considered independently.

For dataset B, a MANOVA also indicated a significant effect for sex (F[2,66] = 3.59, $p \leq .05$, η^2 = .10). In support of Hypothesis 1a, females (M = 3.26, SD = .66) felt that that their contributions were accepted more readily than did men when using the anonymous, collaborative group technology versus if meeting face-to-face (men's M = 2.88, SD = .73; F[1,67] = 5.09, $p \leq .05$, η^2 = .07, ICC = .209). In support of Hypothesis 1b, females (M = 3.72, SD = .60) also enjoyed the collaborative group technology's anonymity more than men did (M = 3.29, SD = .85; F[1,67] = 6.10, $p \leq .05$, η^2 = .08, ICC = .048). Thus, although a significant sex effect was found in both datasets, Hypothesis 1a was supported in one of the two datasets, whereas Hypothesis 1b was supported across both sets of data.

Hypothesis 2 proposed that when working with the anonymous, group technology men would have a greater desire to divulge identifying, personal information than would women. Men's means for t tests on dataset A (M = 4.80, SD = 1.03) were higher than women's (M = 4.07, SD = 1.30), supporting this hypothesis (t[2,56] = 2.06, $p \leq .05$, ICC = –.035). Results of t tests for dataset B, however, did not show a significant difference (men's M = 2.90, SD = .75; women's M = 2.87, SD = .57; t[2,67] = .18, p = n.s., ICC = .028). Thus, Hypothesis 2 received mixed support overall.

Hypothesis 3 posited that for those who report representing their sex to other group members when working in an anonymous, computer-mediated group environment, males would be more likely than females to give the impression of their actual sex, whereas females would be more likely than males to give the impression of the opposite sex. The appropriate variable to test this hypothesis was included only in dataset A. Of the 58 individuals in that dataset, approximately one third (n = 19) reported that they tried to give the impression of being one sex or another: 8 males indicated that they represented themselves as males, whereas of the 11 females who reported representing themselves as a specific sex, 6 indicated that they self-represented as male and 5 as female. Chi-square tests confirmed that these frequencies support Hypothesis 3 (χ^2 = 4.94, df = 1, $p \leq .05$; Fisher's exact probability test, $p \leq .05$).[8]

Hypotheses 4, 5, and 6 were able to be tested using dataset B only. A MANOVA was used to test Hypotheses $4_{a\text{-}d}$, which proposed that females would have higher levels of process-oriented group behaviors than would males, including group cohesion, group trust, task interdependence, and

satisfaction with group process.[9] Means indicated that females had higher levels of group cohesion (men's $M = 3.67, SD = .66$; women's $M = 3.92, SD = .54$, ICC = .358), group trust (men's $M = 3.43$, $SD = .62$; women's $M = 3.75$, $SD = .59$, ICC = .397), task interdependence (men's $M = 3.85$, $SD = .64$; women's $M = 4.18$, $SD = .42$, ICC = .066), and satisfaction with group process (men's $M = 3.74, SD = .54$; women's $M = 3.91, SD = .51$, ICC = .475). A significant effect for sex was found ($F[4,64] = 2.52, p \leq .05, \eta^2 = .14$). Among the hypotheses, there was support for task interdependence (Hypothesis 4c; $F[1,67] = 6.75, p \leq .05, \eta^2 = .09$), group trust (Hypothesis 4b; $F[1,67] = 4.42, p \leq .05, \eta^2 = .06$), and only marginal support for group cohesion (Hypothesis 4a; $F[1,67] = 3.02, p = .09, \eta^2 = .04$). However, relatively high ICC values for the other variables indicate that only the measure of task interdependence can be considered to be unaffected by individuals' shared group experiences in this analysis. Thus, the demonstrated differences between males and females in terms of group trust and group cohesion can likely be explained by group differences rather than individual differences, as hypothesized. Consequently, there is unequivocal support only for Hypothesis 4c (task interdependence).

Hypothesis 5, that females working in anonymous, computer-mediated groups would increase their levels of group cohesion, group trust, task interdependence, and satisfaction with group process over time, was tested by a series of repeated measures ANOVAs. Reverse Helmert contrasts revealed whether the mean values at each of the 7 data points differed from the mean value of all of the preceding measures. As Table 1 shows, few over-time effects emerged. Although there were significant overall effects for both group trust ($F[6,36] = 2.60, p \leq .05$) and satisfaction with group process ($F[6,36] = 3.13, p \leq .05$), within each of these variables there were significant over-time increases at only two time periods apiece. Thus, overall, Hypothesis 5 was not supported.[10]

To test Hypotheses $6_{a\text{-}d}$, that all-female (versus mixed-sex) groups would experience higher levels of process-oriented group behaviors, groups were divided into same-sex (all female) groups ($n = 3$ groups; $n = 17$ individuals) and mixed-sex groups ($n = 9$ groups; $n = 52$ individuals). A MANOVA indicated no overall group composition effect ($F[4,7] = 1.02, p = .46$), although women in all-female groups did report higher levels of group cohesion (all-female $M = 3.96$, $SD = .21$; mixed-sex $M = 3.80$, $SD = .49$), group trust (all-female $M = 3.97, SD = .29$; mixed-sex $M = 3.52, SD = .45$), task interdependence (all-female $M = 4.15, SD = .20$; mixed-sex $M = 4.03, SD = .28$), and satisfaction with group process (all-female $M = 3.96, SD = .15$; mixed-sex $M = 3.83$, $SD = .48$) than did individuals in mixed-sex groups. However, Hypothesis 6 was not supported.

Table 1
Results of Repeated Measures ANOVAs for Hypothesis 5 (Reverse Helmert contrasts)

Variable	*M* Value and *SD* at Different Time Periods			*F* Value	*p* Value	η^2	Power
Group cohesion	T1	3.79	.63				
	T2	3.89	.61	T2 v. T1: .43	.51	.01	.10
	T3	3.75	.67	T3 v. cum. *M*: .69	.41	.02	.13
	T4	3.87	.49	T4 v. cum. *M*: 1.13	.29	.03	.18
	T5	3.79	.65	T5 v. cum. *M*: .38	.54	.01	.09
	T6	3.81	.76	T6 v. cum. *M*: .01	.91	.00	.05
	T7	3.89	.68	T7 v. cum. *M*: 1.36	.25	.03	.21
Group trust	T1	3.61	.72				
	T2	3.69	.65	T2 v. T1: .02	.89	.00	.05
	T3	3.53	.93	T3 v. cum. *M*: .68	.42	.02	.13
	T4	3.65	.71	T4 v. cum. *M*: .48	.49	.01	.10
	T5	3.81	.64	T5 v. cum. *M*: 10.15	.00	.20	.88
	T6	3.74	.81	T6 v. cum. *M*: 1.85	.18	.04	.27
	T7	3.85	.76	T7 v. cum. *M*: 9.66	.00	.19	.86
Group task interdependence	T1	4.21	.60				
	T2	4.25	.61	T2 v. T1: .17	.68	.00	.07
	T3	4.25	.54	T3 v. cum. *M*: .07	.80	.00	.06
	T4	4.17	.53	T4 v. cum. *M*: 1.16	.29	.03	.18
	T5	4.10	.74	T5 v. cum. *M*: .96	.33	.02	.16
	T6	4.08	.59	T6 v. cum. *M*: 2.36	.13	.06	.32
	T7	4.24	.62	T7 v. cum. *M*: .59	.47	.01	.12
Satisfaction with group process	T1	3.98	.69				
	T2	3.90	.66	T2 v. T1: .53	.47	.01	.11
	T3	3.75	.95	T3 v. cum. *M*: 3.34	.08	.08	.43
	T4	3.72	.67	T4 v. cum. *M*: 1.63	.21	.04	.24
	T5	4.02	.57	T5 v. cum. *M*: 6.13	.01	.13	.68
	T6	3.94	.78	T6 v. cum. *M*: .45	.50	.01	.10
	T7	4.06	.61	T7 v. cum. *M*: 7.01	.01	.15	.74

Discussion

This research sought to examine sex differences within an anonymous CMC context. We reframed two theoretical perspectives typically treated as oppositional—the equalization hypothesis and the SIDE model—as complementary and *partial* explanations for the complex processes that seem to operate inside CMC, at least with regard to sex. In addition to offering a different view of how groups work in CMC, and unlike previous CMC/GSS studies characterized by one-shot examinations (Jessup & Tansik, 1991; Kiesler et al., 1984), groups with no prior history, and participants who work on tasks

of little or no personal or long-term relevance (Siegel et al., 1986; Sosik et al., 1997; Valacich et al., 1992; Walther, 1994), this study was novel in its assessment of data from real groups involved in the protracted experience of a collaborative and meaningful task under anonymous conditions.

The findings presented here suggest that, in some instances, men and women differ in their perceptions and experiences of CMC and act strategically with regard to a key feature of the technology—anonymity. In specific instances, there was evidence that men and women either offset or enjoy the anonymous environment, consistent with their respective status differentials in face-to-face communication. In effect, some men and women appear to understand the advantages or disadvantages that may result from an anonymous CMC environment. Furthermore, the data indicate that the strategies employed differentially by men and women tend to correspond with inferred motivations: overall, men are more likely to seek ways to make CMC like face-to-face interaction, whereas women are more likely to employ strategies that maintain the reduced social cues of CMC and afford them more potential influence.

These strategies are best demonstrated in the general support for Hypotheses 1, 2, and 3. The fact that (a) women from dataset B perceived their contributions to be accepted more readily when working with anonymous group technology while (b) females in both datasets enjoyed the anonymity more than men, juxtaposed with (c) men's greater desire to divulge personal information that reveals their sex (in dataset A), offers evidence that women recognize and enjoy the social benefits afforded them through reduced social cues. Men, on the other hand, apparently seek to introduce those cues into CMC to regain an interactional advantage lost through anonymity. Furthermore, of those who went so far as to attempt to signal a particular sex, men did not cross sex lines, whereas some women did. Hence, and again, presentation strategies emerged that appear divided according to sex, with each sex evidencing a goal of maximizing or minimizing the status differentials typically present in face-to-face interactions. Because these findings were not perfectly consistent across both datasets, cautious interpretation is necessary. Nevertheless, these findings do seem to suggest that, on some level, users recognized the equalization potential of CMC and worked strategically either to benefit from or overcome that technological feature. This demonstrates the intersection of the equalization hypothesis and the SIDE model. Albeit limited to the group context, we take these findings to be initial evidence for the sex differences in strategic communication that Canary and Hause (1993) lamented have "eluded us."

This study also explored whether men and women differed in task and relational communication in groups supported by collaborative technologies

and found that women reported greater task-interdependence than men. Although the intraclass correlations for the remaining dependent variables call for careful interpretation of group versus individual effects, it should be noted that women reported higher mean scores than men did for group trust, group cohesion, and satisfaction with group processes. Therefore, it is possible that women working in a CMC environment may be somewhat more process-oriented than men, and irrespective of group composition, women may feel more connected to their coworkers than do men. In addition, although there was no overall support for Hypothesis 6, analyses did reveal that the means for group cohesion, trust, task-interdependence, and satisfaction were all in the anticipated direction, suggesting the possibility that all-female groups might experience higher levels of socio-emotional behaviors than mixed-sex groups in anonymous CMC environments. Of course, further research is essential in order to locate more precisely the nature of any true differences in these respects, since they are only suggested, and not supported, in our data (with the exception of empirical support for task interdependence, from Hypothesis 4c).

Relative to these process-oriented group behaviors, our fifth hypothesis that females working in an anonymous computer-mediated group environment would report increased levels of cohesion, trust, task-interdependence, and satisfaction over time was not supported overall, given significant effects only for group trust and satisfaction with group process at only two time periods each. This was tested by comparing each time period mean with the mean of all preceding time period means collectively, a more conservative test than point-to-point comparisons, or beginning-to-end comparisons. Among the possible explanations for these results are that (a) the processes that lead to cohesion, trust, task-interdependence, and satisfaction may be invariant over time; (b) the time periods were not sufficiently long to capture any over-time differences; or (c) a ceiling effect. Given that one would expect at least some difference from beginning to end during an extended period of interaction, and that longer time periods would increase the likelihood of finding greater differences, the first two explanations seem plausible. The third explanation is also possible, given that the means were fairly close to the high end of the scale. Relational management behaviors may operate more individually and may have less to do with group processes, as well as possibly being a function of variables other than sex.

Limitations and Theoretical Implications

Limitations of this investigation include the self-selected nature of the sample and the fact that participants knew there would be future face-to-face

interaction, which may have impacted (in unknown ways) decisions with regard to whether to divulge personal identity and how participants behaved. In addition, the rather small sample size and the low number of males made some comparisons impossible. Also, Hypotheses 1, 2, and 3 used only single-item indicators. Finally, the mixed support for some hypotheses across datasets, and minimal support for others, warrants careful interpretation of the results.

Returning to the theoretical underpinnings of this study, the findings suggest that technologically deterministic views, consistent with those of the equalization hypothesis (Dubrovsky et al., 1991; Kiesler et al., 1984; Siegel et al., 1986), do not fully capture the complexity of what happens when groups use group support technology. In one of the datasets, males expressed a desire to divulge personal information and some looked for communicative ways to signal their sex to group members. Some women also sought to inject status differentials into the CMC environment, which reveals the potential for status differentials inside CMC where anonymity is not strictly safeguarded. These findings suggest that rather than being entirely deterministic, CMC technology is better described as presenting an opportunity within which members of high and low status seek different ways of introducing status into the CMC environment to serve their respective goals.

The SIDE model also lacks value as a complete explanation for the strategic side of CMC, given its overarching emphasis on group identity. As Postmes et al. (1998) point out, "research [on the SIDE model] has been conducted largely in contexts in which social identity is salient, and shared social norms are readily available or even directly activated" (p. 708). In fact, tests of the SIDE model almost always activate or manipulate group (versus individual) identity (see Postmes et al., 1998, for a review of this research). As a consequence, this strategic element of the SIDE model has remained largely unexplored, in spite of its relevance to understanding group behavior and its particular richness for examining status and power differences (Postmes et al., 1998; Spears & Lea, 1994). Our findings seem to provide evidence of the strategic use of CMC and thereby advance what we know about working in collaborative groups by demonstrating how CMC users may be guided simultaneously by both group and individual identities.

With regard to the relationship between the two theoretical cornerstones of the study, these data suggest that those participating in technological group work (a) take advantage of technology as an enabler of behavior (consistent with the equalization hypothesis) and that (b) group and individual identities are likely to be operating simultaneously to guide motivations (consistent with the SIDE model). Based on our data, each perspective goes

too far in explaining the sources of influence that drive CMC, but each appears to be partially correct.

While our results highlight both sexes' strategic use of group technologies (consistent with impression management and deindividuation theories), these findings also are consistent with theoretical and empirical work emphasizing users' emergent structuring of advanced communication and information technologies over the deterministic structure of those systems (see Contractor & Eisenberg, 1990; Orlikowski & Robey, 1991; Poole & DeSanctis, 1990). Thus, we can conceptualize CMC dynamics as reflecting a structuring process within the parameters of the situation in which the technology is used (Hayes & Walsham, 2000). Furthermore, applications of structuration theory (Giddens, 1984) to communication and information technologies (Orlikowski, 1992; Poole & DeSanctis, 1990; Walsham, 1993) propose that systems of interest are "structurated" through modalities of legitimation, domination, and signification. Accordingly, users' structuring behaviors in CMC may be viewed, respectively, as reflecting those users' norms concerning the technology (legitimation), as a consequence of the facilities for coordination and control afforded by the technology (domination), and as supplying interpretive schemes (signification).

It is important in future research to probe both men's and women's strategic use of CMC in terms of each of these modalities, even as they simultaneously interpenetrate in the production of CMC in use. To what extent, for instance, is strategic use of CMC a function of group members' (a) identification with their respective sexes and implicit understandings of sex-based norms regarding the technology (legitimation), (b) efforts to appropriate the technology for purposes of personal control (domination), and (c) attempts to make sense of the technology and others' use of it (signification)? Our findings suggest the veridicality of these modalities in the partial support for Hypothesis 4 for (a) above and the support provided by Hypothesis 1, Hypothesis 2, and Hypothesis 3 for (b) above. In all cases, however, the partial or mixed support for our hypotheses and the gross statistical analyses attendant to them call for more careful analyses of each modality of structuration. Moreover, it also invites qualitative analysis of the sex-based structure of CMC uses across these modalities and further exploration of the dynamic processes of technology use across sexes.

It also will be important for future researchers to examine behavioral processes that might occur in CMC settings. For example, it would be interesting to look at whether people who portray themselves as a member of the opposite sex behave in ways that are similar to those who do not attempt to represent themselves inaccurately. Researchers then could study whether these

individuals are perceived differently than those who do not attempt to project a false image of their sex. Another question that warrants further research is whether individuals in same-sex CMC groups behave differently from those who are in mixed-sex groups. Limitations in our data preclude these analyses. Nonetheless, the data presented here offer some intriguing advancements to CMC theory and research, a worthwhile endeavor given the growing popularity of this form of group communication and its substantial role as organizational groups become increasingly dispersed, global, and virtual (DeSanctis & Poole, 1997; Monge & Fulk, 1999).

Appendix A
Variable Operationalization Summary

Variable	Item	Cronbach's alpha
Desire for information disclosure	I would like it if group members would reveal their identities to each other	.65[a] .78[b]
	I would like to have more personal information about my group members	
	I want to meet the members of my group in person	
	Scale: 1 = *strongly disagree* to 5 = *strongly agree*	
Group Cohesiveness	Do you feel that you are really a part of this group?	.85
	Scale: 1 = *didn't feel I belonged at all* to 5 = *really a part of my group*	
	How would you feel about moving to another group versus staying with your current group?	
	Scale: 1 = *would want very much to move to another group* to 5 = *would want very much to stay in the same group*	
	How does this group compare with other groups you have worked with in the past on the following points?	
	The way people get along together	
	The way people work together	
	The way people help each other	
	Scale: 1 = *very much worse* to 5 = *very much better*	

(continued)

Appendix A
Continued

Variable	Item	Cronbach's alpha
Group task interdependence	Successful completion of the module assignment required input from other group members	.83
	The module assignment required a team approach	
	The module assignment required a group, not an individual, effort	
	Scale: 1 = *strongly disagree* to 5 = *strongly agree*	
Group trust	*I cannot rely on my fellow group members	.81
	We have confidence in one another in this group	
	*I would not be comfortable giving the other group members a task or problem that is critical to the project if I could not monitor their work	
	Overall, the people in my group are very trustworthy	
	I would be comfortable giving the other members of my group complete responsibility for the completion of the [tasks]	
	Scale: 1 = *strongly disagree* to 5 = *strongly agree*	
Satisfaction with group process	In general, working with my group was satisfying	.86
	*The members of my group were not committed to the group's goals and objectives	
	The decisions in my group were fair	
	*Overall, I was not satisfied with the group decision process	
	Decisions and choices made in my group were well-coordinated	
	Overall, the quality of this group's interaction was high	
	Scale: 1 = *strongly disagree* to 5 = *strongly agree*	

Note. Items marked with an asterisk were reverse-coded.
a. Reflects dataset A.
b. Reflects dataset B.

Notes

1. The authors thank Dennis Gouran, Kathy Kellermann, Michael Roloff, Minu Sebastian, Joe Walther, and anonymous *Communication Research* reviewers for their helpful comments on this manuscript. An earlier version of this manuscript was presented at the National Communication Association convention in Seattle, November 2000.

2. As Postmes, Spears, and Lea (1998) note, computer-mediated communication (CMC) is an umbrella term that conceivably includes any form of interaction conducted with the aid of a computer. Consistent with its more typical usage, however, CMC is taken here to mean largely text-based electronic interaction conducted across space and time.

3. Pretests were used to select proper names that were not readily identified with a specific sex and that were coherent as a group of items. For example, one group was identified by the names of Farm Security Administration photographers working during the Great Depression: Collier, Evans, Lange, Mydans, Shahn, and Wolcott. Other groups were similarly identified by groups of names (e.g., tractor names, vintage watchmaker names, etc.). Although there is a chance that group members may have been familiar with the source of a group's names, it is rather unlikely, based on postclass feedback. Proper names were used in order to more closely approximate real-life situations as opposed to using numeric or nonsensical identifiers, for example.

4. The level of anonymity experienced by users approaches what is more rightly termed *partial anonymity* or that condition where "either a source cannot be individually specified or when there is not a high level of knowledge about a source" (Anonymous, 1998, p. 391). In this way, the pseudonyms served to mask the true identity of the source and functioned "largely the same as the absence of a source in that the receiver likely perceives the source as an anonymous one" (p. 384).

5. Although group membership was randomly assigned, individuals interacted within groups over extended periods of time. Consequently, some degree of interdependence among the observations is likely which, if severe, could pose a serious threat to the analyses. More specifically, shared group membership can result in an underestimation of within-groups variance estimates, because differences between individual scores and group mean scores may be artificially low, due to shared group experiences. If within-groups variance is underestimated, F values can be artificially inflated and the likelihood of Type I error can be increased. To assess the severity of this interdependence, intraclass correlations were calculated for all analyses where interdependence posed a potential threat. Based on these analyses, it appears that the interaction within groups did not severely inhibit the independence of the data, except as noted in the text.

6. It should be noted, though, that according to Kenny (1995), the bias introduced by ICCs is more consequential as group size increases beyond dyadic data. However, no specific ICC value guidelines have been proposed for groups that consist of more than two members.

7. Unequal cell sizes in MANOVAs can be problematic when heteroscedasticity exists (i.e., when the variance-covariance matrices are unequal). As evidenced in the Monte Carlo studies (see Mardia, 1971), if heteroscedasticity does exist, then the F test may be inappropriate because it is often highly biased (Bray & Maxwell, 1985). One acceptable and common solution to this problem is to randomly select individuals from the sample in order to equalize cell sizes and determine whether the same results would emerge (Martin & Games, 1977). Therefore, because heteroscedasticity existed in our data, a random sample was taken from the larger cells to equalize cell sizes, and analyses were rerun multiple times. This yielded results that, for the most part, clearly

supported the original results. Thus, the biasing influence of heteroscedasticity stemming from unequal cell sizes did not drastically alter our conclusions about our hypotheses.

8. Because the results of this hypothesis confirm that sex misrepresentation demonstrated a meaningful pattern in the data, its potential effects were analyzed further: Hypotheses 1 and 2 were reanalyzed for dataset A, using "represented sex" rather than the individual's actual sex as the independent variable. Results showed no effects for represented sex, suggesting that actual sex is a more important factor than one's represented sex, among these participants.

9. Analysis of the relation among these dependent measures revealed moderate to high intercorrelations. Typical correlations were in the .55-.65 range, although the correlation between satisfaction with process and group cohesion was very high (.87). Although MANOVAs account to a large extent for correlations among dependent measures, an alternative strategy would be to factor analyze the items comprising these variables in order to arrive at a set of more distinct measures. However, because (a) these variables were based on existing scales that have been verified consistently in past research, (b) the variables had high internal consistency, as evidenced by the Cronbach's alpha reliability values, and (c) the most highly correlated measures (satisfaction with process and group cohesion) turned out not to be predicted by the factors in Hypotheses 4 to 6, and thus did not cause ambiguity in the interpretation of the results of the analyses, the four variables specified here were retained in the analyses. Correlation matrixes for all analyses are available from the first author upon request.

10. Repeated measures ANOVAs were also performed to see if males decreased their levels of these social or process-oriented behaviors over time. No significant differences were found for any of the variables (group cohesion, group trust, task interdependence, and satisfaction with group process) for males.

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