Testing the Interactivity Principle: Effects of Mediation, Propinquity, and Verbal and Nonverbal Modalities in Interpersonal Interaction

By Judee K. Burgoon, Joseph A. Bonito, Artemio Ramirez, Jr., Norah E. Dunbar, Karadeen Kam, and Jenna Fischer

Early channel reliance research compared different modes of communication to assess relationships among nonverbal and verbal cues. Emerging communication technologies represent a new venue for gaining insights into the same relationships. In this article, the authors advance a principle of interactivity as a framework for decomposing some of those relationships and report an experiment in which physical proximity—whether actors are in the same place ("co-located") or interacting at a distance ("distributed")—and the availability of other nonverbal environmental, auditory, and visual information in distributed modes is varied. Results indicate that both proximity and availability of nonverbal cues affect communication processes, social judgments participants make about each other, and task performance. The authors discuss implications about gains and losses due to presence of nonverbal features.

The study of how verbal and nonverbal systems interact, compensate, and substitute for each other has a long and storied tradition in the context of interpersonal communication under the rubric of "channel reliance." Extensive research on channel reliance has demonstrated systematic differences in communication processes, interpretations, and other outcomes associated with utilization or exposure to various communication "modalities" or modes of communication such as text-

---

Judee K. Burgoon is a professor of communication, professor of family studies and human development, and director for human communication research, Center for the Management of Information, University of Arizona, where Joseph A. Bonito is an assistant professor of communication, Karadeen Kam is a doctoral candidate, and Jenna Fischer is a graduate of the master's program. Artemio Ramirez, Jr., is an assistant professor of communication at the University of Minnesota, Duluth. Norah E. Dunbar is an assistant professor of communication studies at California State University, Long Beach. Correspondence should be addressed to the first author. Portions of this research were supported by funding from the U.S. Army Research Institute (Contract #DASW01–98-K-009). The views, opinions, and/or findings in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision.

only, audio-only, video-only, and audiovisual modalities (see, e.g., Burgoon, 1985, 1994; DePaulo, Zuckerman, & Rosenthal, 1980). Emerging communication technologies—email, chat, audioconferencing, videoconferencing, computer-assisted group support systems, virtual reality—provide a new venue for revisiting these same interrelationships among verbal and nonverbal codes. Indeed, both bodies of literature, that examining communication codes in nonverbal and interpersonal contexts and that investigating communication technologies, appear to share common, even parallel, developmental trajectories. For example, they have employed similar methodologies. Whereas current media richness theorists make comparisons to face-to-face (FtF) interaction for the purpose of informing the study of computer-mediated communication (CMC), channel reliance scholars used technology to strip away verbal and nonverbal cues for the purpose of informing the study of interpersonal communication. Yet the two research traditions fail to converge with or inform each other. For instance, the channel reliance literature has been largely ignored by those conducting new media research. The lack of attention to these early works has likely contributed to much theoretical debate regarding the role of verbal and nonverbal cues in CMC (see, for example, Walther, 1996, for a discussion) as well as confusion about comparisons between FtF and CMC (Bordia, 1997).

From the outset, designers and scholars of new media have treated FtF interaction as the benchmark for assessing CMC. FtF provides individuals with a full array of verbal and nonverbal cues that create social presence and visceral immersion in the interaction, supply important social and contextual information, permit nuanced and coordinated interaction, and add redundancy. Understandably, then, designers and practitioners alike assume that FtF interaction is the superior form of communication (see, e.g., Nohria & Eccles, 1992; O'Hara-Devereaux & Johansen, 1994). Research and theories examining the effectiveness of such technologies, however, have yielded conflicting conclusions and advice. For instance, early media richness theories generally, and social presence theory specifically, proposed that new communication technologies filter out important contextual and social cues, information typically supplied through nonverbal cues (e.g., Culnan & Markus, 1987; Krauss & Fussell, 1990; Rutter, 1987; Short, Williams, & Christie, 1976). The resultant impoverished communication environment was thought to eliminate social presence, degrade the quality of communication, impair working relationships, and undermine task performance compared to FtF interaction unless communicators are able to compensate for such losses. Such views catalyzed substantial engineering efforts to produce richer mediated forms of communication that can simulate the nonverbal contextual information of FtF interaction.

Interestingly, such beliefs about the importance of nonverbal and verbal cues have not been limited to the domain of new media and communication technology. Early channel reliance theorists proposed a similar orientation to that of their media richness counterparts in attempting to shed light on the role that verbal and nonverbal cues play in human interaction. In general, these scholars made a case for visual primacy as a key element in distinguishing between primary and secondary sources of information in interpersonal contexts (e.g., Argyle, 1988; Argyle, Salter, Nicholson, Williams, & Burgess, 1970; Fujimoto, 1972; Mehrabian,

1981). Results from this research suggested that, all else being equal, the more nonverbal cues communicators have available to them, especially in the form of facial expressions, the more positive communicators, interactions, and outcomes should be judged (e.g., Bugental, 1974). A distinguishing feature between media richness and channel reliance theorists, however, is that this literature also identified instances in which the importance of visual cues would diminish and, in turn, verbal or vocalic cues would gain in importance (e.g., decoding of mixed, deceptive, or persuasive messages; see DePaulo & Rosenthal, 1979; Mehrabian, 1981). This literature recognized that communicators may ignore certain cues available to them, regarding them as peripheral or even distracting to the interaction. This stands in direct opposition to, for example, media richness theory, which proposes that richer media—those with the ability to transmit more nonverbal cues—would provide the necessary requirements for communicating accurately in such situations (Daft & Lengel, 1984).

Empirical evidence, however, has been anything but compelling that modalities per se are the issue or that FtF interaction is, in fact, a superior mode of communication (e.g., Krauss & Fussell, 1990; Ramirez & Burgoon, 2001). An emerging alternative view is that FtF is not the inevitable preferred venue for decision making; to the contrary, communicators can effectively compensate for structural shortfalls if given adequate time and motivation (e.g., Chilcoat & DeWine, 1985; Montes, 1992; Walther, 1994, 1996, 1997; Walther & Burgoon, 1992). Moreover, simple comparisons among communication formats alone will not tell the whole story (see Bordia, 1997, and Griffith & Northcraft, 1994, for critiques). What is needed, if we are to understand when, how, and why communicators should opt for one communication arrangement over another, is decomposition of interfaces into their constituent properties and determination of which are essential or useful to accomplish given communication goals. The current study examines just such issues through a new approach, the principle of interactivity, which we offer as an ecumenical framework for understanding the interrelationships of verbal and nonverbal codes associated with FtF and CMC formats. We elaborate this principle, then present results of an experiment testing its relationship to communication processes, social judgments, and performance in a decision-making task.

The Principle of Interactivity

The principle of interactivity is not about nonverbal and verbal codes per se but offers potentially valuable insights into their interrelationships. Its fundamental premise is simple: Human communication processes and outcomes vary systematically with the degree of interactivity that is afforded or experienced (Bonito, Burgoon, Ramirez, & Dunbar, 2000; Burgoon, Bonito, Bengtsson, Ramirez, Dunbar, & Miczo, 1999; Ramirez & Burgoon, 2001). By "interactivity" is meant, in the media realm, some form of interdependent message exchange (Rafaeli, 1988; cf. Biocca, 1992; Palmer, 1995; Stromer-Galley, 2000). Rafaeli argued that it is a property of the communication process itself rather than a medium, although the medium "may set upper bounds, remove barriers, or provide necessary conditions

for interactivity levels" (pp. 119–120). Nonetheless, media themselves are typically referred to as interactive or noninteractive (e.g., interactive television or interactive video games).

In the interpersonal realm, interactivity also refers to interdependent message exchange but, according to Burgoon and colleagues, can be understood in two senses that are derived from the intrinsic properties of FtF interaction (Buller & Burgoon, 1996; Burgoon, Bengtsson, Bonito, Ramirez, & Dunbar, 1999; Ramirez & Burgoon, 2001). The first is according to the fixed, structural properties of communication media or interfaces that "afford" or enable people to engage in interdependent interaction. These affordances can be elaborated more fully to include contingency (whether an interface produces answers tailored to a user's queries), participation (whether users are participants or observers), and synchronicity (whether message exchange occurs in real time or is delayed). Other affordances, such as proximity (whether users are geographically proximal or distributed) and richness of nonverbal contextual information available in the modality being used, may also moderate the extent to which interdependent message exchange is possible. The second sense of interactivity, the processual sense, concerns those dynamic qualities by which interactivity becomes manifest and is "experienced" as interactive. Among these are the degree of involvement (cognitive, emotional, and behavioral engagement in an interaction), interaction ease and coordination (its smoothness and naturalness or difficulty and awkwardness), and mutuality (e.g., perceptions of connection, similarity, receptivity, understanding) that are activated. Other communication qualities—richness, spontaneity, expectedness, and desirability—may also influence, and be influenced by, the degree of phenomenological and behavioral interactivity present.

Parsing interfaces into distinctive structural affordances provides a more precise response to the question of whether FtF interaction is a necessary condition to achieve many communication purposes or whether it is particular affordances that are needed. Decomposing experiential interactivity into its constituent properties allows us to isolate those perceptual and demonstrable qualities that are most likely to mediate the impact of structural affordances upon other processes and outcomes (Burgoon, Bonito, et al., 1999) and to determine if different structural arrangements produce the same level of perceived and demonstrable interactivity. It also allows us to speak to the concerns of channel reliance theorists regarding the relative importance of verbal and nonverbal cues in the presence or absence of other affordances that distinguish FtF from alternative forms of interaction.

It is important to note that interactivity is neither inherently positive nor negative. The extent to which interactivity helps or hinders is a function of a variety of factors including the nature of the interaction, the objectives to be accomplished, and the interactants themselves (Burgoon, Bonito, et al., 1999). A high level of interactivity may, for example, detract from actors' ability to detect erroneous or faulty information during decision-making tasks, or it may assist senders in successfully portraying themselves as credible, thereby making it more difficult for their partners to detect invalid information (Buller & Burgoon, 1996; see also Walther, 1996). Low levels of interactivity may be preferred for tasks requiring

thoughtful reflection. In short, interactivity itself is value-neutral, although the outcomes associated with it may be value-laden. Moreover, structural affordances are not deterministic in their influence on communication processes and outcomes. That is, their effects are neither constant nor time-invariant. Interactants can and do adapt over time to the constraints imposed upon them by a given communication format and, therefore, may achieve their objectives and tasks equally well with different interfaces and arrangements.

The conceptual model set forth by earlier tests of the principle of interactivity (e.g., Bonito, Burgoon, Bengtsson, Ramirez, & Stoner, 2000; Bonito, Burgoon, Ramirez, et al., 2000) posits that, although structural input factors may exert some direct effects on outcomes such as social judgments and task performance, they are especially likely to influence qualities of the interaction process itself, which serve to mediate the impact of affordances on outcomes. Here we offer further tests of this model by examining three structural affordances (mediation, proximity, and modality and context richness) that have particular relevance for the role of verbal and nonverbal cues in human interaction.

Hypotheses

Mediation and Proximity

Mediation refers to the interposition of an electronic or mechanical medium by which messages are transmitted between actors. Usually "mediated interaction" refers to transmission via computers (although technically, telephones, telegraphs, or even pencil and paper would qualify). Relative to FtF interaction, mediated interaction has typically entailed shifting from an oral mode, in which the full range of nonverbal visual, auditory, haptic, proxemic, and environmental cues is available, to a written, text-only one (although the emergence of voice mail and computer telephony may eventually supplant text-based forms). Thus, mediation usually implies a communication format that is leaner than FtF in the range of nonverbal information that is accessible.

Proximity (also referred to as propinquity) refers to geographic closeness or distance. With the exception of group decision-making support systems (GSS), in which team members are located in the same place but use computers to conduct much of their interaction in text mode, the structural affordances of mediation and proximity are interrelated because mediated communication is usually also at a distance, that is, it is geographically distal. Thus, comparisons between FtF and CMC may conflate mediation with proximity as well as other aspects of modalities such as the amount of information they afford (discussed next). Differences between FtF and CMC, then, do not necessarily reflect mediation differences alone; they may actually represent differences due to a combination of factors.

From the standpoint of the principle of interactivity, the issue is whether mediation and/or reduced proximity, both of which may constitute structural reductions in the capacity for interactivity, have adverse effects on interaction processes themselves and on interaction outcomes. One highly relevant consideration is that both mediation and proximity affect nonverbal immediacy, which refers to a con-

stellation of nonverbal behaviors (e.g., physical proximity, eye contact, touch, body orientation, body lean) that enable sensory immersion and create psychological closeness as well as physical and social presence (Coker & Burgoon, 1987; Mehrabian,1981; Short et al., 1976). According to Mehrabian (1981), these behaviors communicate interest and warmth between communicators. Presumably, nonverbal immediacy is more readily achieved through FtF interaction than via CMC (the exception being GSS). When communicators are in close proximity, they have access to both intended and unintended behaviors that may not be available to them when they are distributed. Even in GSS environments, where written messages replace oral discourse, communicators still have access to numerous nonverbal cues. Furthermore, physically copresent interactants may entrain to each other's speech rhythms and nonverbal behavior, coordinating and synchronizing their communication into a unified, smooth-flowing pattern, all seemingly without conscious awareness (see, e.g., Burgoon, Stern, & Dillman, 1995, for a review).

These are the kinds of interactional qualities that mediation may dampen or eliminate. If this is the case, then an argument can be made that FtF interaction should foster higher levels of involvement, interaction ease, and mutuality among collaborators than should CMC. On the other hand, for straightforward tasks, provision of social information via nonverbal cues or a novel technology may elevate users' cognitive load and redirect their attention to social considerations, making it more difficult to complete their task efficiently. If this is the case, task-related social judgments and performance might actually be higher under CMC. In light of the competing possibilities regarding the influence of mediation, we tested a nondirectional hypothesis:

> H1: Mediated interaction differs from nonmediated interaction in communication process qualities and outcomes.

The case for proximity should be less equivocal. Extensive nonverbal literature has demonstrated that the correspondence between physical and psychological closeness is direct and potent: Physical proximity promotes psychological closeness, and physical distance conveys psychological distance. Moreover, sheer proximity between two people activates perceptions of a unit relationship between them. It creates a sense of mutuality, of connection, common ground, and shared understandings (Burgoon et al., 1995; Foppa, 1995; Krauss, Fussell, & Chen, 1995) that should heighten already existing positivity and truth biases (e.g., Burgoon & Newton, 1991; Stiff, Kim, & Ramesh, 1989; Storms, 1973; Street, Mulac, & Wiemann, 1988; Weisband, Schneider, & Connolly, 1993) and promote higher levels of credibility, trust, and influence. This assumes that credibility is central to influence processes (McGuire, 1985) and that sources or messages deemed more believable are also more influential (Burgoon, Birk, & Pfau,1990; O'Keefe, 1990). Conversely, concerns about self-presentation, protecting another's face, maintaining an amicable and trusting relationship, or assuring a comfortable interaction should pale as interactants become physically and psychologically removed from another. Participants, therefore, should have more difficulty establishing credibility and

influencing partners to adopt "best" decisions when not physically copresent. Therefore, we tested as a second hypothesis:

> H2: Proximal interactions result in more favorable interaction processes and outcomes than distal interactions.

Modality and Context Richness

A natural extension of the property of mediation is the number of nonverbal channels or modalities available through which people can communicate. This particular affordance provides a direct window onto the unique and joint contributions of various verbal and nonverbal channels in interpersonal interaction. As already noted, FtF interaction affords participants a full complement of nonverbal information by which to contextualize messages, to glean essential social information, exchange relational messages, and coordinate conversation. By contrast, mediated formats restrict the modalities through which these communication functions can be achieved. Videoconferencing, for example, preserves visual, audio, and verbal information but loses proxemic, haptic, and environmental cues; audioconferencing removes all visual information; text removes vocalic information, leaving only the verbal portion of an interaction.

According to media richness and social presence theories, leaner modalities and reductions in social cues are thought to alter the character of interpersonal relationships and the quality of communication that transpires:

> The more cueless the encounter, the greater the psychological distance; and the greater the psychological distance, we find, the more task-oriented and depersonalized the content of what people say and, in turn, the less spontaneous their style of speech. (Kemp, Rutter, Dewey, Harding, & Stephenson, 1984, p. 257)

Leaner modality formats, by producing a limited cues environment, may reduce not only the total amount of information available upon which people rely to form credibility and other social judgments but may decrease redundant and complementary information that contributes to mutual understanding. As Poster (1990) observes, "In face-to-face interaction, so much depends on not what is said, but on who says it . . . what clothes they wear, their body language, facial and oral expressions. All of this is absent in electronically mediated exchange" (p. 121). Leaner modalities may also restrict feedback processes relative to what is available in multichannel communication (Barefoot & Strickland, 1982; Fowler & Wackerbarth, 1988; Weick, 1995). Daft and Lengel (1984) explain: "Rich media enable multiple cues and rapid feedback. Less rich media might oversimplify complex topics and may not enable the exchange of sufficient information to alter a [member's] understanding" (p. 200). This is especially true when mediated communication is stripped down to the exchange of text information only. Moreover, more talk may be directed toward managing interaction itself because normal routines of FtF speech that guide interaction are missing. As a consequence, it becomes more difficult to access valuable feedback and to resolve uncertainties or ambiguities. In short, these perspectives lead to an expectation that reductions in available context and social cues can jeopardize relationally based outcomes.

Whereas FtF, as the richest mode of communication, should enhance interaction processes and social judgments, reduction of social cues in mediated formats may not produce linear declines in communication quality, social judgments, or task performance. One mitigating factor may be the degree to which different modalities afford adaptation of people's communication. For example, some evidence suggests that communicators can and will compensate for losses that a medium introduces (Ramirez & Burgoon, 2001; Walther, 1996; Walther & Burgoon, 1992). Meader (1995), among others, found that removing visual cues had no significant effect on involvement or performance in distributed CMC groups, presumably in part because group members were highly motivated to perform well. Furthermore, modalities may be uniquely suited for some purposes but pose hindrances for others. Walther, Slovacek, and Tidwell (2001), for example, found that for long-term virtual teams interacting via text-based CMC, adding photographs of team members reduced rather than enhanced affinity for one another. Research by Jensen, Farnham, Drucker, and Kellock (2000), Chilcoat and DeWine (1985), and Stoner (2001) similarly found that the presence of audio cues, and the absence of visual ones, enhanced communicative processes, social judgments, and the quality of collaborative interactions. Jensen et al. concluded that the voice has special properties that evoke a sense of social presence and proclivity to collaborate, even when the voice is synthesized. Moreover, the combined vocal-verbal stream may be sufficient for communicators to transmit information rapidly, adapt and synchronize their respective communication styles, and exchange comprehensible feedback all the while being spared allocation of attentional resources to visual monitoring of the partner, management of their own visual presentation, and interpretation of visual feedback, so that more attention can be devoted to task concerns. That is not to say that monitoring and self-presentational concerns disappear in the absence of visual cues, only that they should simply become less salient. When task partners have access to both verbal (textual) and audio cues, they may be able to function on a par with those in FtF interaction, especially given everyone's familiarity with this format in using the telephone.

By contrast, given the current state of technology, both text-only and videoconferencing formats are affected not only by the novelty and unfamiliarity of such innovations but also by their circumscribed capacity to foster interactions that are synchronized and coordinated. Videoconferencing, for example, often has a slight delay or jerkiness in transmission of the visual image, even though the audio signal is transmitted instantaneously. This lack of correspondence between the audio and video channel does not fully enable communicators to establish synchronized and coordinated interactions and as a result may exert an unintended impact on communicators' perceived level of involvement and mutuality. Additionally, current desktop videoconferencing applications such as Microsoft NetMeeting, by virtue of allowing communicators to view themselves on the computer screen as they are interacting with their partner, may create a distracting and undesirable heightened self-consciousness that reduces mutuality and involvement between participants. Similarly, in the text-only format, coordination is difficult to achieve as communicators are often left to wonder what has become of an interaction in which a partner takes a lengthy amount of time to respond. Further-

more, there may be loss of emotional tone as communicators do not have access to the audio channel and, as a consequence, are unaware of potentially informative vocalic cues. Important feedback and comprehension cues are also absent from the interaction that may contribute to a lack of synchrony between communicators.

Taken together with the prior discussion, we would expect greater mutuality, involvement, ease, and favorable social judgments in FtF interaction than CMC and, among CMC formats, in conditions including vocal cues than in text-only or full audiovisual mediated conditions. Correspondingly better task outcomes should also accrue to the same conditions. Stated formally as Hypothesis 3:

> H3: FtF and audio-based communication formats result in more favorable interaction processes and outcomes than text-based and video-based formats.

Method

Participants and Confederates

Participants (N = 80; 40 males, 40 females) were undergraduate students enrolled in communication and business courses at the University of Arizona who received extra class credit for participating in a study of how people conduct decision-making tasks under different communication formats. They were paired with a same-sex confederate—a male or female undergraduate of similar age—who followed a memorized interaction script. The confederates received extensive training and conducted numerous practice sessions prior to the experiment to insure that they maintained consistency in verbal and nonverbal performance between themselves and across sessions and that they did not deviate from the content of the script except to respond spontaneously and naturally to their partner's comments. The task was straightforward, so confederates were able to adopt a businesslike but pleasant demeanor devoid of negativity, tension, or incongruent behaviors, as verified by a review of the videotaped interactions.

Experimental Conditions and Procedures

The experiment took place in the CMI Communication Research Laboratory, a complex of multiple interaction rooms equipped with mobile computer stations and swivel chairs that permitted flexible configurations. Upon arrival, participants completed consent forms, then were seated before a computer where they received all task instructions, the task scenario, and pre- and postinteraction questionnaires. Participants were randomly assigned to one of five experimental conditions: (a) FtF, which is unmediated and proximal, and afforded participants full access to each other's verbal and nonverbal behavior; (b) proximal text, in which participant and confederate, seated obliquely at adjacent computers (so they could see one another but not each other's monitor), conducted their discussion via text using a synchronous online chat program; (c) distributed text-only, in which the pair, located in separate rooms, conducted the discussion via synchronous online chat (Microsoft NetMeeting); (d) distributed audioconferencing, in which the sepa-

rated pair interacted via Netmeeting with the audio channel also enabled; or (e) distributed videoconferencing, in which the separated pair interacted via Netmeeting with both video and audio enabled, providing access to each other's vocalic and visual information via two display windows showing the upper body and face of each person. In the distributed conditions, participants were seated in a room alone, with the confederate already located at a terminal in an adjoining room; participants in these conditions did not meet their confederate partners face-to-face.

A modified and updated version of the Desert Survival Problem (DSP) served as the decision-making task. The DSP asked participants to imagine that their jeep had crashed in the Kuwaiti desert, that there was no sign of potable water, and that some items from the wreckage were salvageable. The DSP has the advantages of creating a fair amount of experimental control by structuring the task and points of discussion yet approximates features of normal conversation by creating natural turn exchanges and asking participants to give reasons for their choices. Prior to interacting with their confederate partners, participants were told to rank the 12 salvageable items (e.g., a piece of blue canvas, a knife, matches, a mirror) for their survival value. Each confederate was supplied with a script that contained the "correct" (as agreed upon by survival experts working for the National Aeronautical and Space Administration) rankings for each of the 12 items, as well as the reasons or bases for the rankings. The experimenter then asked the participants to discuss their item rankings and to provide a rationale for each ranking. The interaction progressed such that participants alternated presenting their ranking and rationale for a given item before proceeding to the next item on the list until all 12 items had been discussed (with the confederate providing rankings and rationales according to the script). Following discussion, participants completed a set of postinteraction questionnaires, were debriefed, and then given the opportunity to ask questions regarding the study. Sessions took approximately 30 to 45 minutes to complete.

Dependent Variables

Interactivity measures. Interactivity indicators included perceived involvement, mutuality, and interaction ease, supplemented with assessments of the expectedness and desirability of the partner's interaction behavior. Perceived involvement was assessed with three Likert-format items taken from Burgoon and Hale's (1987) Relational Communication Scale (RCS; Cronbach's $\alpha = .75$). Four measures were employed to capture the multidimensional nature of mutuality. Perceptions of partner receptivity (three items) were taken from the RCS ($\alpha = .77$). Perceived similarity (three items) came from McCroskey, Hamilton, and Weiner's (1974) homophily scale ($\alpha = .92$). Aron, Aron, and Smollan's (1992) pictorial instrument, which uses seven increasingly overlapping circles, assessed degree of perceived connectedness between interactants. Perceived understanding was computed with 15 items taken from Cahn and Shulman's (1984) Feelings of Understanding-Misunderstanding Scale, which subtracts a subtotal for misunderstanding from a subtotal for understanding ($\alpha = .86$). Three items taken from previous investigations measured the ease and naturalness of interaction ($\alpha = .77$). This measure was supplemented with 10 items taken from Burgoon and Walther (1990) to assess how

expected or atypical and positively or negatively valenced the partner's behavior was judged (α = .68 and α = .78, respectively).

Social judgment measures. Social judgments included task attraction, four dimensions of credibility, dominance, and utility. Credibility, dominance, utility, and task partner attraction measures were created from several previously published measures. Credibility is a multidimensional construct that at minimum should be operationalized with dimensions of trust (which includes such character-related facets as being truthful, trustworthy, sincere, responsible, and reliable) and competence (which includes such facets as expertise, experience, and intelligence) but may also include dimensions such as sociability (likability, friendliness) and dynamism or extroversion. The first three dimensions were measured with 18 credibility scale items developed and validated by McCroskey and colleagues (e.g., McCroskey & Young, 1981) and related measures used by Moon and Nass (1996). Because dynamism can be subsumed under a broader construct of dominance, which incorporates other facets related to being energetic, confident, loquacious, influential, and powerful, five dominance subscales developed by Burgoon, Johnson, and Koch (1998) were used here. To these were added items originally intended to measure the perceived utility of computer interfaces (e.g., Moon & Nass, 1996) but that tap into some potentially relevant perceptions of helpfulness and efficiency. All of these measures utilized a seven-interval semantic differential format. Partner task attraction, was developed from several measures (e.g., McCroskey & McCain,1974) and, using six Likert-format statements, assessed the degree to which the partner was judged to be a satisfying, professional, and productive contributor to the task. Respective reliabilities for these measures were: trust, .82; competence, .79; sociability, .84; dominance, .73; utility, .72; task attraction, .85.

Task outcome measures. Task performance was operationalized with two measures. Decision quality was computed as the mean absolute discrepancy between participant and confederate rankings on the 12 items. A smaller score indicated higher decision quality, as that reflects close correspondence to the confederate's rankings, which were based on expert rankings. Influence was indicated by how much participants changed their rankings toward the confederate's position (i.e., toward the "best" decision). It was calculated as the absolute change in the difference between (a) each person's preranking and partner preranking and (b) each person's postanking and partner postranking. Higher scores indicated greater distance from the partner's rankings prior to, than following, the interaction.

Results

All hypotheses were first tested with multivariate analyses of variance (MANOVA) to assess whether sets of related process and outcome variables produced significant effects. These were followed by univariate focused contrasts. Where variances were heterogeneous, we employed adjusted degrees of freedom in the *t*-tests. The two MANOVAs for the eight interaction process measures and the two performance measures were nonsignificant. However, the MANOVA for the seven

social judgment measures was significant, $\Lambda = .59$, $F(24,242) = 1.66$, $p = .03$, $\eta^2 = .12$. As evident from the means displayed in Table 1 and as noted below, proximal text generally earned highest ratings where notable differences emerged.

Hypothesis 1

Hypothesis 1—whether mediation reduces interactivity and interaction outcomes—was tested by comparing mediated and nonmediated communication formats. The typical comparison in the literature compares unmediated FtF condition to the combined mediated conditions. An alternative that does not confound mediation with such other structural affordances as proximity and richness is to compare just the two proximal conditions (FtF and text). We utilized both approaches here to maintain comparability with past research. The first contrast, comparing FtF to the average of the other four conditions, failed to produce significant results for any of measures, although six univariate effects (three with unequal variances) would have been significant with one-tailed tests and might reach conventional significance levels with a larger sample size: receptivity, $t(29) = 1.81$, $p = .08$; expectedness, $t(37) = 1.77$, $p = .08$; ease, $t(26) = 1.90$, $p = .07$; sociability, $t(75) = 1.82$, $p = .07$; decision quality, $t(75) = 1.59$, $p = .06$; influence, $t(75) = -1.33$, $p = .09$. Unmediated FtF interaction was perceived as more receptive, expected, easy, and friendly, but it produced less influence and poorer quality decisions than the combined CMC conditions. The second contrast was significant only for interaction ease, $t(75) = 2.72$, $p = .01$, although the competence contrast fell just short of conventional significance, $t(30) = 1.76$, $p = .08$. In this case, FtF was judged as easier, but text yielded higher competence ratings. In sum, neither approach supported H1 except on interaction ease although the resultant patterns are suggestive of unmediated FtF interaction generating more favorable interaction process judgments while mediation confers more competence on a co-located partner. These patterns would, however, need replication before any firm conclusions could be drawn.

Hypothesis 2

Hypothesis 2—that greater proximity promotes greater interactivity and favorable interaction processes, more favorable social judgments, and better task performance—was also tested with two contrasts. The first compared the two proximal conditions to the remaining three distributed conditions. The second compared the two text conditions, thereby producing a comparison of conditions comparable in all other features except proximity. The first contrast produced significance for connectedness, $t(74) = 2.14$, $p = .04$; sociability, $t(75) = 1.82$, $p = .04$; utility, $t(75) = 2.16$, $p = .02$; and task attraction, $t(74) = 1.95$, $p = .03$; as well as a near-significant result for involvement, $t(75) = 1.45$, $p = .07$. Interactivity in the form of connectedness and involvement was higher in the proximal than the distal conditions, as were social judgments of sociability, utility, and task attractiveness. The tests utilizing the second contrast, within the text-only conditions, produced significant or near-significant results for the following: connectedness, $t(74) = 2.14$, $p = .03$; involvement, $t(75) = 1.78$, $p = .03$; competence, $t(75) = 2.12$, $p = .03$; sociability, $t(75) = 2.34$, $p = .01$; utility, $t(75) = 1.83$, $p = .04$; task attraction,

Table 1. Means and Standard Deviations for All Dependent Measures, by Communication Interface Condition

		Unmediated face-to-face	Mediated FtF (proximal text)	Distributed text)	Distributed audiocon-ferencing	Distributed videocon-ferencing
Involvement	Mean	5.71	5.98	5.19	5.75	5.35
	SD	1.39	.91	1.31	1.27	1.21
Receptivity	Mean	5.75	5.38	4.98	5.33	5.04
	SD	1.05	1.76	1.22	1.19	1.11
Connectedness	Mean	4.06	4.07	3.06	3.19	3.69
	SD	1.18	1.91	1.53	1.42	1.54
Homophily	Mean	3.46	4.17	4.00	3.87	3.79
	SD	1.48	1.38	1.37	1.18	1.13
Feeling understood	Mean	2.00	1.75	1.53	1.83	1.59
	SD	1.11	1.44	1.10	1.04	.74
Expectedness	Mean	5.98	5.39	5.63	5.69	5.72
	SD	.66	1.38	1.01	1.16	.68
Evaluation	Mean	5.85	5.81	5.76	5.63	5.58
	SD	1.25	1.07	1.13	.94	.91
Trust	Mean	5.27	5.56	5.25	5.51	4.97
	SD	.72	.67	.66	.73	.76
Competence	Mean	5.00	5.48	4.88	5.23	5.14
	SD	.79	.75	1.00	.64	.74
Dominance	Mean	4.91	4.81	4.91	5.03	4.47
	SD	.85	.71	.82	.74	1.13
Sociability	Mean	5.94	6.13	5.38	5.38	5.03
	SD	1.01	.67	1.02	.83	.96
Utility	Mean	5.73	5.79	5.23	5.46	5.31
	SD	.82	1.00	1.05	.82	.59
Task attraction	Mean	5.60	5.81	5.16	4.93	5.26
	SD	.88	1.42	1.25	1.66	1.27
Absolute influence	Mean	.34	1.10	.50	.69	1.70
	SD	2.31	1.71	.72	2.41	.94
Decision quality	Mean	3.79	3.00	3.10	3.23	2.49
	SD	2.38	1.62	1.28	2.58	1.07

$t(74) = 1.38$, $p = .08$. Within the text-only condition, interacting in proximity created more connectedness and involvement and more favorable social judgments. In sum, proximity increased interactivity and fostered more favorable social judgments but did not affect performance.

Hypothesis 3

The final hypothesis tested the impact of modality/context richness, with the audioconferencing condition expected to exceed the other distributed conditions. A contrast testing this prediction produced a significant difference only for trust, $t(75) = 1.84$, $p = .03$. Trust was higher in the audio than the other two distributed conditions. However, examination of the means showed proximal text earning highest ratings on several measures, and a posteriori tests comparing all conditions to one another using the Least Significant Difference test indicated that proximal text earned higher sociability ratings than the distributed conditions. Further, videoconferencing produced lower sociability ratings than the two proximal conditions and lower trust ratings than the other two distributed conditions, but it did exceed FtF interaction on decision quality and influence. Thus, proximal text and distributed audio were the most advantageous, and distributed video the least so, for promoting trust, sociability, and other favorable social judgments. On the two performance measures, videoconferencing did outstrip FtF interaction but not the other mediated conditions.

Discussion

The accelerating adoption of new communication technologies brings to the fore a question of central importance to scholars and practitioners alike in areas related to nonverbal behavior, interpersonal communication, media, and technology: How does the presence of nonverbal information affect interpersonal interaction and achievement of communication goals? What gains or losses are associated with adding or removing visual, vocal, proxemic, and other nonverbal contextual cues to the verbal channel, and under what conditions?

The principle of interactivity offers one avenue for analyzing this issue. It postulates that the degree of interdependent, contingent, participative, and synchronous interaction afforded by a communication interface or experienced by interlocutors, or both, will systematically and substantially affect outcomes such as social judgments and task performance. Although early theorists and system designers conjectured that any losses in available nonverbal information and reliance exclusively on the verbal channel would have deleterious effects, that view has given way to recognition that humans are capable of adapting to and compensating for deficits in a given communication mode. There is also a growing recognition that sometimes less is more.

The principle of interactivity embraces these more contemporary views. Rather than structural properties of interfaces having sole and deterministic responsibility for outcomes, the intervening interaction processes that are set into motion serve to mediate structural impacts. Thus either structural or processual interactivity,

singly or in combination, may be responsible for the positive or negative consequences that a given interface yields. The principle of interactivity becomes a template, a rubric for parsing the properties of interfaces, especially their verbal and nonverbal properties, and the processes they enable, augment, or suppress—processes that account for beneficial and detrimental outcomes.

Three structural affordances examined here were mediation, proximity, and modality/context richness. Interfaces that are mediated, distal, or lean may restrict the amount and ease of conveying nonverbal information. Theoretically, this can affect everything from how synchronized and coordinated the conversation is and how many social cues are available upon which to base judgments, to how many redundant messages are available to reinforce comprehension, and how many distractions and frustrations impede task performance. Our experimental test of these separate properties confirmed, first, that unmediated FtF interaction is perceived as easier than mediated interaction and may (given the suggestive rather than conclusive nature of the results) impel participants to rate the interaction and partners more positively along a variety of dimensions. However, those evaluations did not translate into better or worse decisions. A more focused comparison of FtF interaction to proximal text discussion (focused in the sense that it held proximity constant and created comparability in terms of access to kinesic nonverbal cues) showed that FtF interaction realized a gain in interaction ease only, but generated somewhat lower ratings of competence compared to the text condition. From these comparisons it would seem that, although the more familiar FtF format is positively valenced, the introduction of mediation per se does not inevitably degrade interaction processes and may even confer an advantage by supplementing FtF interaction with a more permanent, recoverable verbal record. Thus, any dampening or elimination of nonverbal cues may actually heighten attention to the verbally transmitted information. For task-oriented contexts, as was the case in this experiment, this can be beneficial.

The general examination of proximity showed that it is a far more salient consideration in selecting and evaluating interfaces. Proximal interaction was superior for generating involvement and mutuality and for yielding more favorable social judgments on some outcomes. A more specific comparison of the two text interfaces (holding richness and mediation constant) likewise exhibited advantages for proximal text in terms of perceived mutuality, connectedness, and ratings of social judgments, but did not realize performance benefits. These findings imply that proximity is an important factor in evoking involved, mutual interaction and positive evaluations of coparticipants, a conclusion bolstered by extensive nonverbal research literature. Actual or perceived distance can indeed weaken people's task engagement, their sense of connection with one another, and the credibility they ascribe to task mates.

Finally, our evaluation of differences in modality and context richness revealed that the desirability of a given interface depends on what one hopes to achieve—higher involvement, greater mutuality, favorable social judgments, or task performance. The audio condition elicited more trust than did the other two distal conditions (text and videoconferencing). Audioconferencing and proximal text also emerged as more desirable than videoconferencing in several respects. The

benefits of the audio condition may derive from the aforementioned rhythmicity of speech (a key ingredient in establishing interactional coordination and rapport), from the gains in comprehension that come from the vocalic (paralinguistic and prosodic) features of spoken language, or from the diagnostic value of vocal cues that, woven together with verbal content and linguistic style, reveal richly detailed, often unmonitored social information (Burgoon & Hoobler, in press). The proximal text results suggest that physical proximity and availability of other visible nonverbal cues may be sufficient to offset the loss of the audio channel. This particular format also capitalizes on a division of labor, with the verbal channel devoted exclusively to the task at hand while nonverbal channels do the social work so that tasks can be accomplished efficiently without concomitant losses on the social dimension, thus accruing both task and social payoffs. Videoconferencing was least desirable on most fronts but did exceed FtF interaction in terms of performance, doubtless because all the mediated conditions created more task focus than was present in the unmediated FtF condition.

In terms of theoretical implications, the results indicate that complex interfaces, ones that provide for the transmission and interpretation of information at a variety of levels, have correspondingly complex effects on interaction processes and outcomes. Mediation, distance, and reductions in some nonverbal channels did not diminish actual decision quality or influence and in some cases actually promoted performance. It must be kept in mind, however, that these findings may not and should not generalize to all communication contexts. Because participants worked together on a short-term and straightforward decision-making task, they might have concentrated only on factual information, making nonverbal information nonessential for completing tasks of this type. As McGrath and Hollingshead (1994) noted, participants can work on and solve tasks of this type with little or no attention devoted to socio-emotional issues. Because nonverbal behavior is more relevant for identity issues, affective tone, and relational communication, participants may have disregarded such information as superfluous. Thus, the task demands and communication goals associated with a given interactional episode must figure prominently into theorizing and research on CMC and interface design. Hirokawa (1990), Laughlin (1999), McGrath and Hollingshead (1994), and Pavitt (1993; Pavitt & Curtis, 1994), among many others, have identified features of the task that correspond to particular communication processes and outcomes.

For tasks that have demonstrably correct answers and relationships among team members with low likelihood of future interaction, availability of visual nonverbal information should be less of a concern and may be more of a distraction; auditory cues may be sufficient to enhance comprehension. Thus, contrary to the channel reliance tradition, having certain cues filtered out, including visual ones, will not necessarily hinder task completion. Comparatively, tasks involving ambiguity (where processes and outcomes are uncertain), judgmental tasks, collaborative work that depends on group trust and morale, and circumstances requiring efforts to manage issues such as coalitions, status and power differences, and relational work, may require proximity and fuller access to the full gamut of audiovisual nonverbal cues in order to be effective.

The challenge for a theory of interactivity is to specify which experiential features are associated with particular arrays of structural affordances, given what participants typically do vis-à-vis features of the task. Poole and his associates (Poole & DeSanctis, 1992; Poole, Holmes, Watson, & DeSanctis, 1993; Watson, DeSanctis, & Poole, 1988), for example, noted that participants adapt technology to existing communication practice, often in contrast to the ways in which the technology was designed to work. As technologies evolve and new media become increasingly available, people's comfort and familiarity with them will improve, bringing rising expectations for richer and more instantaneous means of communicating. Formats such as videoconferencing may become more commonplace or even supplant text and teleconferencing for task-based interactions, despite the results of this and our other studies showing that it is unwarranted to dedicate greater bandwidth to visual social cues. What emerges as normative or preferred, though, may not be the optimal combination of verbal and nonverbal cues. If nonverbal behavior is consequential for how people interact and work toward particular outcomes, then more complex interfaces are likely needed to allow pairs and groups to incorporate technology into existing patterns of communication among members with particular attributes. If, however, nonverbal information is not a prominent feature of the task and of the participants engaged in it, then text-only interfaces likely will realize performance gains, or at least prevent performance losses, compared to more complex interfaces.

We began our investigation by proposing that current approaches to understanding new media and information technology may do well to reexamine the channel reliance literature, so it is only fitting to conclude with a brief discussion of how our results fit with the same literature. Some but not all of our results are consistent with early research on the relationship between verbal and nonverbal systems. As already noted, proxemic, environmental, and vocalic nonverbal cues were "value-added" relative to text-only interaction. That they resulted in different interaction processes and social judgments implies that they performed important functions such as augmenting and clarifying verbal meanings, providing relational and affective messages, and regulating the flow and pace of conversation. As for the visual primacy bias, the current results are consonant with it only insofar as the FtF condition, which entailed the most visual information in the form of kinesic, proxemic, and environmental cues, and the proximal text condition, which also availed participants of a fair amount of nonverbal visual information, produced positive social judgments and desirable interaction processes. In other respects, visual cues were not only unnecessary but a possible hindrance. The poor showing for the videoconferencing condition on all but performance measures indicates that, in this context at least, the visuals were unneeded and may even have been distracting (especially given the somewhat poor quality and small size of the video windows available in NetMeeting). The emergence of the audio condition as superior for engendering trust suggests that the verbal-vocal stream can be sufficient to achieve both task and social objectives.

As a single-task study, the current experiment did not address temporal changes associated with conducting multiple tasks nor the impact of increased familiarity with team members and technologies in moderating structural effects. However, a

longitudinal study in progress is testing our conjecture that, with sufficient time, participants will be able to adapt to even the most impoverished and distal of mediated formats and may even prosper on tasks because of the freedom to limit attentional resources to fewer channels of information. Under such circumstances, structural features of interfaces will pale in comparison to interaction processes themselves in their influence on social judgments and task performance. Research that focuses explicitly on what nonverbal cues are available to augment verbal information and how such cues are actually utilized in the interaction process will contribute immeasurably to understanding the interplay between verbal and nonverbal cues in accomplishing communicators' goals.

References

Argyle, M. (1988). *Bodily communication* (2nd ed.). London: Methuen.

Argyle, M., Salter, V., Nicholson, H., Williams, M., & Burgess, P. (1970). The communication of inferior and superior attitudes by verbal and nonverbal signals. *British Journal of Social and Clinical Psychology, 9*, 230.

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology, 63*, 596–612.

Barefoot, J. C., & Strickland, L. H. (1982). Conflict and dominance in television-mediated interactions. *Human Relations*, *7*, 559–565.

Biocca, F. (1992). Virtual reality technology: A tutorial. *Journal of Communication, 42*(4), 23–72.

Bonito, J., Burgoon, J. K., Bengtsson, B., Ramirez, A., Jr., & Stoner, G. M. (2000). *The role of expectations in human-computer interaction*. Manuscript submitted for publication.

Bonito, J., Burgoon, J. K., Ramirez, A., Jr., & Dunbar, N. E. (2000). *Participation and decision-making: The role of interactivity in communication processes and outcomes*. Manuscript submitted for publication.

Bordia, P. (1997). Face-to-face versus computer-mediated communication: A synthesis of the experimental literature. *Journal of Business Communication, 34,* 99–120.

Bugental, D. E. (1974). Interpretation of naturally occurring discrepancies between words and intonation: Modes of inconsistency resolution. *Journal of Personality and Social Psychology, 30,* 125–133.

Buller, D. B., & Burgoon, J. K. (1996). Interpersonal deception theory. *Communication Theory, 6,* 203–242.

Burgoon, J. K. (1985). The relationship of verbal and nonverbal codes. In B. Dervin & M. J. Voight (Eds.), *Progress in communication sciences, Vol. 6* (pp. 263–298). Norwood, NJ: Ablex.

Burgoon, J. K. (1994). Nonverbal signals. In M. L. Knapp & G. R. Miller (Eds.), *Handbook of interpersonal communication* (pp. 344–390). Beverly Hills, CA: Sage.

Burgoon, J. K., Bengtsson, B., Bonito, J., Ramirez, A., Jr., & Dunbar, N. (1999, January). Designing interfaces to maximize the quality of collaborative work. *Proceedings of the Thirty-second Annual Hawaii International Conference on Computer and Systems Sciences*, Maui, HI.

Burgoon, J. K., Birk, T., & Pfau, M. (1990). Nonverbal behaviors, persuasion, and credibility. *Human Communication Research, 17,* 140–169.

Burgoon, J. K., Bonito, J., Bengtsson, B., Ramirez, A., Jr., Dunbar, N. E., & Miczo, N. (1999–2000). Testing the interactivity model: Communication processes, partner assessments, and the quality of collaborative work. *Journal of Management Information Systems, 16,* 35–58.

Burgoon, J. K., & Hale, J. L. (1987). Validation and measurement of the fundamental themes of relational communication. *Communication Monographs*, *54*, 19–41.

Burgoon, J. K., & Hoobler, G. (in press). Nonverbal signals. In M. L. Knapp, J. Daly, & G. R. Miller (Eds.), *Handbook of interpersonal communication* (3rd ed., pp. 240–299). Thousand Oaks, CA: Sage.

Burgoon, J. K., Johnson, M. L., & Koch, P. T. (1998). The nature and measurement of interpersonal dominance. *Communication Monographs, 65*, 309–335.

Burgoon, J. K., & Newton, D. A. (1991). Applying a social meaning model to relational messages of conversational involvement: Comparing participant and observer perspectives. *Southern Communication Journal*, *56*, 96–113.

Burgoon, J. K., Stern, L. A., & Dillman, L. (1995). *Interpersonal adaptation: Dyadic interaction patterns*. New York: Cambridge University Press.

Burgoon, J. K., & Walther, J. B. (1990). Nonverbal expectancies and the evaluative consequences of violations. *Human Communication Research*, *17*, 232–265.

Cahn, D. D., & Shulman, G. M. (1984). The perceived understanding instrument. *Communication Research Reports, 1,* 122–125.

Chilcoat, Y., & DeWine, S. (1985). Teleconferencing and interpersonal communication perception. *Journal of Applied Communication Research, 18,* 14–32.

Coker, D. A., & Burgoon, J. K. (1987). The nature of conversational involvement and nonverbal encoding patterns. *Human Communication Research, 13,* 463–494.

Culnan, M. J., & Markus, M. L. (1987). Information technologies: Electronic media and intraorganizational communication. In F. M. Jablin, L. L. Putnam, K. H. Roberts, & L. W. Porter (Eds.), *Handbook of organizational communication: An interdisciplinary perspective* (pp. 420–444). Newbury Park, CA: Sage.

Daft, R. L., & Lengel, R. H. (1984). Information richness: A new approach to managerial behavior and organization design. In B. M. Staw & L. L. Cummings (Eds.), *Research in organizational behavior,* (Vol. 6, pp. 191–233). Greenwich, CT: JAI Press.

DePaulo, B. M., & Rosenthal, R. (1979). Ambivalence, discrepancy, and deception in nonverbal communication. In R. Rosenthal (Ed.), *Skill in nonverbal communication: Individual differences* (pp. 204–248). Cambridge, MA: Oelgeschlager.

DePaulo, B. M., Zuckerman, M., & Rosenthal, R. (1980). Detecting deception: Modality effects. In L. Wheeler (Ed.), *Review of personality and social psychology* (pp. 125–162). Beverly Hills, CA: Sage.

Foppa, K. (1995). On mutual understanding and agreement in dialogues. In I. Marková, C. Graumann, & K. Foppa (Eds.), *Mutualities in dialogue* (pp. 149–175). Cambridge, UK: Cambridge University Press.

Fowler, G. B., & Wackerbarth, M. E. (1988). Audio teleconferencing versus face-to-face conferencing: A synthesis of the literature. In S. D. Ferguson & S. Ferguson (Eds.), *Organizational communication* (2nd ed., pp. 431–451). New Brunswick, NJ: Transaction Books.

Fujimoto, E. K. (1972). The comparative communicative power of verbal and nonverbal symbols (Doctoral dissertation, Ohio State University, Columbus). *Dissertation Abstracts International, 32,* 7A.

Griffith, T. L., & Northcraft, G. B. (1994). Distinguishing between the forest and the trees: Media, features, and methodology in electronic communication research. *Organizational Science, 5,* 272–285.

Hirokawa, R. Y. (1990). The role of communication in group decision-making efficacy: A task contingency perspective. *Small Group Research, 21,* 190–204.

Jensen, C., Farnham, S. D., Drucker, S. M., & Kollock, P. (2000, April). The effect of communication modality on cooperation in online environments. *Proceedings of CHI 2000* (pp. 470–477), The Hague, Netherlands.

Kemp, N. J., Rutter, D. R., Dewey, M. E., Harding, A. G., & Stephenson, G. M. (1984). Visual communication and impression formation. *British Journal of Social Psychology, 23,* 133–145.

Krauss, R. M., & Fussell, S. R. (1990). Mutual knowledge and communication effectiveness. In J. Galegher, R. Kraut, & C. Egido (Eds.), *Intellectual teamwork* (pp. 111–145). Hillsdale, NJ: Erlbaum.

Krauss, R. M., Fussell, S. R., & Chen, Y. (1995). Coordination of perspective in dialogue: Intrapersonal and interpersonal processes. In I. Marková, C. Graumann, & K. Foppa (Eds.), *Mutualities in dialogue* (pp. 124–145). Cambridge, UK: Cambridge University Press.

Laughlin, P. R. (1999). Collective induction: Twelve postulates. *Organizational Behavior & Human Decision Processes, 80,* 50–69.

McCroskey, J. C., Hamilton, P. R., & Weiner, A. N. (1974). The effect of interaction behavior on source credibility, homophily, and interpersonal attraction. *Human Comunication Research*, *1*, 42–52.

McCroskey, J. C., & McCain, T. A. (1974). The measurement of interpersonal attraction. *Speech Monographs*, *41*, 261–266.

McCroskey, J. C., & Young, T. J. (1981). Ethos and credibility: The construct and its measurement after three decades. *Central States Speech Journal, 32,* 24–34.

McGrath, J. E., & Hollingshead, A. B. (1994). *Groups interacting with technology*. Newbury Park, CA: Sage.

McGuire, W. J. (1985). Attitudes and attitude change. In G. Lindzey & E. Aronson (Eds.), *The handbook of social psychology* (3rd ed., pp. 233–346). New York: Random House.

Meader, D. (1995). *Supporting distributed, design discussions: A study of video effects on engagement and critical discussion in desktop, multimedia conferencing*. Unpublished dissertation, University of Michigan.

Mehrabian, A. (1981). *Silent messages: Implicit communication of emotions and attitudes* (2nd ed.). Belmont, CA: Wadsworth.

Montes, G. M. (1992). Is interaction the message? The effect of democratizing and non-democratizing interaction in videoconferencing small groups on social presence and quality of outcome. In U. E. Gattike (Ed.), *Technology-mediated communication* (pp. 187–223). Berlin, Germany: De Gruyter.

Moon, Y., & Nass, C. (1996). How "real" are computer personalities? Psychological responses to personality types in human-computer interaction. *Communication Research, 23*, 651–674.

Nohria, N., & Eccles, R. G. (1992). *Networks in organizations: Structure, form and action*. Boston: Harvard Business School Press.

O'Hara-Devereaux, M., & Johansen, R. (1994). *Globalwork: Bridging distance, culture, and time*. San Francisco: Jossey-Bass.

O'Keefe, D. J. (1990). *Persuasion: Theory and research*. Newbury Park, CA: Sage.

Palmer, M. T. (1995). Interpersonal communication and virtual reality: Mediating interpersonal relationships. In F. Biocca & M. Levy (Eds.), *Communication in the age of virtual reality* (pp. 277–299). Hillsdale, NJ: Erlbaum.

Pavitt, C. (1993). Does communication matter in social influence during small group discussion? Five positions. *Communication Studies, 44,* 216–227.

Pavitt, C., & Curtis, E. (1994). *Small group discussion: A theoretical approach* (2nd ed). Scottsdale, AZ: Gorsuch Scarisbrick.

Poole, M. S., & DeSanctis, G. (1992). Microlevel structuration in computer-supported group decision making. *Human Communication Research, 19,* 5–49.

Poole, M. S., Holmes, M., Watson, R., & DeSanctis, G. (1993). Group decision support systems and

group communication: A comparison of decision making in computer-supported and nonsupported groups. *Communication Research, 20,* 176–213.

Poster, M. (1990). *The mode of information: Poststructuralism and social context.* Chicago: University of Chicago Press.

Rafaeli, S. (1988). Interactivity: From new media to communication. *Sage Annual Review of Communication Research, 16,* 110–134.

Ramirez, A., Jr., & Burgoon, J. K. (2001, November). *The effect of interactivity on predicted outcome values I: The role of richness and mediation in initial interactions.* Paper presented to the annual meeting of the National Communication Association, Atlanta, GA.

Rutter, D. (1987). *Communicating by telephone.* Oxford, UK: Pergamon Press.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications.* London: Wiley.

Stiff, J. B., Kim, H. J., & Ramesh, C. N. (1989, May). *Truth-biases and aroused suspicion in relational deception*. Paper presented at the annual conference of the International Communication Association, San Francisco, CA.

Stoner, G. M. (2001). *Decision-making via mediated communication: Effects of mediation, mode, and time pressure on communication processes, social judgments, and task performance*. Unpublished thesis, University of Arizona.

Storms, M. D. (1973). Videotape and the attribution process: Reversing actors' and observers' points of view. *Journal of Personality and Social Psychology*, *27*, 165–175.

Street, R. L., Mulac, A., & Wiemann, J. M. (1988). Speech evaluation differences as a function of perspective (participant versus observer) and presentational medium. *Human Communication Research*, *14*, 333–363.

Stromer-Galley, J. (2000). On-line interaction and why candidates avoid it. *Journal of Communication, 50*(4), 111–132.

Walther, J. B. (1994). Anticipated ongoing interaction versus channel effects on relational communication in computer-mediated interaction. *Human Communication Research, 20,* 473–501.

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research, 23,* 3–43.

Walther, J. B. (1997). Group and interpersonal effects in international computer-mediated collaboration. *Human Communication Research, 23,* 342–369.

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

Walther, J. B., Slovacek, C. L., & Tidwell, L. C. (2001). Is a picture worth a thousand words? Photographic images in long-term and short-term computer-mediated communication. *Communication Research, 28*, 105–134.

Watson, R., DeSanctis, G., & Poole, M. S. (1988). Using a GDSS to facilitate group consensus: Some intended and unintended consequences. *MIS Quarterly, 12,* 463–478.

Weick, K. (1995). *Sensemaking in organizations.* Newbury Park, CA: Sage.

Weisband, S. P., Schneider, S. K., & Connolly, T. (1993). In G. deMichelis, C. Simone, & K. Schmidt (Eds.), *Proceedings of the Third European Conference on Computer-Supported Cooperative Work* (pp. 265–279). Dordrecht, Netherlands: Kluwer Academic.