Communication Research
Volume 34 Number 3
June 2007 313-331

10.1177/0093650207300431
http://crx.sagepub.com
hosted at
http://online.sagepub.com

Effects of Geographic Distribution on Dominance Perceptions in Computer-Mediated Groups

Jorge Peña[1]
University of Texas at Austin
Joseph B. Walther
Michigan State University, East Lansing
Jeffrey T. Hancock
Cornell University, Ithaca, New York

This study examined how the geographic distribution of group members affected dominance perceptions in a field experiment involving 65 computer-mediated groups communicating over a 2-week period. Dominance perceptions were more extreme when group members did not share a geographic location (distributed groups) than when they did (collocated groups). Collocated groups showed greater convergence between self and partner dominance perceptions than distributed groups, suggesting more symmetrical perceptions. More symmetrical groups exhibited more attraction and cohesion than less symmetrical groups. These results lend some support to recent models of computer-mediated communication that take into consideration the social psychological processes involved in distributed work and run counter to studies suggesting status equalization in mediated group collaboration.

Keywords: *computer-mediated communication; dominance; virtual groups; distributed work; impression formation; social information processing; hyperpersonal model; symmetry*

People in social interaction frequently attempt to influence others by asserting dominance in an effort to elicit submission and compliance (see Bales, 1970; Burgoon & Dunbar, 2000; Ellyson & Dovidio, 1985). This makes dominance and submission one of the fundamental dimensions of social interaction (Dillard, Solomon, & Samp, 1996). At the individual level, dominance is seen as a need for control (Mehrabian & Hines, 1978) or a disposition to raise or maintain status (see D. J. Kiesler, 1983; Wiggins & Broughton, 1985). At the interactional level, dominance is established when people exchange messages by which they mutually position themselves in dominant or submissive roles (see Ellis, 1976; Rogers & Escudero, 2004; Rogers & Farace, 1975). Whether dominance is caused by individual predispositions or stems from social interaction, a common theme remains: Dominance relates to attempts to lead, argue, persuade, and in the present context, perceptions of influence in the group decision-making process (e.g., Bales & Cohen, 1979; D. J. Kiesler, 1983).

Despite its importance, the study of dominance has been controversial in the context of groups using computer-mediated communication (CMC) technologies such as e-mail, group decision support software, multiuser chat, and others. Because dominance is often conveyed by nonverbal cues such as gestures, age, gaze, posture, and vocalics (see Dovidio, Ellyson, Keating, Heltman, & Brown, 1988; Dunbar & Burgoon, in press; Ellyson & Dovidio, 1985; Tiedens & Fragale, 2003; Tusing & Dillard, 2000) that are not available in most computer-mediated settings, early CMC models predicted diminished dominance when people communicate through computers in comparison to face-to-face (FtF) interaction (S. Kiesler, Siegel, & McGuire, 1984; see also Rice, 1984).

These predictions garnered some empirical support. For example, comparisons between computer-mediated and face-to-face groups found more equalized levels of participation in CMC (Dubrovsky, Kiesler, & Sethna, 1991; McGuire, Kiesler, & Siegel, 1987; Rains, 2005; Siegel, Dubrovsky, Kiesler, & McGuire, 1986; Sproull & Kiesler, 1986). Because an individual's increased participation (e.g., "talkativeness" or quantities of communication) has been traditionally associated with more dominance in face-to-face interaction (see Bales & Cohen, 1979; Schmid Mast, 2002), researchers interpreted more equalized participation quantities among CMC group members as evidence of diminished individual dominance and more equalized status.

Support for this equalization phenomenon in CMC, as operationalized by participation levels, is not unanimous across available studies (see Hollingshead, 1996; McLeod & Liker, 1992). For instance, Weisband, Schneider, and Connolly (1995) showed that high status members in both CMC and face-to-face groups participate more and have more influence in decisions than lower status members. Straus and McGrath (1994) also found that participation levels diverged when CMC groups were given ample time for interaction, concluding that short-term, synchronous CMC, where all participants may type at once (a common practice in most experiments), does not lower the verbosity of dominant individuals so much as occlude them from controlling the floor (see also Walther & Burgoon, 1992). Indeed, some have questioned whether equal participation is a good measure of reduced status differences at the psychological level (see Boucher, Hancock, & Dunham, 2004; Spears & Lea, 1994; Walther, 1992, 1996), including questions about the theoretical basis for and measurement of dominance in some CMC research and the need to revisit conceptual and operational definitions of the construct.

As research on CMC has progressed, so has recognition that not all groups using CMC are the same. Group members may be completely distributed from one another, geographically collocated, or mixed, and these combinations stimulate different perceptions and behaviors at a variety of levels (see e.g., Cramton, 2001; Fiol & O'Connor, 2005; Hinds & Mortensen, 2005; Walther, Boos, & Jonas, 2002). In the present study we examine the influence of group members' geographic distribution on dominance by directly measuring perceptions of dominance after an asynchronous decision-making interaction. To do so, this research involved student participants in decision-making groups of four members each. All groups used an asynchronous CMC bulletin board system exclusively for their communication, including those groups whose members (a) all resided at a similar geographic location and the same institution as one another, (b) resided at completely different locations/institutions, or (c) had a combination of two proximal and two remote members. As all groups used only CMC, this approach rules out the potentially confounding effects of actual face-to-face interaction in exploring the perceptual basis of geographic distribution effects on dominance perceptions and behavior. Although a considerable amount of research has used synchronous CMC systems, most geographically distributed groups rely on asynchronous tools (Burke, Aytes, Chidambaram, & Johnson, 1999). Although various time frames affect the relational dynamics of online groups, short-term groups such as those with a 2-week (asynchronous) span appear to present the greatest relational challenges (for review, see Walther, 2002) and are therefore most likely to exhibit sensitivity to extrinsic effects on dominance.

Geographic Location and the Intensity of Dominance Perceptions

When humans communicate through computers, many situational factors that go beyond medium features become relevant. Consider for instance that one of the advantages of communicating through computers is the capacity to relay information and coordinate the actions of many people across the globe (see Hinds & Kiesler, 2002). Some have taken this idea as far as arguing that in today's world "several technological and political forces have converged, and that has produced a global, Web-enabled playing field that allows for multiple forms of collaboration without regard to geography or distance" (T. Friedman, quoted in Pink, 2005, p. 152).

This optimistic view is somewhat at odds with current observations. Group members' relative locations may incur forces that disrupt unbiased and equalized perceptions of partners. For example, geographic and institutional differences within virtual groups may foster in-group/out-group identifications (e.g., Fiol & O'Connor, 2005), although the empirical support for these claims is tenuous (Tanis & Postmes, 2003), especially when there is bona fide communication among distributed group members (Hinds & Mortensen, 2005). Shared location with collocated partners versus lack of situational information about remote partners has been suggested to increase attributional errors about distributed partners (Cramton, 2001). Distribution leads individuals to blame remote partners for one's own performance problems in CMC (Walther & Bazarova, 2007; Walther et al., 2002). Geographic subgroups withhold information from each other (see Bos, Shami, Olson, Cheshin, & Nan, 2004). Any or all of these events should affect interpersonal perceptions and communication, including greater conflict in distributed teams. In contrast, groups that share a physical location (i.e., collocated CMC groups) tend to show more community co-membership, common ground, willingness to cooperate, more shared everyday activities, and more social bonding than groups that do not share a physical location (i.e., distributed CMC groups; see Kraut, Fussell, Brennan, & Siegel, 2002; Nardi & Whittaker, 2002; Olson & Olson, 2000). Whereas these effects may partly be attributable to unspecified aspects accompanying the face-to-face communication that can occur among collocated partners, interestingly, such effects often appear even when, as in the present study, collocated members use only CMC.

A number of recent CMC models have been developed to account for some of these effects in computer-mediated groups. The hyperpersonal model (Walther, 1996) predicts that computer-mediated group members may form stereotyped, more extreme impressions of their partners when they lack physical cues to personal, social, and situational factors. These effects arise through a process of selective self-presentation, the reallocation of cognitive resources to message encoding and decoding, idealized perception by receivers, and the reciprocation of self-fulfilling partner impressions (Walther, 1996; Walther, Slovacek, & Tidwell, 2001).

The hyperpersonal model does not specify whether individual dominance behavior should be greater or lesser, merely that it should be exaggerated in CMC, whatever its direction. In terms of direction, there are competing precedents in the CMC literature, although none stand on firm theoretical ground. For instance, in addition to the aforementioned studies involving participation equalization, some studies suggest a degree of passivity in CMC groups, especially asynchronous ones, unless deliberate interventions are introduced (e.g., Walther & Bunz, 2005). In contrast, many other studies characterize CMC groups as being hostile and domineering (e.g., Weisband, 1992; for review, see Lea, O'Shea, Fung, & Spears, 1992), suggesting elevated dominance among all members of a particular group.

In the context of dominance perceptions, the hyperpersonal model predicts disparities between CMC groups having different levels of available social information. In particular, as members of distributed groups have less information about one another than do people in collocated groups, distributed partners may develop more extreme dominance perceptions by exaggerating impressions of partners' control or retreat attempts, even if the stimulus behaviors by others are no more extreme than those occurring in collocated groups. Reflecting this prediction, Hancock and Dunham (2001) found that partner impressions differed after CMC versus face-to-face interactions. Face-to-face interactions resulted in more comprehensive personality perceptions, but impressions were more extreme or intense in CMC, as indicated by larger deviation scores from the neutral range of a Likert scale. These findings suggest that more extreme partner impressions arise when people lack social information about one another (see Hancock & Dunham, 2001).

Because collocated virtual groups—even those who do not meet face to face—know more about one another (Cramton, 2001), the hyperpersonal model predicts that dominance perceptions in distributed groups will be more extreme when compared to collocated groups. At the measurement level, collocated group members' dominance ratings should cluster around the neutral range of a Likert scale. Members of distributed groups however should rate partners away from the neutral range (i.e., either as high or low on dominance). As such, Hypothesis 1 predicts that

Hypothesis 1 (H1): Dominance perceptions in distributed groups are more extreme than in collocated groups.

Thus, some dominance scores may be high, and others may be low, but either would contribute to greater extremity than more neutral ratings. Dominance will be more extreme in distributed groups even if the overall dominance average does not differ between conditions. Whether dominance will be high or low in different conditions is taken up in other hypotheses.

Geographic Location and the Symmetry of Dominance Perceptions

A central theme in the study of dominance is the distinction between symmetry and complementarity (Bateson, 1958; Dryer & Horowitz, 1997; Parks, 1977; Rogers & Escudero, 2004; Tiedens & Fragale, 2003). Symmetry is associated with people's perception or messages that mirror each other. Three possible relational configurations include competitive symmetry (e.g., a dominant act followed by a dominant reply), submissive symmetry (e.g., a submissive message followed by submissive reply), and neutralized symmetry (e.g., a neutral message followed by a neutral message) (Parks, 1977; Rogers & Escudero, 2004). Complementarity on the other hand has been defined as people or messages that are different yet mutually "fit" each other (e.g., a dominant person interacting with a submissive partner, a sender's dominant message followed by submissive reply from a receiver, etc.). The exhibition of symmetry or complementarity depends on directional differences in the levels of dominance behavior, in contrast to H1.

How might geographic location impact dominance symmetry and complementarity in computer-mediated groups? Recall that collocated groups tend to engender more positive processes than do distributed groups (see Kraut et al., 2002; Olson & Olson, 2000). This might be due to the fact that collocated group members anticipate future interaction with each other. Anticipated interaction prompts more socially desirable self-presentation in face-to-face interaction (McGlone & Batchelor, 2003). A growing number of studies indicate that a sense of anticipation is quite potent in CMC interactions as well. Bradner and Mark (2002) found that members of CMC dyads who did not know their partners believed they were more likely to encounter such partners again when they believed they were living in the same city (somewhere in Irvine, California) than when one partner was in Boston, Massachusetts. Also, Walther (1994) found that anticipated future interaction overrode CMC/FtF differences in several dimensions of relational communication. Finally, Gibbs, Ellison, and Heino (2006) found that anticipated future interaction affected a variety of self-presentation strategies in an online dating setting. This implies that in collocated groups, overtly dominant and submissive behaviors of members should be comparatively minimized because of self-presentation and social equity concerns (see Goffman, 1967). If this is the case, then members of collocated groups should inhibit dominant and submissive behavior in favor of more equitable behavior. And, people's inhibition of more dominant and submissive bids should lead to fewer differences in perceived dominance between members of collocated groups, resulting in more relational symmetry. In contrast, because members of distributed groups are less likely to anticipate future interactions, they will also be less subject to self-presentation concerns. Therefore, they may be more likely to exhibit both more dominant and submissive behaviors, effectively resulting in more relational complementarity. This prediction is reflected in Hypothesis 2:

Hypothesis 2 (H2): Collocated groups exhibit more symmetrical dominance than distributed groups.

Previous research in face-to-face contexts has tried to establish whether symmetrical or complementary dominance social relations predict attraction, trust, empathy, and other positive effects (Parks, 1977). A number of studies indicate that people are likely to prefer more symmetrical than complementary partners (i.e., equally dominant or equally submissive; see Klohnen & Luo, 2003; Tiedens & Fragale, 2003). People even feel more attraction to symmetrically dominant or submissive computer interfaces in relation to themselves (Moon & Nass, 1996; Nass, Moon, Fogg, Reeves, & Dryer, 1995). More socially satisfied participants also tend to rate partners more like themselves in dominance and submission (Dryer & Horowitz, 1997). In contrast, complementary relations are associated with more envy, less empathy, and disconfirmation (i.e., ignoring another person's view to the extent of denying his or her existence) (Parks, 1977).

Given that more symmetrical dominance perceptions are associated with more positive social relations (Parks, 1977), then a corollary to Hypothesis 2 is that groups with more symmetrical dominance perceptions should also display more positive social relations, such as increased attraction and group cohesiveness. Hence, Hypotheses 3 and 4 predict that

Hypothesis 3 (H3): Groups with more symmetrical dominance ratings experience more attraction than groups with complementary dominance ratings.

Hypothesis 4 (H4): Groups with more symmetrical dominance ratings experience more group cohesiveness than groups with complementary dominance ratings.

Dominance Perceptions in Partially Distributed Groups

As noted earlier, computer technologies provide the means for work to be carried out in different geographic locations (see Hinds & Kiesler, 2002). In addition to entirely collocated and entirely distributed groups, partially distributed groups, in which some members are separated from a main subset of collocated members but all are linked via CMC (see Burke et al., 1999), have interested scholars because these groups share characteristics of both collocated and distributed groups (see Johnson, 1999). Although little research to date has examined partially distributed groups, Burke et al. (1999) noted that isolated members of these groups are more likely to be sources or targets of hostility than collocated members. Similarly, Johnson (1999) observed that isolates tend to feel an increased need to make their work known to managers, perhaps fearing the “out of sight, out of mind” effect.

One approach to examine how being in partially distributed groups may affect dominance perceptions is to consider subgroup affiliation dynamics. Traditionally, situational factors in face-to-face groups (e.g., chair arrangement) may unify some members based on salient similarities while polarizing the group into subgroups (see also Bales & Cohen, 1979). Similarly, in CMC groups, subgroups tend to form between members of a group that are located in the same place (Bos et al., 2004; Cramton, 2001). Given this tendency to form subgroups, numeric majorities that emerge within an overall group may exert influence over numerically weaker subgroups (e.g., Asch, 1956). In the present case, collocated members of partially distributed groups may align with each other based on location similarity, increasing their perceived dominance in comparison to isolates with no other members sharing their location. Hypothesis 5 represents this “strength in numbers” prediction:

Hypothesis 5 (H5): Collocated members in partially distributed groups are more dominant than isolated members.

Method

Participants

A total of 286 participants were initially recruited from six different colleges in North America from communication, speech, English, and psychology classes and were given course credit for their participation. Participants were told that they will interact in online groups and that groups who found the correct solution to a decision-making task would enter into a drawing to win four iPod music players.

Participants initially volunteered by accessing a Web site where they could provide informed consent; demographic and contact information; information on course, instructor, and institution; and a pretest personality measure (reported elsewhere). Participants received mailed hard copies of the task and were asked to e-mail their prediscussion project preferences to the researchers.

A small number of participants withdrew from the project formally or were later removed from the data set because of attrition, erroneous location or task information set assignments, "groups" with only two members, or misunderstanding instructions ($n = 28$). The final sample included 258 participants, and their ages ranged from 17 to 49 ($M = 21.28$, $SD = 5.1$). Of the participants, 58% were female. In addition, 86 participants were from Cornell University, 81 were from Ohio State University, 37 were from Rensselaer Polytechnic Institute, 29 came from Texas Tech University, 18 came from Merritt Community College, and 7 were recruited from McMaster University. Of the participants, 25% were seniors, 28% were juniors, 29% were sophomores, 16% were freshmen, and 2% were graduate students. Participants were assigned to four-person groups ($n = 63$), but due to attrition some groups contained three members ($n = 2$). Therefore, this study had participants assigned to 65 groups in total.

Materials

Task. This study employed an original "hidden profile" task with a demonstrably correct answer (see Stasser & Titus, 1985). The information needed to discover the correct solution was distributed among group members in advance for them to exchange through an online discussion board. The information sets given to the majority of group members favored an incorrect alternative. The full set of information however supported the correct alternative (see Stasser & Titus, 2003), which was verified by pretests. The task itself dealt with the case of a fictitious city faced with the choice of three urban development projects. No leaders were appointed for this task. Participants were required to select the best project and rank order the three alternatives based on decision criteria built into the task. The task was pilot tested on separate samples of undergraduate and graduate students. More information on the task can be requested from the authors.

Geographic location. There were three conditions of group geographic location. The first condition was collocated, in which all four of the group members were from the same school. The second condition was distributed, in which each of the four group members was at a different school. The third condition was partially distributed, in which two of the members were from the same school, and the remaining two were each solo members from their respective schools. Participants' awareness of the locations of each group member was made salient by including participants' real name and school logo in online discussion boards. No instructions precluded participants from sharing information with one another about their respective locations.

To balance the number of participants in the experimental groups we used a stratified sampling procedure. The procedure subgrouped participants according to schools because there were differences in the number of volunteers across schools. Each school was treated as a subgroup, and random samples were drawn from each subgroup. This procedure guaranteed that different schools were represented in the sample, thus it prevented having disproportionate groups formed by participants from the schools with the greatest numbers of volunteers. Thus, the blocking design was employed so that no condition was comprised of members from only one school or was based on a disproportionate combination of schools.

Communication medium. All participants communicated via an asynchronous discussion board in the Blackboard online courseware system hosted at one university and available via the Internet. To enter Blackboard, participants used IDs and passwords provided to them on receipt of individual prediscussion preferences on the urban development projects. Each group had a separate discussion board, and, as mentioned, the opening page of each group discussion board displayed the real names and college logo of each group's respective members. The opening page also contained instructions on how to finish the discussion (i.e., by entering a "Final Answer" posting, followed by agreement messages by each member). All postings in Blackboard were saved into a text file for future analyses. Overall, participants exchanged a total of 5,787 sentences during the 2-week period (M = 22.34, SD = 29.83). Collocated groups exchanged an average of 18.68 sentences (SD = 17.77), ranging from 0 to 81 sentences per participant. Distributed groups relayed an average of 14.54 sentences (SD = 18.18), ranging from 0 to 94 sentences per participant. Finally, partially distributed groups produced an average of 28.29 sentences (SD = 37.47), and the range of exchanged sentences was from 0 to 225.

Procedure

Each group had 2 weeks to make decisions on the projects, and group discussion boards were available 24 hours a day. The starting date for each group was counted from the day group members received their Blackboard user IDs and passwords. Then, 3 days prior to the time limit, groups received an administrator's message with a deadline reminder and instructions on how to finish the discussion. This information was also posted in the group discussion boards.

Participants were instructed to communicate via the group discussion board exclusively. Face-to-face communication among collocated members was not explicitly discouraged because of ecological validity concerns on how collocated groups work (see Nardi & Whittaker, 2002). A full inspection of the transcripts indicated that no face-to-face interactions took place. However, one group used Instant Messenger and was therefore removed from the analysis.

Dependent Measures

After their 2-week group interaction, participants completed questionnaires that included eight 7-interval Likert scales based on Burgoon and Hale's (1987) relational communication measure assessing both their own and each of their partner's levels of dominance, in a round-robin fashion. Using items from a number of published scales (Evans & Jarvis, 1986; Gouran, 1973; McCroskey & McCain, 1974; Piper, Marrache, Lacrois, Richardson, & Jones, 1983; Seashore, 1954; Spears, Lea, & Lee, 1990; Tyler, 1999), participants also rated their attraction (17 items) and group cohesion levels (11 items). Participants also completed scales measuring individual and group task decisions/performance and attributions not reported here.

Principal components factor analyses were performed on all the dependent measures, using Eigenvalues higher than 1.5 as a retention criterion. Factor analyses on self and partners' dominance scores consistently revealed distinct "dominance" factors for both assessments. Attraction scores were best fitted into an overall "attraction" variable rather than treating these as separate constructs (e.g., task vs. social attraction). Finally, cohesion items fitted best into a single and unidimensional "cohesiveness" solution. This solution accounted for 26% of the variance for attraction and 20% of the variance for cohesion.

Reliability for all measures was calculated using Cronbach's alpha. The average reliability for partner's perceived dominance, based on data from one participant regarding one partner and then repeated for each of the other two partners, was satisfactory ($\alpha = .88$). Reliability for self-ratings of dominance was also satisfactory ($\alpha = .88$). In the present study, task and social attraction did not factor independently, and items were collapsed as a one-dimensional measure. Average reliability for attraction was high ($\alpha = .90$). Group cohesiveness items were as reliable as the previous scales ($\alpha = .88$).

Results[2]

Hypotheses 1 and 2: Hyperpersonal Dominance Perceptions

In this section we sequentially discuss individual hypotheses tests. An overall summary of this study's hypotheses and results is provided in Table 1.

Did geographic location polarize participants' dominance perceptions? Based on the hyperpersonal model, Hypothesis 1 predicted that distributed groups have more extreme dominance perceptions than collocated groups. To test for this effect, perceived dominance scores were transformed in terms of their deviation from the neutral point of a 7-point Likert scale based on procedures suggested by Hancock and Dunham (2001). For example, a score of 1 or of 7 would result in a deviation score of 3 units from neutral (4); a score of 2 or a 6 was a 2-unit deviation and so on. Thus, the resulting scores for dominance ranged from 0 (*neutral*) to 3 (*extreme*), and we

Table 1
Hypotheses, Mean, and Standard Errors for Group Types and Results

Prediction	Group Type	*M*	*SE*	Result
Hypothesis 1: Dominance perceptions in distributed groups are more extreme than in collocated groups.	Collocated Distributed	1.34 1.58	.09 .08	Supported
Hypothesis 2: Collocated groups exhibit more symmetrical dominance than distributed groups.	Collocated Distributed	1.54 2.04	.15 .13	Supported
Hypothesis 3: Groups with more symmetrical dominance experience more interpersonal attraction than more complementary groups.	—	$b = -.18$		Supported
Hypothesis 4: Groups with more symmetrical dominance experience more group cohesiveness than more complementary groups.	—	$b = -.34$		Supported
Hypothesis 5: Collocated members in partially distributed groups are more dominant than isolated members.	Collocated Distributed	3.33 3.28	.13 .13	Not supported

Note: The mean for Hypothesis 1 represents the mean deviation from midpoint scores in Likert scales. The mean in Hypothesis 2 refers to the difference between self and partner dominance ratings (more details in Results section). The mean for Hypothesis 5 refers to mean ratings of dominance.

refer to this measure as the intensity of the ratings. To illustrate, a member might rate himself and one partner as very dominant and rate another two partners as very submissive; all these ratings would contribute to greater dominance intensity despite an average dominance rating of neutral.

A mixed model analysis was employed in which observations were repeated within participants and participants were nested in groups and experimental distribution conditions. The first analysis compared the intensity of dominance scores between distributed and collocated groups. Participants in distributed groups rated their partners with greater dominance intensity ($M = 1.59$, $SE = .08$) than participants in collocated groups ($M = 1.34$, $SE = .09$), one-tailed $t(124) = 2.04$, $p = .02$, $\eta^2 = .12$, supporting Hypothesis 1.[3] Unlike the intensity scores, an exploratory post hoc comparison of mean dominance ratings showed no difference between collocated groups ($M = 3.19$, $SE = .13$) and distributed groups ($M = 3.08$, $SE = .12$), even at unadjusted $p < .05$. These results suggest that a key difference between collocated and distributed groups' dominance was that people in collocated groups considered their partners' dominance to be closer to the midpoint. People in collocated and distributed groups did not significantly differ in just how high they perceived their partners' dominance to be besides increased differentiation in dominance in distributed to collocated groups.

Hypotheses 2, 3, and 4: Symmetry of Dominance Perceptions, Attraction, and Cohesiveness

Did participants in collocated groups develop more symmetrical dominance perceptions than members of distributed groups? Did participants who rated others' dominance more closely to their own also feel more attraction and group cohesiveness? To test these hypotheses, a measure of symmetry was calculated employing the difference between participants' self-rated dominance scores and their ratings of each partner's dominance. The mean of the absolute value of these differences provides a measure of perceived dominance symmetry: A smaller average represents fewer differences among the ratings of each member's dominance, whereas a larger average difference indicates more complementarity.

A mixed model analysis comparing collocated and distributed members' symmetry scores revealed that participants in collocated groups had more symmetrical dominance perceptions ($M = 1.54$, $SE = .15$) relative to distributed groups ($M = 2.04$, $SE = .13$), one-tailed $t(32) = 2.60$, $p = .005$, $\eta^2 = .19$, thus confirming Hypothesis 2. Also as predicted, more symmetrical dominance (i.e., lower differences between self and all partner ratings) was associated with increased attraction. A mixed model analysis was conducted across all distribution conditions, with attraction ratings to each partner hierarchically nested within participant and group. The result was significant, $b = –.18$, $t(73) = –5.18$, $p < .001$, two-tailed, indicating that more symmetrical dominance ratings were associated with increased interpersonal attraction. More symmetrical dominance was also associated with greater cohesiveness (with cohesiveness by participants nested within groups), $b = –.34$, $t(113) = –6.94$, $p < .001$, two-tailed. These results confirmed Hypotheses 3 and 4.

Hypothesis 5: Dominance Perceptions in Partially Distributed Groups

Did collocated subgroups dominate more than isolated members in partially distributed groups? A mixed model analysis revealed that in partially distributed groups, collocated group members ($M = 3.33$, $SE = .13$) were not perceived as more dominant than isolated members ($M = 3.28$, $SE = .13$), $F(1, 215) = .10$, *ns*. This result failed to support the strength in numbers principle represented by Hypothesis 5.

Discussion

The present study examined the effect of geographic distribution on participants' dominance perceptions in computer-mediated groups after completing a 2-week-long decision-making task. Despite earlier models' predictions of equalized dominance among people interacting through computers (Kiesler et al., 1984), dominance perceptions clearly emerged among study participants and were affected by geographic distribution. Computer-mediated groups in which members did not share a physical location (i.e., distributed groups) had more extreme dominance perceptions than groups in shared locations (i.e., collocated groups). This finding is congruent with the hyperpersonal model (Walther, 1996), which assumes that CMC affords interpersonal processes (e.g., selective self-presentation, idealized perception, self-fulfilling prophecies, etc.) that may intensify impression formation. The data are also consistent with empirical research pointing to CMC conditions in which the lack of available social information fosters extreme instead of reduced interpersonal impressions (Hancock & Dunham, 2001) and with studies indicating that dominance and status differences persist rather than wane in computer-mediated collaboration (Boucher et al., 2004; Hollingshead, 1996; McLeod & Liker, 1992; Weisband, 2002; Weisband et al., 1995). For instance, when compared to face-to-face, CMC participants may establish clearer boss and subordinate roles in their ratings of both self and other (Boucher et al., 2004).

How can research suggesting that dominance perceptions are maintained or exacerbated in CMC be reconciled with earlier work that reported equalization effects when people collaborated through computers (e.g., Dubrovsky et al., 1991; Rains, 2005; Sproull & Kiesler, 1986)? One response has been to note that situational factors are more critical to the operation of dominance perceptions than media-specific factors (e.g., Spears & Lea, 1994; Walther, 1992). That is, cognitive and social factors within CMC may create, reinforce, relieve, or maintain dominance differences beyond what between-media comparisons may illuminate. If this is the case, then an important long-term goal is to determine which specific factors predict these seemingly disparate within-media effects. For instance, although the hyperpersonal model provides a cognitive account for more extreme dominance perceptions in CMC, we also need a better understanding of the social behaviors that may underlie perceptions of dominance in computer-mediated groups. As Weisband (1992; Weisband et al., 1995) noted, people in CMC rely on others' contributions to online discussions to make status evaluations. As such, the use of interaction analyses might be necessary to uncover if, for instance, extreme dominance perceptions in distributed groups are related to different qualities, quantities, or sequences of bids for control and acquiescence when compared to collocated groups. Efforts are underway to examine dominance and submission in the present groups from this type of interactional perspective.

This study also found reduced differences between self and partner dominance ratings in collocated relative to distributed groups. This is evidence of more symmetrical dominance perceptions in the former and dominance complementarity in the latter. This was predicted to result from collocated group members' anticipation of future interaction (see Walther, 2002). This anticipation would in turn lead to more socially desirable self-presentation strategies, effectively reducing perceived dominance differences in collocated versus distributed groups. Although this rationale successfully predicted symmetry and complementarity in CMC groups, the underlying communication process needs further confirmation with behavioral evidence.

Regardless of the specific underlying behaviors that lead to changes in dominance symmetry, the data also revealed that more symmetrical dominance perceptions were associated with increased attraction and group cohesiveness. This is consistent with previous research showing that in general, dominance symmetry is related to more positive interpersonal relations (e.g., Dryer & Horowitz, 1997; Parks, 1977). These findings are also congruent with studies showing how people holding similar attitudes and traits show more attraction than dissimilar partners (see Byrne, 1997; Klohnen & Luo, 2003). The similarity-attraction effect is the result of cognitive and affective evaluations of targets based on similar attitudes, positive qualities, and other characteristics (Montoya & Horton, 2004). The present study suggests that the communication medium in which these characteristics are expressed and evaluated does not prevent the operation of the similarity-attraction effect in relation to interpersonal dominance. Finally, these results reveal that like social interactions that take place face to face (Zaccaro & Lowe, 1988), group cohesiveness is closely related to attraction in computer-mediated work groups.

Finally, the hypotheses that collocated subgroups in partially distributed groups would be perceived as more dominant than isolates were not supported. One possibility is that being a member of a small, collocated subgroup without being a numerical majority over the number of isolates is not sufficient to be perceived as more dominant than other members. In this case, the strength in numbers principle does not seem to apply. It is possible that with larger, more salient differences between the majority and minority (e.g., a collocated or isolated component comprised of more than half of the total members), majority members will in fact be perceived as more dominant.

A strength of the present study is that the effects of geographic distribution and collocation were not confounded with differences in communication mode. Face-to-face contact was not prohibited, as noted, but did not occur nevertheless. Therefore, there is no question that effects were rooted in cognitive rather than channel differences. Some degree of FtF communication may have changed dynamics in collocated or mixed distributed groups. Indeed, some researchers see a minimal amount of FtF interaction as an "antidote" to the problems that virtual groups encounter (e.g., Nardi & Whittaker, 2002). The downside of this method however is that many collocated or mixed groups outside the research environment do use a variety of communication channels. Mixed-mode communication systems certainly warrant further investigation, although robust theory with which to drive such inquiries is not yet apparent (Walther & Parks, 2002).

At a broader level, the present study raises questions about overtly optimistic views of technology envisioning flawless collaboration regardless of geographic location (cf. T. Friedman in Pink, 2005). An equalized, flatter playing field was not established among members of geographically distributed groups; instead, they developed more extreme and complementary dominance perceptions than members of collocated groups. Members of collocated groups, who developed relatively symmetrical dominance perceptions, experienced more attraction and cohesion as a group. These results highlight the role of geographic location in social perceptions and underscore that distance still matters in computer-mediated collaboration (Olson & Olson, 2000).

Notes

1. The authors are grateful to all those involved in the Virtual Groups Project, including collaborators Natalie Bazarova, Tucker Barrett, Kajsa Dalrymple, Tracy Loh, Poppy McLeod, Sadat Shami, Zuoming Wang, and our colleagues from other institutions that allowed their students to participate in the project: Hilary Altman, Junho Choi, Angela Eaton, Art Ramirez, and David Shore. The Virtual Groups Project was funded by a Hatch Grant awarded to Joseph B. Walther. Please address correspondence to Jorge Peña, Department of Communication Studies, University of Texas at Austin, 1 University Station A1105, Austin, TX 78712; e-mail: jorge.pena@mail.utexas.edu.

2. Additional variables involved in the omnibus research design included attributional goals between groups and the distribution of majority/minority information sets among group members. Preliminary analyses indicated no significant interactions between geographic location, attribution, and majority/minority information manipulations on dominance measures, suggesting that these factors did not play a role in the dominance findings reported in this study.

3. To facilitate appropriate interpretations of the statistical tests for directional hypotheses, observed F coefficients (with numerator $df = 1$) were transformed into corresponding t values and assessed using one-tailed criteria (see Levine & Banas, 2002). Because dominance intensity coefficients and symmetry coefficients were calculated from the same set of round-robin ratings of partner dominance, hypothesis tests for Hypothesis 1 and Hypothesis 2 observed the Bonferroni correction, $p < .025$.

References

Asch, S. E. (1956). I. Studies of independence and conformity: A minority of one against a unanimous majority. *Psychological Monographs*, *70*, 1-51.

Bales, R. F. (1970). *Personality and interpersonal behavior*. New York: Holt, Rinehart & Winston.

Bales, R. F., & Cohen, S. P. (1979). *SYMLOG: A system for multiple level observation of groups*. New York: Free Press.

Bateson, G. (1958). *Naven: A survey of the problems suggested by a composite picture of the culture of a New Guinea tribe drawn from three points of view*. Stanford, CA: Stanford University Press.

Bos, N., Shami, N. S., Olson, J. S., Cheshin, A., & Nan, N. (2004). In-group/out-group effects in distributed teams: An experimental simulation. In *Proceedings of computer supported collaborative work '04* (pp. 429-436). New York: ACM Press.

Boucher, E., Hancock, J. T., & Dunham, P. J. (2004, January). *The perception and maintenance of social status in computer-mediated and face-to-face conversations: An examination of the equalization phenomenon*. Poster presented at the annual meeting of the Society of Personality and Social Psychology, Austin, TX.

Bradner, E., & Mark, G. (2002, November). *Why distance matters: Effects on cooperation, persuasion and deception*. Paper presented at the ACM conference on computer-supported cooperative work, New Orleans, LA.

Burgoon, J. K., & Dunbar, N. E. (2000). An interactionist perspective on dominance-submission: Interpersonal dominance as a dynamic, situationally contingent social skill. *Communication Monographs*, *67*, 96-121.

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

Burke, K., Aytes, K., Chidambaram, L., & Johnson, J. J. (1999). A study of partially distributed groups: The impact of media, location, and time on perceptions and performance. *Small Group Research*, *30*, 453-490.

Byrne, D. (1997). An overview (and underview) of research and theory within the attraction paradigm. *Journal of Social and Personal Relationships*, *14*, 417-431.

Cramton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science*, *12*, 346-371.

Dillard, J. P., Solomon, D. H., & Samp, J. A. (1996). Framing social reality: The relational relevance of relational judgments. *Communication Research*, *23*, 703-723.

Dovidio, J. F., Ellyson, S. L., Keating, C. F., Heltman, K., & Brown, C. E. (1988). The relationship of social power to visual displays of dominance between men and women. *Journal of Personality and Social Psychology*, *54*, 233-242.

Dryer, D. C., & Horowitz, L. M. (1997). When do opposites attract? Interpersonal complementarity versus similarity. *Journal of Personality and Social Psychology*, *72*, 592-603.

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

Dunbar, N. E., & Burgoon, J. K. (2005). Measuring nonverbal dominance. In V. L. Manusov (Ed.), *The sourcebook of nonverbal measures* (pp. 361-374). Mahwah, NJ: Lawrence Erlbaum.

Ellis, D. G. (1976). *An analysis of relational communication in ongoing group systems*. Unpublished doctoral dissertation, University of Utah.

Ellyson, S. L., & Dovidio, J. F. (1985). Power, dominance, and nonverbal behavior: Basic concepts and issues. In S. L. Ellyson & J. F. Dovidio (Eds.), *Power, dominance, and nonverbal behavior* (pp. 1-28). New York/Berlin: Springer-Verlag.

Evans, C. R., & Jarvis, P. A. (1986). The group attitude scale: A measure of attraction to group. *Small Group Behavior*, *17*, 203-216.

Fiol, C. M., & O'Connor, E. J. (2005). Identification in face-to-face, hybrid, and pure virtual teams: Untangling the contradictions. *Organization Science*, *16*, 19-32.

Gibbs, J. L., Ellison, N. B., & Heino, R. D. (2006). Self-presentation in online personals: The role of anticipated future interaction, self-disclosure, and perceived success in Internet dating. *Communication Research*, *33*, 1-26.

Goffman, E. (1967). *Interaction ritual: Essays in face-to-face behavior*. New York: Anchor.

Gouran, D. S. (1973). Correlates of member satisfaction in group decision-making discussion. *Central States Speech Journal*, *24*, 91-96.

Hancock, J. T., & Dunham, P. J. (2001). Impression formation in computer-mediated communication revisited: An analysis of the breadth and intensity of impressions. *Communication Research*, *28*, 325-347.

Hinds, P. J., & Kiesler, S. (Eds.). (2002). *Distributed work*. Cambridge, MA: MIT Press.

Hinds, P. J., & Mortensen, M. (2005). Understanding conflict in geographically distributed teams: The moderating effects of shared identity, shared context, and spontaneous communication. *Organization Science*, *16*, 290-307.

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

Johnson, J. J. (1999, January). A field study of partially distributed group support. In *Proceedings of the 32nd Hawaii international conference on system sciences*. Retrieved February 20, 2005, from csdl .computer.org/comp/proceedings/hicss/1999/0001/01/00011025.PDF

Kiesler, D. J. (1983). The 1982 interpersonal circle: A taxonomy for complementarity in human transactions. *Psychological Review*, *90*, 185-214.

Kiesler, S., Siegel, J., & McGuire, T.W. (1984). Social psychological aspects of computer-mediated communication. *American Psychologist*, *39*, 1123-1134.

Klohnen, E. C., & Luo, S. (2003). Interpersonal attraction and personality: What is attractive—Self similarity, ideal similarity, complementarity, or attachment security? *Journal of Personality and Social Psychology*, *85*, 709-722.

Kraut, R. E., Fussell, S. R., Brennan, S. E., & Siegel, J. (2002). Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. In P. J. Hinds & S. Kiesler (Eds.), *Distributed work* (pp. 137-162). Cambridge, MA: MIT Press.

Lea, M., O'Shea, T., Fung, P., & Spears, R. (1992). "Flaming" in computer-mediated communication: Observations, explanations and implications. In M. Lea (Ed.), *Contexts of computer-mediated communication* (pp. 89-112). London: Harvester-Wheatsheaf.

Levine, T. R., & Banas, J. (2002). One-tailed *F*-tests in communication research. *Communication Monographs*, *69*, 132-143.

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

McGlone, M. S., & Batchelor, J. A. (2003). Looking out for number one: Euphemism and face. *Journal of Communication*, *53*, 251-264.

McGuire, T. W., Kiesler, S., & Siegel, J. (1987). Group and computer-mediated discussion effects in risk decision making. *Journal of Personality and Social Psychology*, *52*, 917-930.

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

Mehrabian, A., & Hines, M. (1978). A questionnaire measure of individual differences in dominance-submissiveness. *Educational and Psychological Measurement*, *38*, 479-484.

Montoya, R. M., & Horton, R. S. (2004). On the importance of cognitive evaluation as a determinant of interpersonal attraction. *Journal of Personality and Social Psychology*, *86*, 696-712.

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

Nardi, B. A., & Whittaker, S. (2002). The role of face-to-face communication in distributed work. In P. J. Hinds & S. Kiesler (Eds.), *Distributed work* (pp. 83-112). Cambridge, MA: MIT Press.

Nass, C., Moon, Y., Fogg, B. J., Reeves, B., & Dryer, D. C. (1995). Can computer personalities be human personalities? *International Journal of Human-Computer Studies*, *43*, 223-239.

Olson, G. M., & Olson, J. S. (2000). Distance matters. *Human-Computer Interaction*, *15*, 139-178.

Parks, M. (1977). Relational communication: Theory and research. *Human Communication Research*, *3*, 372-381.

Pink, D. H. (2005). Why the world is flat. *WIRED*, *13*(5), 150-153.

Piper, W. E., Marrache, M., Lacrois, R., Richardson, A. M., & Jones, B. D. (1983). Cohesion as a basic bond in groups. *Human Relations*, *36*, 93-108.

Rains, S. A. (2005). Leveling the organizational playing field—Virtually: A meta-analysis of experimental research assessing the impact of group support system use on member influence behaviors. *Communication Research*, *32*, 193-234.

Rice, R. E. (1984). Mediated group communication. In R. E. Rice & Associates (Eds.), *The new media: Communication, research, and technology* (pp. 129-156). Beverly Hills, CA: Sage.

Rogers, L. E., & Escudero, V. (2004). *Relational communication: An interactional perspective to the study of process and form*. Mahwah, NJ: Lawrence Erlbaum.

Rogers, L. E., & Farace, R. V. (1975). Analysis of relational communication in dyads: New measurement procedures. *Human Communication Research*, *1*, 222-239.

Schmid Mast, M. (2002). Dominance as expressed and inferred through speaking time: A meta-analysis. *Human Communication Research*, *28*, 420-450.

Seashore, S. (1954). *Group cohesiveness in the individual work group*. Ann Arbor, MI: Institute for Social Research.

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

Spears, R., & Lea, M. (1994). Panacea or panopticon?: The hidden power in computer-mediated communication. *Communication Research*, *21*, 427-459.

Spears, R., Lea, M., & Lee, S. (1990). De-individuation and group polarization in computer-mediated communication. *British Journal of Social Psychology*, *29*, 121-134.

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

Stasser, G., & Titus, W. (1985). Pooling unshared information in group decision making: Biased information sampling during discussions. *Journal of Personality and Social Psychology*, *53*, 81-93.

Stasser, G., & Titus, W. (2003). Hidden profiles: A brief history. *Psychological Inquiry*, *14*, 304-313.

Straus, S. G., & McGrath, J. E. (1994). Does the medium matter? The interaction of task type and technology on group performance and member reactions. *Journal of Applied Psychology*, *79*, 87-97.

Tanis, M., & Postmes, T. (2003). Social cues and impression formation in CMC. *Journal of Communication*, *53*, 676-693.

Tiedens, L. Z., & Fragale, A. R. (2003). Power moves: Complementarity in dominant and submissive nonverbal behavior. *Journal of Personality and Social Psychology*, *84*, 558-568.

Tusing, K. J., & Dillard, J. P. (2000). The sounds of dominance: Vocal precursors of perceived dominance during interpersonal influence. *Human Communication Research*, *26*, 148-171.

Tyler, T. R. (1999). Why do people help organizations?: Social identity and pro-organizational behavior. In R. I. Sutton & B. M. Staw (Eds.), *Research on organizational behavior* (Vol. 21, pp. 201-246). Greenwich, CT: JAI.

Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication Research*, *19*, 52-90.

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. (2002). Time effects in computer-mediated groups: Past, present, and future. In P. J. Hinds & S. Kiesler (Eds.), *Distributed work* (pp. 235-257). Cambridge, MA: MIT Press.

Walther, J. B., & Bazarova, N. (2007). Misattribution in virtual groups: The effects of member distribution on self-serving bias and partner blame. *Human Communication Research*, *33*, 1-26.

Walther, J. B., Boos, M., & Jonas, K. (2002). Misattribution and attributional redirection in distributed virtual groups [Electronic version]. In *Proceedings of the 35th Hawaii international conference on system sciences*. Washington, DC: IEEE Computer Society.

Walther, J. B., & Bunz, U. (2005). The rules of virtual groups: Trust, liking, and performance in computer-mediated communication. *Journal of Communication*, *55*, 828-846.

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

Walther, J. B., & Parks, M. R. (2002). Cues filtered out, cues filtered in: Computer-mediated communication and relationships. In M. L. Knapp & J. A. Daly (Eds.), *Handbook of interpersonal communication* (3rd ed., pp. 529-563). Thousand Oaks, CA: Sage.

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.

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

Weisband, S. P. (2002). Maintaining awareness in distributed team collaboration: Implications for leadership and performance. In P. J. Hinds & S. Kiesler (Eds.), *Distributed work* (pp. 311-333). Cambridge, MA: MIT Press.

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

Wiggins, J. S., & Broughton, R. (1985). The interpersonal circle: A structural model for the integration of personality research. In R. H. Hogan & W. H. Jones (Eds.), *Perspectives in personality 1*, (pp. 1-47). Greenwich, CT: JAI.

Zaccaro, S. J., & Lowe, C. A. (1988). Cohesiveness and performance on an additive task: Evidence for multidimensionality. *Journal of Social Psychology*, *128*, 547-55.

Jorge Peña (MS, Cornell University) is a doctoral candidate at Cornell University. He will soon join the faculty at the University of Texas at Austin. His research focuses on how interaction takes place and impressions develop during online work and play.

Joseph B. Walther (PhD, University of Arizona) is a professor in the Department of Telecommunication, Information Studies & Media and the Department of Communication at Michigan State University. His research explores how the Internet impacts the ways we coordinate and relate to one another, including the effects of computer media on collaboration and relationship formation.

Jeffrey T. Hancock (PhD, Dalhousie University) is an assistant professor in the Department of Communication and in the Faculty of Computing and Information Science at Cornell University. His research focuses on social interactions mediated by information and communication technology with an emphasis on how people produce and understand language.