GENDER DIFFERENCES IN THE EFFECTS OF MEDIA RICHNESS

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Media richness theory argues that performance improves when team members use "richer" media for equivocal tasks. Virtually all research on media richness theory has focused on perceptions: surveys of individuals' beliefs about media rather than investigating actual performance with richer versus leaner media. This experiment studied the effects of media richness on decision making in two-person teams (all male, all female, and mixed gender) using one form of "new media" (computer-mediated communication). Participants took longer to make decisions with computer-mediated communication. Matching richness to task equivocality only resulted in better performance for the all-female teams, likely because females are more sensitive to nonverbal communication and more affected by its absence in computer-mediated communication. For remaining teams, using richer face-to-face communication did not improve performance to a greater extent for more equivocal than less equivocal tasks. Results support media richness theory only for all-female teams.

Today's workplace brings with it increasing technological sophistication in hardware, software, and communications, accelerating user skills and escalating managerial and customer expectations. Use of the so-called "new media" of computer-mediated communication (CMC) (Rice, 1984) is now commonplace (Panko & Kinney, 1995a), as is the use of remote teams (Kinney & Panko, 1996).

One widely known theory that addresses the effects of using different media is media richness theory (Daft & Lengel, 1986). The main premises of media richness theory are that (a) media differ in

SMALL GROUP RESEARCH, Vol. 30 No. 4, August 1999 405-437

"richness," with face-to-face communication being the richest, whereas other media capable of sending fewer cues (e.g., CMC) are "leaner" and that (b) performance improves when people use richer media for equivocal tasks (when there are multiple interpretations of available information) and leaner media for nonequivocal tasks (Daft & Lengel, 1986; Daft, Lengel, & Trevino, 1987). Media richness theory initially evolved without direct consideration of the new media (El-Shinnawy & Markus, 1992), but they have been retroactively fit into the theory's framework (e.g., Daft et al., 1987; El-Shinnawy & Markus, 1992; Rice, 1992).

Most studies testing media richness theory have examined the perceptions of media fit by surveying the media choice of message senders, not by examining the actual performance effects of media use by sender and receiver (Dennis & Kinney, 1998). Because these studies have examined media choice rather than media use, the central proposition of media richness theory remains largely untested (Dennis & Kinney, 1998; Rice, 1992): Does the use of richer rather than leaner media for equivocal tasks improve performance?

The central proposition of media richness theory hinges on the belief that lean media, such as CMC, inhibit the sending and receiving of nonverbal cues, with the degree of effect differing with the nature of the task. In general, women have a greater ability than men to send and receive certain forms of nonverbal communication (Briton & Hall, 1995; Burgoon & Dillman, 1995). Women, therefore, may be more strongly affected by the lack of nonverbal cues in CMC than men. Gender differences in CMC are increasingly important, because women now make up more than 40% of the nation's on-line population, as opposed to the 3% of 4 years ago, and more than 50% of newcomers are women (GVU, 1998). Women who work with desktop computers outnumber men by more than two to one and are more enthusiastic about new office technology than are men (Peltz, 1999).

A lack of cues in CMC has been suggested to democratize communication by encouraging more equal participation between women and men due to the absence of status- and gender-marked cues (Graddol & Swann, 1989; Herring, 1993; Kiesler, Seigel, &

McGuire, 1984). Studies of Internet communication, however, suggest a substantial bias against female participation in on-line discourse, counter to the predictions of technology as having an equalizing force (Clausen, 1991; Mason, 1994).

We decided to investigate the effects of media richness and gender differences, using the controlled environment of a laboratory experiment and using only one of the new media: CMC. A host of studies have compared CMC to face-to-face interaction, but few have actually tested media richness theory by manipulating task equivocality; most have simply used media richness theory as a theoretical base, making it impossible to draw conclusions about the applicability of the theory to the new media.

THEORETICAL FRAMEWORK

The most commonly used medium for communication is face-to-face communication (Panko & Kinney, 1995b). Face-to-face communication enables participants to use varying modes of communication: words, vocal cues (e.g., voice inflection, sighs), nonverbal communication (e.g., gestures, touch), and written or drawn communication (e.g., paper, blackboards). These modes combine to transmit factual information about the task and social information about the personal characteristics of team members. Other media have lesser abilities to transmit these different forms of communication. The degree to which media affect communication can change the way teams work and lead to better or worse performance.

MEDIA RICHNESS THEORY

Daft and Lengel (1986), in their seminal work on media richness, argued that managers could improve performance by matching media to the needs of organizational information-processing tasks. Media richness theory postulated that media varied in information richness (later called media richness) based on their

capacities to facilitate shared meaning within a given time interval. The theory asserted that four factors influenced this media richness: the ability of the medium to transmit multiple cues (e.g., vocal inflection, gestures), immediacy of feedback, language variety, and the personal focus of the medium. Richer media, the theory claimed, enabled users to communicate more quickly and to better understand ambiguous or equivocal messages and, therefore, would lead to better performance on equivocal tasks. In contrast, leaner media were better for low equivocality tasks, because rich media provided communicators with too much information and superfluous messages. Thus, Daft and Lengel concluded that the use of richer media (such as face-to-face meetings) would lead to better performance for equivocal tasks (such as deciding whether to acquire a company), whereas use of leaner media (such as written memos) would lead to better performance for less equivocal tasks (such as determining customer reactions to product labels).

At this point, media richness theory was a theory of media use, not media choice. It argued under what conditions each media would be most effective; that is, how managers should use media, not how managers actually choose media. Virtually all subsequent tests of the theory, however, have followed the empirical work of Daft et al. (1987) and Trevino, Daft, and Lengel (1990) by examining media choice (not use), perceptions of message senders (not actual performance of all participants), and communication tasks (not information-processing tasks).

These studies, however, do not examine the central proposition of media richness theory as offered by Daft and Lengel (1986). Does the use of richer rather than leaner media improve performance for equivocal tasks? There have been a host of studies on the effects of CMC versus face-to-face communication (see Fulk & Collins-Jarvis, in press), but few have studied decision-making performance for tasks that differ in equivocality. Of the three known tests of media richness theory for decision-making tasks that differed in equivocality, all have found little support for it (Dennis & Kinney, 1998; Kinney & Watson, 1992; Valacich, Mennecke, Wachter, & Wheeler, 1994).

MEDIA RICHNESS AND TASK PERFORMANCE

Does matching media richness to task equivocality improve performance for the new media? The three key elements to this question are media richness, task equivocality, and performance.

Task Equivocality

Given the prior empirical evidence and the later formulations of media richness theory by Trevino et al. (1990), this study focuses solely on task equivocality[1], the extent to which there are multiple interpretations of the available information. Daft and Lengel (1986) argue that the use of richer media rather than leaner media will lead to better task performance for high- rather than low-equivocality tasks.

Media Richness

In this study, which examined dyads (two-person teams), we believed that the primary factors affecting media richness between face-to-face communication and CMC would be the multiplicity of information cues and the immediacy of feedback. Language variety and personal focus were relatively constant between the two media.[2]

Multiplicity of information cues refers to the number of ways in which information can be communicated, such as tone of voice or physical gestures (Daft & Lengel, 1986; Daft & Wiginton, 1979). The greater the number of cues, the greater the richness. Face-to-face communication is potentially the richest medium, although participants may choose not to use all available modes of expression. Face-to-face interaction can convey nonverbal cues (facial expressions and gestures), vocal intonations (volume, pitch, and pauses), and the words themselves. CMC is generally regarded as less rich, as it conveys only the message text with few other cues (Daft et al., 1987; Rice, 1992).

Immediacy of feedback is the extent to which the medium enables users to receive rapid feedback (Daft & Lengel, 1986). To the message sender, the ability of the medium to enable bi-directional messages determines this capability; that is, the degree to which the message sender can monitor message processing by the receiver(s) and adjust the message as needed. To the receiver, the interruptability of the medium determines the immediacy of feedback; that is, the ease with which the receiver can interrupt the sender to seek clarification or redirect the conversation (see Rice, 1987). In both cases, faster feedback implies greater richness.

In face-to-face communication, the receiver can provide simultaneous feedback while the message sender is communicating. Head nods and murmurs, for example, are commonly used to indicate understanding and agreement. Immediate feedback is more difficult in CMC, as it takes longer to type than to speak or gesture. Even with synchronous, split-screen electronic communication (in which each person types in one part of the screen and all members can view all parts of the screen simultaneously), a writer may be intently typing a message and not notice another member signaling an interruption.

Performance

Media richness theory is imprecise about the definition and measurement of performance. Daft and Lengel (1986) state that organizations process information to "attain adequate performance" without ever defining "performance" (pp. 567-568). In a summary of media richness theory articulating its conceptual framework, Trevino et al. (1990) discuss performance in three terms: making better decisions (decision quality), establishing shared systems of meaning (consensus among participants), and making better use of their time (time required to reach conclusions). User satisfaction is also suggested as an element of performance, albeit less directly. Lengel and Daft (1988) state, "Effective communication depends on the selection of a medium that has the capacity to engage both the sender and receiver" (p. 229). They describe a medium as "an extension of self" and maintain that

"The selection of a medium signals the senior executive's management style, which may be cool and detached or warm and personal" (p. 230). Given that media-task fit is defined in this article in terms of communication success, we believe that communication *satisfaction* of sender and receiver(s) is another element of performance. We believe that this multidimensional definition (decision quality, consensus, time, satisfaction) provides a reasonable way to triangulate on the concept of "performance."

GENDER DIFFERENCES IN COMMUNICATION

Studies in sociology have identified gender as one of the mediators in group interaction process. In general, men and women have differing abilities to communicate. Women are more expressive and can send messages more clearly using nonverbal cues (Briton & Hall, 1995; Burgoon & Dillman, 1995; Spangler, 1995). Women also are better than men in decoding, understanding, and using nonverbal cues sent by others (Briton & Hall, 1995; Kette & Konecni, 1995; LaFrance & Henley, 1994). In short, nonverbal cues play a greater role in the communication behaviors of women compared to men.

Men and women also employ different interaction styles in groups. Women tend to focus more on social-oriented activities, whereas men focus more on task-oriented activities than do women (Carli, 1984; Rhodes & Wood, 1990). Research using linguistic methods also stresses that women's talk is generally oriented toward maintaining relationships and developing intimacy. They found that women are more likely than men to express agreement or ask for another's opinion (Eakins & Eakins, 1978), to acknowledge points made by the other speaker at the beginning of a turn, to provide nonverbal or back-channel support for other speakers (Hirschman, 1973; McLaughlin, Cody, Kane, & Robey, 1981), and to use other conversational devices that serve to draw out one's conversational partner (McConnell-Ginet, 1975). Women work harder than men to facilitate conversation and ask more questions, whereas men's speech is marked by features (e.g., statements) that do little to ensure further talk (Fishman, 1983) and tend to be more competitive and express dominance (Briton & Hall, 1995; LaFrance &

Henley, 1994). A study of decision making by senior marketing executives (Maguire, 1999) found that men were perceived to make faster decisions, whereas women worked to build more consensus during decision making and acted more thoughtfully when choosing their courses of action. These same patterns carry over into CMC. Tannen (1990) found that males are more likely to use CMC to get and give information, whereas females use it as a place to pose questions and come to a consensus of understanding.

HYPOTHESES

Decision time. The time required for decision making in organizational settings is an eclectic construct, making accurate measurement of decision time difficult. Within the controlled environment of a lab study, however, measurement is much clearer. Decision time is the time required to exchange information, identify and discuss criteria and alternatives, and then come to agreement—a measurement that is relatively straightforward and permits media comparisons.

In empirical studies, researchers have routinely demonstrated that CMC requires more time than face-to-face communication (Chapanis, 1988; Siegel, Dubrovsky, Kiesler, & McGuire, 1983; Williams, 1977). This may be due to the ability to convey information more quickly using the multiple channels available in face-to-face interactions. Increased efficiency also could be a function of the presence of others increasing activity speed and motivation (social facilitation, Zajonc, 1965). It also may be due to the need to type, simply because typing is slower than talking (Chapanis, 1988; Fowler & Wackerbarth, 1980). In this context, typing is better thought of as a delay cost (Reinsch & Beswick, 1990) rather than as a richness factor.

Daft and Lengel (1986) define information processing as "the ability of information to change understanding within a time frame" (pp. 559-560). Media richness theory contends that leaner media slow down communication and decision making for equivocal tasks and that richer media provide excess cues and surplus

information for unequivocal messages, increasing decision time (Lengel & Daft, 1988). Thus, use of richer media should prove fastest for equivocal tasks but slowest for nonequivocal tasks, whereas use of leaner media should prove fastest for nonequivocal tasks but slowest for equivocal tasks.

Although many studies have examined media effects, we are aware of only two that manipulated task equivocality. Valacich et al. (1994) and Dennis and Kinney (1998) found that use of CMC increased decision time compared to face-to-face communication but had no differential effects on task equivocality.

Our hypotheses consider media richness theory and previous empirical research. In general, use of leaner media will result in longer decision-making time due to reduced capacity for transmitting rich information, reduced social facilitation, and delay costs due to typing. These effects will be the strongest for more equivocal tasks. However, past empirical research does not support media richness theory's contention that use of richer media requires more time for nonequivocal tasks (Rice, 1992), particularly due to the delay costs of typing in CMC. Therefore,

Hypothesis 1a: The use of leaner media will increase decision time.
Hypothesis 1b: The use of leaner media will increase decision time to a greater extent for more equivocal tasks than less equivocal tasks.

As argued in the previous section, women are more likely than men to use and act on nonverbal communication. Its absence in CMC, therefore, is likely to have a greater effect on women than men. Women are also more likely than men to exhibit consensus-seeking behavior that uses nonverbal communication to a greater extent in the more equivocal task. Therefore, women will have to compensate for the lack of nonverbal communication to a greater extent in the more equivocal task.

Hypothesis 1c: The use of leaner media will increase decision time to a greater extent for women for more equivocal tasks than less equivocal tasks.

Decision quality. The ability of a medium to support rich interaction should directly affect the quality of the decision that emerges from its use, depending on task equivocality (Trevino et al., 1990). It is more accurate for most people to send and receive the verbal and nonverbal cues in their native verbal or nonverbal format than to encode them in the text itself (Walther, 1992; Walther & Burgoon, 1992). Media richness theory argues that communication fails when a lean medium for equivocal communications ("data starvation") or a rich medium is used for unequivocal communications ("data glut") (Lengel & Daft, 1988). Rice (1992) found limited evidence for performance improvements when rich media are used for equivocal tasks but concluded that performance does not decrease when rich media are used for unequivocal tasks. Again, in the only empirical study of media use and decision quality of which we are aware, Valacich et al. (1994) found no significant differences in decision quality (independent of task equivocality) based on media.

Our position, then, is a synthesis of media richness theory and empirical evidence. Our first hypothesis, H2a, is directed toward media richness effects, irrespective of task equivocality. The second hypothesis, H2b, specifically considers part of media richness theory's position on equivocality. We hypothesize that use of richer media should improve decision quality to a greater extent for more equivocal tasks, but we make no hypotheses about the use of richer media for unequivocal tasks.

Hypothesis 2a: The use of leaner media will decrease decision quality.
Hypothesis 2b: The use of leaner media will decrease decision quality to a greater extent for more equivocal tasks than less equivocal tasks.

Given that women rely more on nonverbal communication and are more consensus-seeking, they will have to make a greater adjustment in communication style to compensate for the lack of nonverbal communication with CMC. Specifically, in the CMC conditions, they will have to put more effort into resolving the higher equivocal task than the lower equivocal task and will put

more effort into resolving the higher equivocal task than will men. Therefore, use of leaner media will have a greater impact on women performing the more equivocal task compared to their face-to-face performance.

Hypothesis 2c: The use of leaner media will decrease decision quality to a greater extent for women for more equivocal tasks than less equivocal tasks.

Consensus change. Consensus is defined as a general agreement or shared understanding (Daft & Lengel, 1986). Individuals enter team tasks either with predefined opinions or with predispositions toward specific ways of completing the task, based on their unique prior knowledge. Effective teams will demonstrate greater participation by considering these differing viewpoints and by incorporating the information and resources of all members in coming to a final shared position (consensus). Participation by itself is not a predictor of decision quality (Hiltz, Johnson, & Turoff, 1981). Indeed, one of the touted benefits of computer-mediated communication is that the relative anonymity provided by the lack of face-to-face communication encourages more equal and uninhibited participation (Tyran, Dennis, Vogel, & Nunamaker, 1992). Rather, information exchange that leads to shared viewpoints has the potential to improve performance.

Media richness theory contends that richer media improve understanding and, therefore, lead to greater consensus change (i.e., differences in initial individual positions narrow) for higher equivocal tasks than for lower equivocal tasks. Again, media richness theory also suggests that less feedback and fewer cues will lead to greater consensus change for a less equivocal task, but the work of Rice (1992) suggests that little evidence exists to support this position.

Substantial evidence exists, however, in the social psychology literature that attitudinal change can occur without face-to-face interaction (through reading or listening to a counter-attitudinal message) (Eagly & Chaiken, 1984; Petty & Cacioppo, 1986). Short, Williams, and Christie's (1976) and Christie's (1985) review

of research on consensus change in mediated bargaining found inconclusive results. Outcomes were subject more to differences in tasks, research procedures, and outcome criteria than to media. In their summary of teleconferencing media (audio, audio/video, and computer conferencing), Johansen, Vallee, and Spangler (1979) conclude that all three media prove less suitable than face-to-face meetings for promoting consensus building and change in negotiation tasks. Therefore, as with decision quality, our hypotheses are in keeping with media richness theory as it relates to high equivocality tasks. Again, the first hypothesis is directed toward media richness effects, regardless of task equivocality, and the second hypothesis specifically considers task equivocality. Note that consensus change is the narrowing or coming together of different positions.

Hypothesis 3a: The use of leaner media will decrease consensus change.

Hypothesis 3b: The use of leaner media will decrease consensus change to a greater extent for more equivocal tasks than less equivocal tasks.

Computer-mediated communication interferes with women's use of nonverbal communication and consensus-seeking behavior by eliminating nonverbal communication—a channel more important for women than men. Therefore, use of leaner media will have a greater impact on women performing the more equivocal task compared to their face-to-face performance.

Hypothesis 3c: The use of leaner media will decrease consensus change to a greater extent for women for more equivocal tasks than less equivocal tasks.

Communication satisfaction. In media richness theory, the selection of the medium and the determination of satisfaction with it is based on user perceptions. User perceptions are likely to be based on rational measures of the value of medium (time and effectiveness) as well as subjective measures of the medium (personal preferences for specific media). Communication satisfaction

encompasses many different emotional responses and behaviors, such as agreement in thinking, cooperativeness, sensitivity to partner, and openness (Downs & Hazen, 1977; Hoskins, 1983). These behaviors tend to occur more frequently in richer contexts and are more likely to develop within face-to-face teams than between participants linked by leaner media (Thomas & Williams, 1975; Wichman, 1970).

Yet, other components of communication satisfaction seem to flourish in the leaner environment of computer-mediated communication. Kerr and Hiltz (1982) note that the leanness of computer communication increases the focus on the words themselves as cues to the emotional content and may lead to higher levels of sensitivity and kindness. Computer conferencing can enhance candor (Hiltz & Turoff, 1978) and strengthen personal interaction (Vallee, Johansen, Lipinski, Spangler, & Wilson, 1978). Given the disparity in findings, our hypotheses follow the same pattern as previous hypotheses: positive effects for the use of richer media and for richer media with higher equivocality tasks. Likewise, we believe that women will be less satisfied with CMC for the more equivocal task because it limits their ability to use nonverbal cues.

Hypothesis 4a: The use of leaner media will decrease satisfaction.
Hypothesis 4b: The use of leaner media will decrease satisfaction to a greater extent for more equivocal tasks than less equivocal tasks.
Hypothesis 4c: The use of leaner media will decrease satisfaction to a greater extent for women for more equivocal tasks than less equivocal tasks.

METHOD

The research design was a 2×2 repeated-measures design, varying medium (face-to-face interaction versus CMC) and task equivocality (higher, lower). Participants were randomly assigned to one of these two media conditions and completed both higher and lower equivocality tasks using the same medium. Task order was crossed to control for order effects.

PARTICIPANTS

Participants were 70 sophomore, junior, and senior students recruited from a core business course with a requirement for experimental participation. There were 18 face-to-face dyads (4 all female, 3 all male, 11 mixed gender) and 17 CMC dyads (3 all female, 6 all male, 8 mixed gender). The average age was 20.8 years.

INDEPENDENT VARIABLES

Participants interacted using either face-to-face communication or CMC. In the face-to-face conditions, participants sat at a table and discussed the issues verbally. In the CMC treatment, participants worked in separate rooms, connected only by the computer software called Chat. Chat used a two-window split screen for simultaneous communication (one window for each participant) so that every keystroke was immediately displayed on both participants' screens.

TASK

Our tasks were selected to vary based on equivocality, not complexity (see Note 1). Equivocality exists when multiple (possibly conflicting) interpretations for available information exist or when the framework within which to interpret the information is unclear (Daft & Lengel, 1986). The higher equivocality task was a version of the undergraduate admissions task drawn from Dennis (1996). This task asked participants to rank order from best to worst five students seeking admission to the university's undergraduate business program. Each participant was presented with incomplete information so that she or he needed to pool the information to reach a decision (i.e., a hidden profile task, see Stasser, 1992). Several pieces of information had several interpretations that the participants had to resolve, such as the relative merit of grade-point average versus Scholastic Aptitude Test (SAT) scores and of extracurricular activities versus part-time jobs. In several teams,

resolving the relative importance of this information generated heated discussions.

The lower equivocality task was a set of four questions similar to those used on SAT tests. The set included one each of a mathematical, geometric, physics, and logical reasoning question, each of which provided a clear framework for problem resolution. Participants received incomplete information requiring them to share facts to form the complete information necessary to correctly complete the task. For example, one question read, "Find the equation of the line passing through the points (1, 2) and (5, 6)." Each participant received one of the two formulas necessary to solve the problem. Both tasks informed participants that they had incomplete information. Both tasks were ones with which the participants had some degree of familiarity.

PROCEDURE

Participants first completed both tasks individually and recorded their individual decisions. They were then introduced to their partners (face-to-face in the control group and through the medium in the CMC condition) and completed a 5-minute warm-up task designed to familiarize the participants with each other and with the medium. Next, they worked as a dyad to complete the first task, reaching a shared decision. Then each individually completed a questionnaire and made another individual decision on the same task, a decision that could be either the same as or different from the dyad's decision. They then completed the second task as a dyad, reaching a shared decision, individually completed the questionnaire, and made an independent decision.

MEASURES

The dependent variables were measured at either the individual or dyadic level. Time, consensus, and decision quality are necessarily team (dyadic) measures, because they depend on the information processing of both participants. Perceptions (e.g., communication

satisfaction) are measured at the individual level, because they represent the individual, participative viewpoint of the sender and receiver. Therefore, participants' questionnaire responses were analyzed as separate units, not as a dyad but using a dyad-nested-within-treatment term to capture any correlation between members of the same dyad (i.e., it is likely that the questionnaire responses from the two members of the same dyad are correlated to some extent, because they shared the same experiences; see Walther & Burgoon, 1992, p. 67).

Decision time was measured by the number of minutes required for the dyad to agree on the decision for each task. To avoid skewing the data in the CMC and delayed conditions, no time limits were imposed (see Walther, 1992 for a discussion of the impact of time limits).

Decision quality for the lower equivocality task was measured by counting the number of correct answers for the four questions comprising the task. This raw score was then converted to a *z* score, (x – mean) ÷ standard deviation, to make it easier to compare between the two tasks. The higher equivocality task was designed following the university's undergraduate admissions regulations to provide a correct rank ordering of the five candidates. Seven experts (the director and assistant director of undergraduate admissions, plus five admissions officers) independently evaluated the candidates. They unanimously agreed on the rankings for the top two candidates but did not agree on the rankings for the remaining three. Therefore, decision quality was measured by counting the number of correct rankings of only the top two candidates. This raw score was then converted to a *z* score.

Consensus change was measured by examining changes in agreement among participants' pre- and postdiscussion individual choices. The number of identical answers on individual postdiscussion decisions minus individual prediscussion decisions was expressed as a proportion of the number of answers (see Watson, DeSanctis, & Poole, 1988). In no case did positions become more divergent.

Communication satisfaction was measured using the Communication Satisfaction Inventory (Hecht, 1978). This instrument uses

19 items on a 1 to 7 Likert scale (see the Appendix). Reliability was adequate (alpha = .91).

We also included three perceptual measures on the questionnaire as manipulation checks. Equivocality (six items, Likert-scale format, alpha = .84) includes the three questions that Daft and Macintosh (1981) used to measure equivocality plus three more questions drawn from Daft and Lengel's (1986) definition of equivocality. Complexity (two items, Likert-scale format, alpha = .85) used a straightforward measure of task simplicity and difficulty. Perceived media richness was measured using the scale of Dennis and Kinney (1998) (eight items, Likert-scale format, alpha = .89). Refer to the Appendix for the questionnaire items for these measures.

RESULTS

Table 1 shows the means and standard deviations. Table 2 shows the statistical results.

MANIPULATION CHECKS

The higher equivocality task was perceived to be more equivocal than the lower equivocality task, $F(1, 34) = 41.15$, $p = .001$. No significant difference in complexity was found between the two tasks, $F(1, 34) = 3.19$. Participants perceived CMC to have less media richness than face-to-face communication, $F(1, 34) = 57.64$, $p = .001$. Thus, the manipulations appear to have been successful.

DECISION TIME

The variance of the decision-time measure was not homogeneous across treatments. The standard deviation appeared to increase with the treatment means, so a square root transformation was applied to the data before performing the ANOVA; the transformation was root(x) + root(x+1) (see Kirk, 1968, pp. 64-65). Analysis of variance revealed significant main effects for decision

TABLE 1: Means and Standard Deviations of Dependent Measures

		Face-to-Face			*Computer-Mediated*		
Measure	*Task Equivocality*	*Female Groups*	*Male Groups*	*Mixed-Gender Groups*	*Female Groups*	*Male Groups*	*Mixed-Gender Groups*
Decision time	Low	7.00 (2.16)	9.67 (3.21)	9.55 (2.21)	23.33 (11.37)	25.83 (8.47)	27.75 (7.44)
	High	6.00 (2.58)	9.67 (8.02)	10.45 (6.14)	31.67 (10.41)	17.33 (10.44)	14.88 (7.75)
Decision quality	Low	.32 (.68)	.52 (.68)	.16 (.80)	.91 (.00)	–.47 (1.39)	–.57 (1.05)
	High	.86 (.49)	–.63 (.78)	.17 (.95)	.39 (1.06)	–.29 (1.11)	–.36 (1.07)
Consensus change	Low	.188 (.239)	.417 (.382)	.227 (.325)	.167 (.289)	.542 (.292)	.000 (.582)
	High	.625 (.595)	.417 (.382)	.500 (.387)	.583 (.382)	.375 (.542)	.437 (.513)
Satisfaction	Low	4.99 (.66)	5.25 (1.09)	5.09 (.72)	5.33 (.84)	5.00 (.50)	4.90 (.75)
	High	4.88 (.64)	5.23 (1.11)	4.98 (.86)	5.46 (.89)	4.78 (.64)	4.83 (.88)

NOTE: Decision time in minutes. Decision quality in *z* scores. Consensus change scored from –1 to +1. Satisfaction scored from 1 to 7.

TABLE 2: Results of Statistical Analyses on Dependent Measures

Measure	*Medium*	*Task*	*Gender Mix*	*Medium ⋄ Task*	*Gender Mix ⋄ Medium*	*Gender Mix ⋄ Task*	*Gender Mix ⋄ Task ⋄ Medium*
Decision time	53.96	3.21	0.04	0.78	2.34	2.43	3.85
	(.001)***	(.084)	(.962)	(.385)	(.115)	(.107)	(.033)*
Decision quality	1.15	0.66	3.34	0.39	0.60	0.82	1.19
	(.292)	(.432)	(.050)*	(.536)	(.556)	(.450)	(.319)
Consensus change	0.10	8.19	0.48	0.00	0.19	3.55	0.45
	(.757)	(.008)**	(.626)	(.963)	(.831)	(.042)*	(.645)
Satisfaction	0.00	0.97	0.40	0.02	1.10	0.02	0.67
	(.974)	(.329)	(.670)	(.900)	(.338)	(.880)	(.514)

*$p < .05$. **$p < .01$. ***$p < .001$.

time due to medium, $F(1, 28) = 53.96$, $p = .001$, and a Gender Mix × Task × Medium interaction effect, $F(1, 28) = 3.85$, $p = .033$. All-female teams took significantly longer than all-male and mixed-gender teams when using CMC for the more equivocal task. Thus, H1a and H1c were supported, but H1b was not.

DECISION QUALITY

Analysis of variance showed one significant main effect for gender mix, $F(1, 28) = 3.34$, $p = .050$. On average, all-female teams made better decisions regardless of communication medium or task. Thus, H2a, H2b, and H2c were not supported.

CONSENSUS CHANGE

Analysis of variance showed a significant main effect for consensus change due to task, $F(1, 28) = 8.19$, $p = .008$, and a Gender Mix × Task interaction effect, $F(1, 28) = 3.55$, $p = .042$. The higher equivocality task showed greater increases in consensus change. The all-male teams showed less consensus change for the more equivocal task. Both effects are consistent with previous research. Thus, H3a, H3b, and H3c were not supported.

COMMUNICATION SATISFACTION

No statistically significant effects were found for communication satisfaction. Thus, H4a, H4b, and H4c were not supported.

DISCUSSION

This study had three fundamental sets of hypotheses. First, we hypothesized that use of leaner CMC would reduce performance in terms of decision time, decision quality, consensus change, and communication satisfaction. This set of hypotheses was supported only for decision time. Use of leaner CMC did require teams to work longer but had no other effect on their performance. Decision

makers often trade off outcomes (particularly time and quality) so that effects sometimes appear in only one measure (Beach & Mitchell, 1978; Payne, 1982). We conclude that these results are generally supportive of the theory: use of leaner media results in lower performance—at least in terms of time required to make decisions.

The second set of hypotheses focused on the central proposition of media richness theory, that matching media richness to task equivocality would improve performance. We found no media by task interactions for any performance measure. However, that is not the whole story.

The third set of hypotheses argued that media richness theory should have stronger effects on women than men, that women's performance should be more negatively affected by the loss of nonverbal cues in CMC when performing the more equivocal task. Once again, this set of hypotheses was supported only for decision time. If one believes the arguments that decision makers trade off outcomes so that effects appear in only one measure (Beach & Mitchell, 1978; Payne, 1982), then these results are generally supportive of the theory: Female teams felt the loss of cues in CMC to a greater extent than male teams. In other words, females were willing to work longer to achieve their goals of quality and consensus. Were men willing to sacrifice decision quality for speed?

If we take a closer look at decision time, we see that all three gender-mix conditions (all female, all male, and mixed gender) took two-and-a-half to three times as long to complete the less equivocal task in the CMC condition. Media richness theory would predict that the increase in time to complete the higher equivocal task would be greater than three for all teams. Instead, we found that the all-male teams and the mixed-gender teams had lower increases in time (took less than twice as much time to complete the higher equivocal task). Only the all-female teams performed as predicted by media richness theory. The all-female teams took five times as long to complete the higher equivocal task in the CMC condition as face-to-face. In short, media richness theory "worked" for the all-female teams but failed for the all-male and mixed-gender teams.

Why would media richness theory only hold true for the all-female teams? Perhaps the all-female groups were less competent and less confident than men in their use of computers (Karma, 1994; Neuman, 1991), which would increase decision-making time. Grint (1992) found that students held to these conventional assumptions about computer literacy, regardless of the absence of external evidence to support it, once gender was revealed. If the females in this study were less competent and confident, we would have expected lower scores for decision quality and decreased satisfaction. Decision quality for the equivocal task for the all-female teams, however, was the second highest in all treatment conditions, second only to the all-female face-to-face team. Furthermore, they were no less satisfied when using CMC. Therefore, we discount this possibility.

We predicted that use of leaner media would result in longer decision-making time due, in part, to delay costs of typing. Perhaps the women were slower typists than the men. We can argue at face value, however, that women would not be expected to be slower typists than men. Women are overrepresented in typist positions and are more likely to have taken typing classes in school than men. And, if this were true, it also should have affected the less equivocal task as well, which it did not. Therefore, we discount this possibility.

We hypothesized that the leaner media will result in longer decision-making time due to reduced capacity for transmitting rich information. This is the heart of media richness theory, "the ability of information to change understanding within a time frame" (Daft & Lengel, 1986, pp. 559-560). Previous research has shown that females are more capable than males of sending and receiving nonverbal cues—these same nonverbal cues that are missing in CMC. We conclude, therefore, that the lack of nonverbal cues in CMC had a greater impact on the performance of all-female teams than on all-male or mixed-gender teams. Use of CMC may greatly reduce the performance of all-female teams (at least in terms of the time needed to reach decisions) to a greater extent than all-male or mixed-gender teams, when those teams work on equivocal tasks for

which women are likely to rely more on nonverbal communication to achieve consensus.

Why also did we not find increased decision time for CMC for more equivocal tasks in the mixed-gender teams? Perhaps the women in those groups attempted to use nonverbal cues in the face-to-face treatment, but the men were less skilled at sending and receiving these cues, so they added little value. Research with newsgroups, listservs, MUDs (Multi-User Domains), and other on-line discussion groups provides another possibility. Herring (1993) reports that in mixed-gender discussion groups, women routinely participate at lower rates than men because men ignore them or attempt to delegitimize their contributions. Because women are uncomfortable with direct conflict, they tend to be more intimidated by these practices and reduce their participation.

Rather than matching the solution time pattern set by the all-female teams, the mixed-gender teams were notably similar to the all-male teams, suggesting that the male communication pattern predominated. However, we have no evidence that the women perceived their participation to be of no value. Although communication satisfaction scores for mixed gender were the second lowest of all treatment conditions, the differences were not statistically significant.

LIMITATIONS

Clearly, questions remain about the generalizability of these results to other teams, tasks, and media. This study suffers from the weaknesses inherent in laboratory research. The participants were students, who may be more or less familiar with the media than managers. We studied only one size of team, dyadic, but 60% of all managerial meetings are dyadic (Panko & Kinney, 1995a). Participants worked together for only a limited amount of time— but 20% to 30% of managerial meetings are handled through one-time contacts (Kinney & Panko, 1996; Monge, McSween, & Wyer, 1989).

The participants had only a limited history of working together and few established social norms—a form of collaboration that occurs naturally in organizations (Galegher & Kraut, 1990). We

believe that our use of participants with limited prior experience with each other and with CMC strengthens our findings. It has been argued that media expertise may influence one's perception of a medium's richness (Fulk, 1993; Schmitz & Fulk, 1991). Teams with long histories and much experience with lean media can often communicate rich messages through lean media (Lee, 1994; Yates & Orlikowski, 1992); for the teams in our study, who had no such shared history, the leaner media were clearly quite lean.

CONCLUSION

The significance of our findings lies in the potential for managerial use of computer-mediated communication. Media richness theory has long argued that an effective manager should choose such a rich medium as face-to-face interaction for communicating equivocal information (e.g., see Trevino et al., 1990, p. 78). Proponents of media richness theory urge organizations to be cautious when considering adoption of "computerized management information systems, electronic mail, and teleconferencing systems" (Trevino et al., 1990, p. 90). They believe that mediated communication cannot compensate for the power of face-to-face communication for resolving equivocal tasks. In keeping with this advice, many managers may believe they need to bring employees together to resolve differences and make team decisions because, lacking empirical evidence to the contrary, this is what they have been taught and what their perceptions tell them to do.

Our results challenge media richness theory, at least for the new media studied here. We found that, whereas participants were able to recognize differences in media richness, matching richness to task equivocality did not improve decision quality, time, consensus, or communication satisfaction for all-male or mixed-gender teams. For these teams, the loss of nonverbal communication in CMC had no effect on performance for tasks differing in equivocality. The males in these teams were less likely to use nonverbal cues, so they were less sensitive to their absence.

In contrast, media richness theory successfully predicted the reduced performance of all-female teams when nonverbal cues were absent for more equivocal tasks. The females in these teams were able to successfully use a combination of verbal and nonverbal communication to come to a good decision quickly, and their performance was reduced when they were forced to use CMC, eliminating nonverbal communication. (But, we should note that on average, the all-female teams made better quality decisions than their all-male or mixed-gender counterparts.)

Despite CMC's pervasiveness in the workplace and predictions of its equalizing force for women in management, upper management remains a male-dominated bastion. Gender difference do exist in communication and males assume the same roles in CMC as they do in face-to-face communications. Gregory (1997) argues that male monopolization of CMC continues to limit female participation. This study provides support for that assertion.

Today's workplace stresses the importance of fast decision making to remain competitive. Technologies are marketed and used to eliminate time delays by rapidly analyzing large quantities of data and encouraging quick conclusions for complex problems. If our findings are correct and able to be generalized, women could find themselves increasingly handicapped in this new communication environment that devalues consensus, accepts trade-offs in quality, eliminates one of women's key communication modalities (nonverbal communication), and then denies them the opportunity to compensate for the loss with increased time.

Our findings also suggest that management should be cautious about its assumptions of diversity with mixed-gender teams. Only the all-women teams were willing to invest more time in the process to preserve goals and quality and consensus. In the mixed-gender teams, outcome measures followed the all-male style. On the basis of communication satisfaction measures, it appears that the women willingly altered their communication goals and processes to match those of the men. Women's communication strengths and adaptability, therefore, may be lost by the inclusion of equal numbers of men in the team. The competitive goals typical of

men will likely outweigh the consensus goals of women, particularly when using CMC.

Management also should be aware that the standards it holds for success may be more heavily weighted toward decision speed than toward decision quality and consensus, negatively affecting job-related performance measures for women. In studies done with managers in the workforce, not only do we find a clear pattern of women taking longer to make decisions, but we also find a clear pattern of criticism that women can't make decisions more quickly. In a study of senior marketing executives' decision-making styles, researchers found that "a harried approach to marketing decision making may be a significant factor in the poor performance of most marketing programs" (Copernicus, 1998, p. 1). They found that most marketing decisions by men are more rushed, rely on less research, and are more likely to focus on short-term results than holds for women. Computer-mediated communication should exacerbate the differences between the male and female decision-making patterns and increasingly penalize females if corresponding adjustments are not made in decision-making standards to increase the value of quality over speed. Clearly more research is needed to better understand gender effects in the use of CMC.

APPENDIX
QUESTIONNAIRE MEASURES

Equivocality

Different people could have different opinions about the best solution for this task.[a]

Most people would clearly agree on what information is important and unimportant for this task.

The information needed to solve this task can be interpreted differently by different people.[a]

More than one reasonable solution exists for the problems faced in this task.[a]

The information needed to complete this task can be found in books.

The rules and criteria for solving this problem are clear and can be found in books.

Complexity

This was a simple task to complete.
This was a difficult task to complete.[a]

Perceived Media Richness

When we disagreed, the communication conditions made it more difficult for us to come to agreement.
When we disagreed, our communication environment helped us come to a common position.[a]
The conditions under which we were communicating got in the way of our sharing of opinions.
I could easily explain things in this environment.[a]
The communication conditions helped us communicate quickly.[a]
I couldn't easily communicate some ideas to my partner because of the communication conditions.
The communication condition under which we communicated helped us to better understand each other.[a]
The communication condition under which we were communicating slowed down our communications.

Communication Satisfaction

I had something else to do.
Nothing was accomplished.
I did not enjoy the interaction.
The interaction went smoothly.[a]
We each got to say what we wanted.[a]
I was very satisfied with the interaction.[a]
We talked about something I was NOT interested in.
I would like to have another interaction like this one.[a]
The other person genuinely wanted to get to know me.[a]
I felt I could talk about anything with the other person.[a]
The other person showed me that he/she understood what I said.[a]
The other person expressed a lot of interest in what I had to say.[a]

I felt that we could laugh easily together.[a]	The other person let me know that I was communicating effectively.[a]
I was very dissatisfied with the conversation.	The other person did NOT provide support for what he/she was saying.
The other person frequently said things that added little to the interaction.	During the interaction, I was able to present myself as I wanted the other person to view me.[a]
The other person changed the topic when his/her feelings were brought into the interaction.	

NOTE: Scoring: All 7-point Likert scales scored 1 for *strongly agree* and 7 for *strongly disagree*.
a. Indicates reverse scoring. High scores indicate high presence of measured construct.

NOTES

1. Across their many articles, Daft and Lengel discuss five primary task-related factors that may affect performance: equivocality, uncertainty, routineness, complexity, and emotional content. Equivocality and uncertainty were initially described as two different factors, with uncertainty omitted in later studies. The three other factors were sometimes used interchangeably with equivocality. We do not necessarily agree that all tasks can be clearly categorized along these dimensions (e.g., they make no provisions for routine, complex tasks or nonroutine, simple tasks) nor do we necessarily agree that equivocality, complexity, nonroutineness, and high emotionality are synonymous (they may be task characteristics that frequently overlap). Nonetheless, in keeping with the direction Daft and Lengel were taking in media richness theory, we choose to focus on equivocality, to match degree of routineness to level of equivocality, to disregard uncertainty as a separate factor, and to balance levels of complexity and emotional content between the tasks.

2. Daft and Wiginton (1979) identified nine different types of languages: art, nonverbal cues, poetry, general verbal expression, jargon, linguistic variables, computer languages, probability theory, and analytical mathematics. Daft et al. (1987) broadly group these into two categories: natural language and numbers. Both media (face-to-face and CMC) provide similar capabilities to use natural language and numbers. The tasks chosen for this study require communicators to exchange information using natural language and numbers, thus controlling for the variability.

Personal focus is the extent to which the sender can customize the message to meet the individual needs of the receiver. Media often have been generalized as having inherent degrees of personal focus (fliers, for example, cannot be personalized because of their wide

general distribution). However, any medium directed to a specific individual can be personalized. The media of interest in this study both easily support personalization.

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