One of the Gang: Supporting In-Group Behavior for Embodied Mediated Communication

Irene Rae
University of Wisconsin–Madison
1210 W. Dayton St., Madison, WI
irene@cs.wisc.edu

Leila Takayama
Willow Garage, Inc.
68 Willow Rd., Menlo Park, CA
takayama@willowgarage.com

Bilge Mutlu
University of Wisconsin–Madison
1210 W. Dayton St., Madison, WI
bilge@cs.wisc.edu

ABSTRACT
As an emerging technology that enables geographically distributed work teams, mobile remote presence (MRP) systems present new opportunities for supporting effective team building and collaboration. MRP systems are physically embodied mobile videoconferencing systems that remote co-workers control. These systems allow remote users, *pilots*, to actively initiate conversations and to navigate throughout the local environment. To investigate ways of encouraging team-like behavior among local and remote co-workers, we conducted a 2 (visual framing: decoration vs. no decoration) ×2 (verbal framing: interdependent vs. independent performance scoring) between-participants study ($n = 40$). We hypothesized that verbally framing the situation as interdependent and visually framing the MRP system to create a sense of self-extension would enhance group cohesion between the local and the pilot. We found that the interdependent framing was successful in producing more in-group oriented behaviors and, contrary to our predictions, visual framing of the MRP system weakened team cohesion.

Author Keywords
Embodied mediated communication, remote presence, in-group behavior

ACM Classification Keywords
H.5.3 Information Interfaces and Presentation: Group and Organization Interfaces – *computer-supported cooperative work*; H.4.3 Information Systems Applications: Communications Applications – *computer conferencing, teleconferencing, and videoconferencing*

General Terms
Design, Experimentation, Human Factors

INTRODUCTION
As geographically distributed collaboration becomes more commonplace, workplaces have been challenged to find ways of coordinating communication to ensure effective team outcomes. The productivity of group activity has been attributed

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

CHI'12, May 5–10, 2012, Austin, Texas, USA.

Copyright 2012 ACM 978-1-4503-1015-4/12/05...$10.00.

Figure 1. The Mobile Remote Telepresence (MRP) System used in our study shown with a participant.

to factors such as access to communication behaviors of participants [40], knowledge of the environment and context of the situation [24], and a sense of membership within the organization [4]. Past approaches to facilitating geographically distributed teamwork have ranged from text-based communications to high-fidelity group videoconferencing. Research in computer-mediated communication has focused on carrying aspects of face-to-face communication over to remote collaboration using computing technology.

One of the most recent demonstrations of this research are mobile remote presence (MRP) systems (see Figure 1). Although these types of mobile remote presence systems have been available for over 15 years (e.g., Personal Roving Presence [26]), they have only recently reached the consumer market. A number of these systems are now beginning to see use in a variety of business, medical, and educational settings [1, 10, 27, 30, 37]. Outside of work contexts, these systems have been used to enable sick children to attend school (e.g., PEBBLES [9]) and to participate in extracurricular activities after school (e.g., VGo [29]). Their potential applications for older adults [3, 33] and homecare [17] have also been explored. However, because these systems have been used most extensively in business settings (e.g., Bi-Reality [12], Texai [15], and VGo [34]), we have placed the current study within the context of geographically distributed work.

Mediated communication platforms are unique in two major ways. First, they provide a remote user, the *pilot*, the autonomy to drive and control the system, granting the ability to adjust his or her position to see the visual behaviors of the local users, *locals*. This capability enables the pilot to explore the environment and points of interest, preventing feelings of disorientation or helplessness [24]. Second, in addition to the visual and aural information provided by the audio/video feed of the pilot, they provide the locals with a physical entity to interact with. This embodiment of the remote user provides supplemental cues of presence. For example, when the pilot changes the direction of the system to see the current speaker, locals become aware of the change in the pilot's orientation and the apparent shift in attention. While providing a physical representation of the remote user opens up new design opportunities for augmenting current modes of communication, it also has the potential to interpose a new barrier between users as those who are local to the system may perceive the MRP system as its own entity.

In this paper, we study how the physical presence of the MRP system affects the team dynamic between the local user and the remote user, as well as the impact this may have on collaborative work outcomes. In particular, we explore how the relationship between remote and local users might be manipulated to increase the local user's feelings of in-group membership with the pilot. In order to do this, we applied two different theoretical methods. In the first method, we use the physical embodiment of the system to improve the local user's perceptions of the pilot through the use of visual framing through self-extension [5, 11, 19, 31]. The second method focuses on the relationship between the local and the pilot as group members, verbally manipulating the framing of the pilot within the context of the team [35].

The next section outlines related work to provide background on how the creation and development of in-group identity in other media might inform our efforts toward achieving similar outcomes with MRP systems.

BACKGROUND

In organizations, the dynamics of group effectiveness are complex and influenced by a number of factors including access to communication behaviors of participants [40], awareness of the environment and the context of the situation [24], and sense of membership within the organization [4].

Computer-mediated communication (CMC) systems such as videoconferencing, support geographically distributed collaboration by enabling communicative behaviors through the implementation of movable [21] or multi-viewpoint directional displays [23]. Other systems improve knowledge of the environment and situational context through the use of immersive media spaces [16]. Each of these systems has treated the medium as a tool, using advances in technology to improve communication bandwidth, but they did not necessarily consider how the medium might be leveraged to promote a sense of membership between remote team members, an integral factor in deciding collaborative work outcomes.

Group cohesion is associated with promoting cooperation between group members, increased instances of people helping and training each other within the team, and improved productivity [4, 24]. In addition, groups with strong feelings of identity and membership tend to self-regulate, lessening the need for direct supervision and working more flexibly to resolve problems [4]. Conversely, the lack of group cohesion can sabotage organizational and team dynamics. People have been shown to be less cooperative and less trusting of those that they feel are out-group, and to deprive people that they do not identify with of positive consequences, acting against them [36].

Work on both human–human and human–computer interaction has shown *framing*—the presentation of information to encourage particular interpretations—to be effective in changing people's decisions [35] and their perceptions of others. For example, in studies where an opponent was *verbally framed* as a human as opposed to a computer [25], where a robot was presented as autonomous versus being as remote controlled [41], or where participants were told before the interaction that evaluation of their performance would either be interdependent with a team member or as an individual [22], the choice of framing had a significant effect on attitudes and behaviors toward the entity being framed.

In other examples, research in personality has shown that the use of *visual framing*, such as through the design and customization of objects, can increase group identity, improve judgments of the ease-of-use of an item, and promote *self-extension*—the feeling that a possession has meaning associated with a person's self-identity [5, 19]. These effects extend to objects or machines that have the ability to move autonomously or without the control of the person customizing them [11, 31].

In this paper, we will build on the concept that verbal and visual framing can be effective ways to manipulate perceptions by examining the effect framing has on the relationship between the locals and the pilot in the context of the MRP system. In our study, we employ a *verbal framing* variable and a *visual framing* variable to cultivate feelings of in-group identity and improve group cohesion with the goal of optimizing collaborative task outcomes.

In the next section, we present our research hypotheses and methodology, including both a pilot test and full laboratory experiment.

HYPOTHESES

We formulated our hypotheses based on previous work that focused on creating a sense of in-group identity between humans and computers [22]:

Hypothesis 1: Participants will perceive the pilot of the MRP system as more similar to themselves and as more trustworthy, exhibiting more signs of group identity through greater disclosure and more agreement with the pilot when the pilot is introduced with interdependent verbal framing as opposed to individual verbal framing.

Hypothesis 2: Participants will perceive the pilot of the MRP system as more similar to themselves and as more trustworthy, exhibiting more signs of group identity through greater disclosure and more agreement with the pilot when the system has been visually framed (decorated) by the participant than they will if the system is not visually framed.

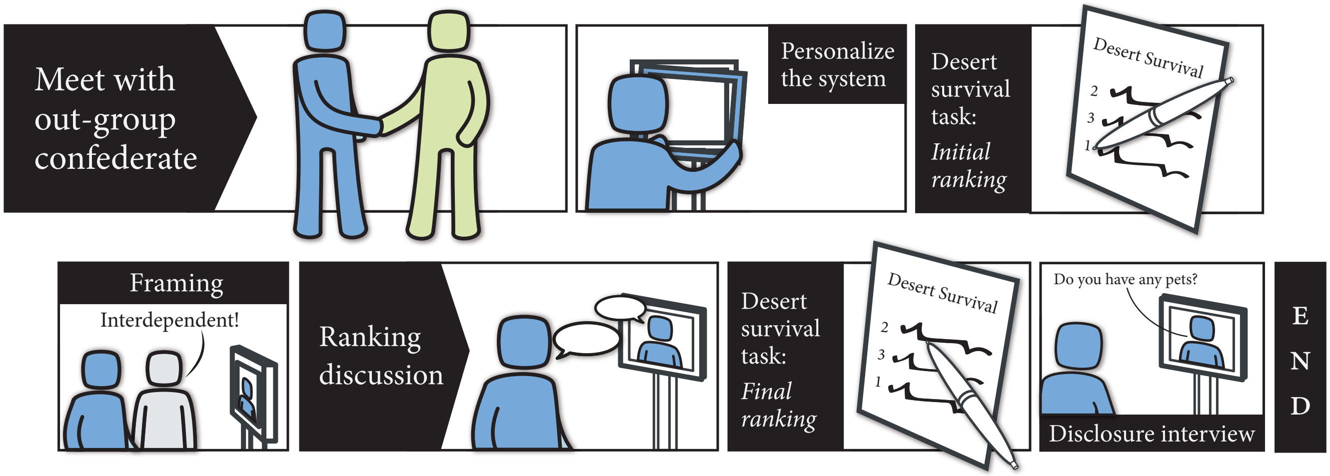

Figure 2. Storyboard of study procedure, depicting a participant's experience in the personalize and interdependent condition.

METHOD

We conducted a laboratory experiment to test these hypotheses and, due to the lack of previous work on MRP systems, we performed an extended pilot test to form a methodological basis for our experiment. These pilot tests were based on related research in the fields of human–computer interaction, computer–mediated communication, and human–robot interaction. We used our observations from the pilot test as a guide for our final experimental design. Below we describe how the pilot test influenced each aspect of our study procedure.

Experiment Procedure

Participants were met at the lobby of Willow Garage by the experimenter and led to the room in which the study took place. There, the participant was introduced to an *out-group confederate*, who identified himself by name and stated that he was also participating in the study. This confederate's role was to provide an out-group member to compare against for an infrahumanization test in the experiment questionnaire. The experimenter explained to both the participant and the out-group confederate that there were two teams, a "blue team" and a "green team". The experimenter then told the participant that he/she was on the blue team, that the out-group confederate was on the green team, and that the teams would be separated. At that point, the experimenter led the out-group confederate out of the room. When the experimenter returned to the room, she had the participant complete a consent form.

After filling out the consent form, the experimenter instructed the participant on the Desert Survival Task (described in greater detail in our study measures) and asked the participant to perform an initial ranking of items in three minutes. Once completed, the experimenter introduced the participant to an *in-group confederate* who was logged into the MRP system as the pilot and the participant and the in-group confederate engaged in a ten minute discussion of their individual rankings of the Desert Survival Task items. After the participant and the pilot had concluded their discussion, the in-group confederate pilot exited the room and the experimenter asked the participant to do a second, three minute, final ranking of the task items. The participant then filled out a questionnaire, described in greater detail in our study measures. Following the questionnaire, the experimenter re-introduced the pilot (still logged into the MRP system) to the room and gave the participant a list of questions. The experimenter told both the pilot and the participant that they would be engaging in an untimed "getting to know you" (disclosure) task and that they had each received a list of questions, one odd numbered, one even numbered. They were instructed to alternate asking each other these questions after the experimenter left the room and to inform her when finished. After the disclosure task was complete, the pilot drove the MRP system out of the room and the participant was debriefed.

A full list of the disclosure task questions is available in Appendix I and a diagram of the full procedure is shown in Figure 2.

Modifications From Pilot Test. In pilot tests, two participants guessed that the pilot was a confederate. To counter this, we added a white backdrop to remove environmental cues. In addition, we found during the pilot test that some participants had taken an inordinately long time to rank the desert survival items and discuss their rankings with the confederate; therefore, we found it necessary to add time limits to both the ranking and discussion portions of the Desert Survival Task.

Experiment Design

We used a MRP system with a touch screen mounted on a mobile platform, standing at approximately 1.58 meters or 5′ 2″ tall, as shown in Figure 1. If the participant was in the visual framing manipulation, immediately after completion of the consent form the experimenter gave the participant three items in the blue team's colors to use as decorations on the MRP system: a rectangular frame to be placed on the screen, a chest shaped body piece, and a magnetic name tag (see Figure 3). We positioned the MRP system in the hallway outside of the experiment room, asked the participant to write the *in-group confederate pilot's* name on the name tag and had him/her personalize the placement of the decorative pieces on the MRP system. After the participant finished placing the decorations, we asked him/her to return to the experiment room and continued by instructing him/her on the Desert Survival Task.

If the participant was in the interdependent framing condition, the experimenter explained that performance on the Desert Survival Task would be evaluated as a team. If the participant was in the independent framing condition, the experimenter explained that performance on the Desert Survival Task would be evaluated independently. During the study, participants interacted with two separate confederates, the *in-group confederate pilot* who was on their team and an *out-group confederate* who they were told was on the opposite team.

Modifications From Pilot Test. Because of the lack of related work in the field of embodied-mediated communication, we conducted pilot tests based on six different methods, each of which was informed by the manipulations used in previous studies on feelings of group identity or self-extension. Three of these methods sought to foster a sense of self-extension toward the embodied system through the use of visual framing or design elements and three attempted to build a stronger sense of group identity through the use of verbal framing. A total of 17 participants were pilot tested and three were eliminated, two due to a technical failure and one after guessing that the pilot was a confederate, leaving a total of two participants per condition ($n = 14$).

Visual framing: In Nass et al.'s study on creating a sense of team identity with a computer, people were found to act more collaboratively toward a computer visually framed with colored bands that matched the participant's group color [22]. We sought to create a similar manipulation by pre-decorating the MRP system in colors matching the participant's group, illustrated in Figure 3b. In this condition the procedure was the same as that of the full experiment and the MRP system was pre-decorated in blue.

Visual framing through self-extension: Blom et al. found that the personalization of mobile phones and web portals led to a feeling of self-extension among participants [5]. In this condition, we strengthened the visual framing manipulation by allowing people to choose where to place the colored markers, "personalizing" the system. Our goal was to create a sense of self-extension while limiting the level of customization to avoid possible confounds. In this condition, prior to being instructed on the Desert Survival Task, we gave participants the blue decorations and asked them to place them on the system, as shown in Figure 3a.

Mimicry: This condition was based on studies on mimicry [2] and the person-positivity bias [28] that concluded that similarity to an individual produces more trust and liking. In the case of the MRP system, creating human-like movement was an attempt to de-mechanize the appearance of the system, making it more similar to the participant. In this condition, the procedure was identical to that of the full experiment, but during both the desert survival and the disclosure tasks the pilot rotated the MRP system to the right and left by a small degree when stationary.

Choice: Demoulin et al. found that participants given a choice of what team they were on had a greater sense of team identity and favored their team members more than those who were assigned a team [8]. In order to reproduce this manipulation, we allowed the participant to choose his/her team color. In this condition, we asked participants which team they wanted to be on after informing them of the two team colors and assigned the out-group confederate to the opposite group.

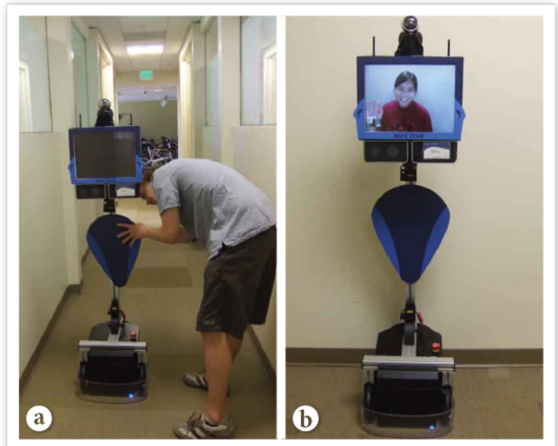

Figure 3. The MRP system (a) being decorated and (b) with decorations on.

Individuality: In his work on the person-positivity bias, Sears found that verbal framing of professors and politicians resulted in more positive or negative evaluations. When presented as individuals, professors and politicians received more positive evaluations than when presented as an aggregate. This result supported Sears's hypothesis that the more an entity resembles an individual person, the more positively people are inclined to judge it [28]. We similarly attempted to verbally frame the pilot as an individual by providing details on her interests. In this condition, when the pilot was introduced we told the participant "Your teammate will be [name], and she enjoys reading fiction novels, baking, and swimming. She said that she would one day like to bake the perfect cake."

Interdependency: Nass et al.'s study on creating a sense of team identity with a computer found that when participants were told that their performance would be dependent on how well they did as a team, their levels of cooperation and trust increased [22]. We replicated this by telling participants that they would be evaluated as a team. In this condition, when we instructed the participant on the Desert Survival Task the experimenter told the participant that their evaluation would be interdependent with that of the pilot.

Neutral: No manipulation of design or framing to serve as a control.

Using our observations of this pilot test, we determined that the visual framing through self-extension and the verbal framing manipulations were the most promising, as they nominally demonstrated the largest effects. The similarity of our pilot test results to Nass et al.'s experiment in building team identity between participants and computers [22] was also a factor in our choice of manipulations. The final experimental design

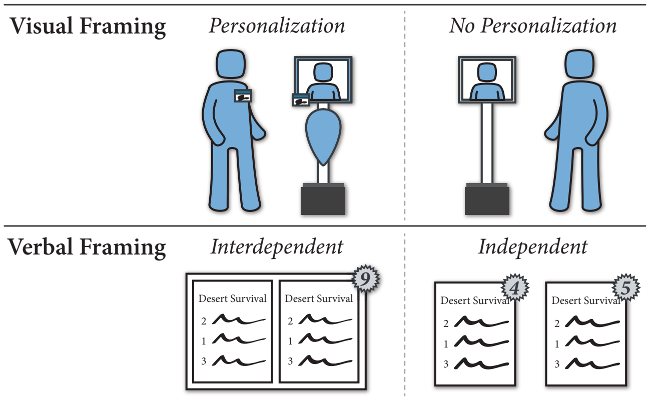

Figure 4. Diagram of study design conditions.

involved a 2 (visual framing: no personalization vs. personalization) $\times 2$ (verbal framing: individual vs. interdependent) between-participants manipulation, as illustrated in Figure 4.

Participants

Twenty adult women (five in each condition) and twenty men (five in each condition), $n = 40$, whose ages ranged between 18 and 82 years, $M = 34.8$, $SD = 15.8$, volunteered to participate. They were recruited via a local university's online bulletin board, postings at two local newspapers, word of mouth from participants of previous studies, and posters placed around the neighborhood. Participants reported that on average they were somewhat familiar with robots, $M = 3.05$, $SD = 1.77$ (1 = not very familiar; 7 = very familiar), and were compensated $20 for each hour of their participation.

Measures

The measures we used for the study included video footage taken with a single camera of the personalization session, the Desert Survival Task, and the disclosure interview. We also collected attitudinal data using a three-part questionnaire and included a demographic information survey.

Desert Survival Task Rankings

The Desert Survival Task [14] is a collaborative decision-making task, modified from the original design to include items that would be relevant to a present-day survival situation. Participants were provided with a written scenario of a bus crash in the desert and were asked to rank nine items in order of importance for survival to create an initial ranking. The list of items included (1) a map of New Mexico, (2) the book "Edible Animals of the Desert", (3) duct tape, (4) first aid kit, (5) cosmetic mirror, (6) flashlight (four-battery size), (7) magnetic compass, (8) one 2-quart flask per person that is full of 180 proof vodka, and (9) one plastic raincoat per person.

We chose the Desert Survival Task primarily because it was used in Nass et al.'s study on creating a sense of team identity between a participant and a computer [22] and also because it has been validated and tested for reliability. Related work has also used the Desert Survival Task as a measure of team alignment and agreement both because participants are inclined to believe that they should be good at the task and because a large amount of variance is regularly found in the ratings. After the initial ranking, the confederate and the participant discussed the differences in their orderings. For this discussion, we created a set of rankings for the confederate that would be consistently different across participants using an algorithm based on previous work [14], (see Appendix II). After the discussion, we asked participants to re-rank the nine items to create a final ranking.

Modifications From Pilot Test. In the pilot test, we used 12 items in the Desert Survival Task; however, we found that participants were spending a great deal of time ranking the items and there was confusion on what some of the items were, so we removed three from the task, resulting in a total of nine. In addition, we added a time limit of three minutes to perform rankings and of ten minutes for the discussion.

Questionnaires

Our questionnaire was split into three sections. In the first section, we used the assessment of perceived homophily developed and validated by McCroskey et al. to measure how similar the participant felt that the pilot was to himself or herself. This test consisted of nine adjective pairs (e.g., "similar to me vs. different from me" and "from a social class similar to mine vs. from a social class different from mine"), each in a seven-point semantic differential scale.

In the second section of the questionnaire, we used the interpersonal solidarity measure developed and validated by Wheeless [39] to measure how trustworthy the participant felt that the pilot was. This consisted of 23 statements (e.g., "This person has a great deal of influence over my behavior." and "We share a lot in common."), each paired with a seven-point ranking scale to indicate level of agreement ranging from 1 (strongly disagree) to 7 (strongly agree).

We based the third section of the questionnaire on measures used in studies of infrahumanization—the belief that members of one's group are more human than those outside of it [7, 8, 28, 36, 38]. This section consisted of two pages and was informed by the tests used in related infrahumanization work [7, 8, 36, 38]. Both pages included the following directions: "For the person listed on the left, draw lines connecting him/her with 8–10 words on the right that you think he/she may experience in a given day." Each page had sixteen words listed on the right side. These words were chosen from prior work which categorized and validated them as either primary (non-uniquely human) emotions (e.g., attraction, desire, excitement, pleasure, agitation, anger, fear, rage), or secondary (uniquely human) emotions (e.g., regret, disappointment, compassion, love, hope, admiration, bitterness, enthusiasm). The left side of the first page showed the name of the in-group confederate pilot and their team identification (*blue* team). The left side of the second page showed the name of the out-group confederate and their team identification (the *green* team).

Modifications From Pilot Test. During our initial observations of these measures in the pilot test we found that the response to all three sections was promising, thus we kept all three sections. In our final questionnaire we added questions about the name of the in-group confederate and the team color as manipulation checks.

Disclosure Interview

The disclosure questions were developed and selected from related work that employed the disclosure task to test trust and group identity [6, 18, 32]. Similar to these previous studies, questions were asked on a gradually increasing scale of intimacy and the participant and in-group confederate pilot alternated asking questions. The confederate's responses to the questions were scripted (see Appendix I for the questions used in the study).

Modifications From Pilot Test. In our initial pilot test the disclosure task was a one-sided interview in which the pilot asked the participant questions and the participant responded. Feedback from the participants and our observations led to our changing the disclosure task to be two-sided, with the participant and pilot taking turns to ask questions.

Analyses

For the Desert Survival Task, we calculated Spearman's ρ—a rank-order correlation—to assess the similarity between the participant's final rankings and the confederate's initial rankings. This measure captured how much the participant changed his/her rankings to align more closely with those of the confederate. The distribution for our data from this measure showed a positive skew; therefore, we used Tukey's ladder of powers to take a $\log_{10}$ transformation of the dependent variable. Finally, we used an analysis of variance (ANOVA) to analyze the effects of personalization and framing (independent variables) on how much the participant aligned his or her final rankings to match the confederate's rankings (dependent variable).

The video data from the disclosure interview was transcribed and analyzed for the degree of self-disclosure and consistent with previous self-disclosure studies [6, 18, 32]. The breadth of disclosure was measured by the length of responses through word count and compared using an ANOVA.

We used an analysis of covariance (ANCOVA) to identify differences across conditions in each of the three sections of the questionnaire data.

RESULTS

The results of our data analyses showed that verbal framing of the situation as interdependent had a positive effect on performance ratings and group cohesion, which was consistent with the first hypothesis. However, we also found that visual framing of the MRP system unexpectedly had a negative effect, going in the opposite direction of our second hypothesis. All of the statistically significant results are shown in Figure 5.

Behavioral Measures

Decision making

In the collaborative decision making task, we found a trend of participants aligning to the confederate's scores less when the system was visually framed, but this effect was not significant at $p < .05$. Participants who did not have a visually framed MRP system tended to move their final decisions closer to the in-group confederate's, $M = \log(0.75)$, $SE = 0.12$, than participants in the visual framing through self-extension condition, $M = \log(0.65)$, $SE = 0.12$, $F(1, 36) = 2.83$, $p = .10$, $\eta_p{}^2 = .073$.

Disclosure

In the disclosure interview, participants who were told that performance would be interdependent with their teammate's performance disclosed more to the confederate, providing longer responses which were measured by word count ($M = 530$, $SD = 284$) than participants who were told that their performance would be judged independently ($M = 357$, $SD = 184$, $F(1, 35) = 4.85$, $p = .034$, $\eta_p{}^2 = .12$).

Attitudinal Measures

Perceived homophily

Our analysis of the first section of questionnaire data, which controlled for video-game experience[1] in all tests, showed several main effects that approached, but did not reach significance. Participants who did not participate in the visual framing condition seemed more likely to report that they and the pilot worked well together, $M = 6.05$, $SD = 1.15$, than those who adorned the robot with team colors in the visual framing through self-extension condition, $M = 5.30$, $SD = 1.42$, $F(1, 35) = 3.80$, $p = .059$, $\eta_p{}^2 = 0.098$. Participants who did not participate in the visual framing condition also seemed to show a tendency toward feeling that the pilot was more similar to them, $M = 5.05$, $SD = 1.23$, than participants in the visual framing through self-extension condition, $M = 4.35$, $SD = 1.46$, $F(1, 35) = 3.48$, $p = .070$, $\eta_p{}^2 = .091$.

Interpersonal solidarity

In the second section of the questionnaire, controlling for video game experience, we found that participants who did not participate in the visual framing condition were more interested in interacting with the pilot outside of the study, $M = 5.35$, $SD = 0.88$, than those who decorated the system in the visual framing through self-extension condition, $M = 4.65$, $SD = 1.14$, $F(1, 35) = 4.65$, $p = .038$, $\eta_p{}^2 = .12$. Participants to whom the system was not visually framed also made more of an effort to cooperate with the pilot, $M = 6.45$, $SD = 0.61$, than participants who personalized the system did, $M = 6.05$, $SD = 0.39$, $F(1, 35) = 5.68$, $p = .023$, $\eta_p{}^2 = .14$.

In contrast, participants who were told that evaluation of their performance was interdependent with that of the pilot's liked their teammate more, $M = 6.75$, $SD = 0.44$, than those who were told that their performance would be evaluated individually, $M = 6.20$, $SD = 0.70$, $F(1, 35) = 8.10$, $p = .007$, $\eta_p{}^2 = .19$.

Controlling for videogame experience, there was also an interaction effect between visual framing through self-extension and interdependence, $F(1, 34) = 4.40$, $p = .043$, $\eta_p{}^2 = .12$. For participants who did not decorate the MRP system in the visual framing condition, having interdependent scores made them feel more like they and the pilot did helpful things for each other, $M = 5.90$, $SD = 0.57$, than when their scores were verbally framed as being evaluated individually, $M = 4.60$, $SD = 1.08$, $F(1, 17) = 11.05$, $p = .004$, $\eta_p{}^2 = .39$. For participants who decorated the system in

[1] Video-game experience significantly correlates with people's perceptions of robots, as suggested by our previous research [20].

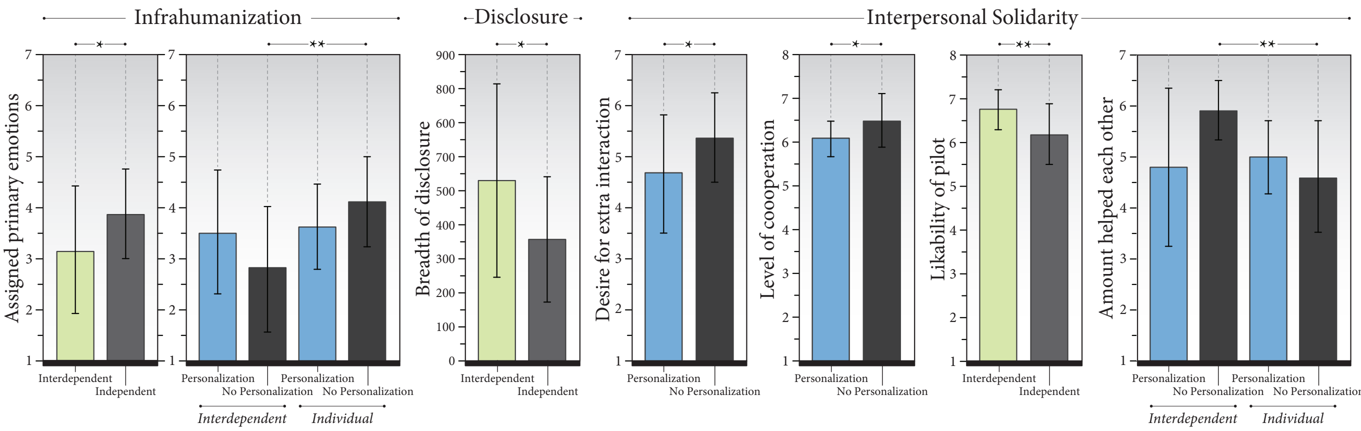

Figure 5. Results from the infrahumanization, disclosure, and interpersonal solidarity measures. (*) and (**) denotes $p < .05$ and $p < .01$, respectively.

the visual framing condition, having interdependent vs. individual scores did not significantly influence how much they felt that they and the pilot did helpful things for each other, $F(1, 16) = 0.16$, $p = .69$, $\eta_p{}^2 = .010$.

We also found several other marginal main effects, which approached, but did not reach significance at the $p < .05$ level. Participants with scores verbally framed as being judged interdependently with their teammate's scores appeared to cooperate more, $M = 6.40$, $SD = 0.50$, than those with individually framed scores, $M = 6.10$, $SD = 0.55$, $F(1, 35) = 3.63$, $p = .065$, $\eta_p{}^2 = .094$. Those who did not decorate the system in the visual framing through self-extension condition seemed to feel that they and the pilot understood each other more, $M = 5.75$, $SD = 0.97$, than those who did, $M = 5.05$, $SD = 1.36$, $F(1, 35) = 3.82$, $p = .059$, $\eta_p{}^2 = .098$. In addition, those who did not participate in the visual framing through self-extension condition seemed to feel that they had more in common with the pilot, $M = 4.90$, $SD = 0.91$, than those who did participate in the visual framing through self-extension, $M = 4.22$, $SD = 1.22$, $F(1, 33) = 3.79$, $p = .060$, $\eta_p{}^2 = .10$.

Infrahumanization

In the test for infrahumanization, controlling for video game experience across conditions, we found a main effect for verbal framing. Participants assigned more primary, non-uniquely human emotions to the pilot when told that performance was judged individually $M = 3.85$, $SD = 0.88$, than participants who were told that they would be judged interdependently, $M = 3.15$, $SD = 1.23$, $F(1, 35) = 4.32$, $p = .045$, $\eta_p{}^2 = .11$. This indicates that participants who believed that performance would be judged individually felt that the pilot was less human than those who believed that judgment of performance would be evaluated interdependently with their teammate's performance.

We also found an interaction effect between visual framing and verbal framing conditions. For participants not in the visual framing through self-extension condition, having individual scores caused them to assign more primary or non-uniquely human emotions to the pilot on average, $M = 4.10$, $SD = 0.88$, than having interdependent scores, $M = 2.80$, $SD = 1.23$, $F(1, 17) = 16.1$, $p = .001$, $\eta_p{}^2 = .49$. For participants for whom the system was visually framed through self-extension, having interdependent vs. individual scores did not significantly influence how many primary or non-uniquely human emotions they assigned to the pilot, $F(1, 17) = 0.07$, $p = .79$, $\eta_p{}^2 = .004$.

DISCUSSION

When the pilot's presence was verbally framed by instructing the participants that their performance would be interdependent with their teammate's, participants liked the pilot more and offered greater breadth of disclosure, showing more willingness to talk to the pilot. They also seemed to feel more cooperative and experienced weaker feelings of infrahumanization toward the pilot, meaning that they thought of the pilot as more human. These results support our first hypothesis.

Our results showed that participants who decorated the MRP system in the visual framing through self-extension condition were less inclined toward interacting with the pilot outside of the study and cooperated less with their teammate. They also tended to be less affected by the pilot's arguments in the Desert Survival Task and seemed to feel that they worked less well together, were less similar, understood each other less, and had less in common, than they did when the MRP system was not visually framed. This negative bias toward the pilot using the visually framed MRP system is inconsistent with our second hypothesis.

The results also showed that when participants did not personalize the MRP system in the visual framing condition and were told that their performance would be interdependent with the out-group confederate's, they felt greater group identity with the pilot and they believed that they had helped each other more as a team.

These results are consistent with some aspects of prior work (e.g., [22]); we found that interdependence between the task performances of the locals and the pilots increased in-group behaviors and attitudes. However, some of our results are also inconsistent with previous findings. Visually framing of the MRP system by decorating it with the team's colors did not encourage the development of in-group behaviors and attitudes, decreasing group cohesion and feelings of team identity.

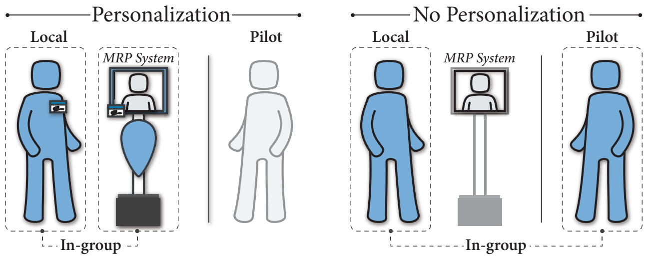

Figure 6. Our results suggest that personalization led participants to perceive the MRP system as an independent entity, diminishing collaborative outcomes between the local and the pilot.

This inconsistency with previous research on building group membership with machines [22] and creating a sense of self-extension through personalization [11] suggests a potential disparity between the local user's perception of the MRP system as a communication medium and the local's awareness of the system as its own entity.

The negative feelings that people expressed toward the pilot of the visually framed MRP systems suggests that unlike communications facilitated by computer-mediated communications, embodied-mediated platforms such as MRP systems may be perceived as independent entities (see Figure 6). In previous work on personalization, people who put a face on the item in the process of customizing it experienced negative feelings of self-extension toward the the item; in contrast, those who did not put a face on the item attributed a more positive bias toward it [13]. This negative reaction was attributed to the addition of the face, which was believed to have given the object a new identity as an individual in its own right. In the case of our study, the addition of the decoration step of the visual framing may have created a sense of self-extension or feelings of group identity between the local and the MRP system. The subsequent materialization of a face on the screen when the pilot logged on may have been perceived by the local as the intrusion of an out-group member on the in-group local-system team, thereby soliciting a hostile reaction. This creation of a relationship between the local and the MRP platform is a factor unique to embodied–mediated communication, requiring new research approaches.

In this study, we found that the physical presence of an embodied-mediated communication system creates a communication dynamic unlike that found in human–computer and computer–mediated communication. While the intricacies of this dynamic have yet to be fully explored, we have taken a first step toward understanding how both visual and verbal framing may impact the perceptions that local users have of the system, thus affecting their subsequent treatment of the pilot. Although we have not yet untangled the full consequences of highlighting or de-emphasizing the physical presence of the MRP system for the local, it is clear that this unique aspect of embodied–mediated communication has a number of implications for future design and research.

Design Implications

For designers of current and future MRP systems, there is a need to be aware that locals may perceive the MRP system as an independent entity and how this may impact their perceptions of pilots trying to use the system. In fact, although people often customize and personalize their domestic robots [31], this paradigm is not necessarily ideal for mobile mediums that are inhabited and controlled by remote users. A possible solution may be to design the system to be less obtrusive and to highlight the presence of the pilot while de-emphasizing the physicality of the system. Ways of accomplishing this may be to create systems that bear less of a resemblance to humans and are more generic in appearance. Other design heuristics for future MRP systems may include avoiding unique markers, actively discouraging decoration of the system by locals, or creating more mechanical physical interfaces; however, these approaches would require further study before implementation to ensure full understanding of their impact.

Organizational Implications

For businesses that use these systems, the importance of verbally framing the remote member as part of the team by reminding locals about the need to work together should not be underestimated. Managers of geographically distributed teams would benefit from communicating to the teams that their job performance will be judged in terms of team performance rather than being based solely on individual contributions.

Research Implications

For research in the field of embodied–mediated communication, our study has highlighted one of the critical key differences between other technological solutions and MRP systems. We have illustrated the importance of considering how the physical presence of MRP systems may significantly affect collaborative outcomes, ultimately leading to the success or failure of such systems in the future. We have also demonstrated that cultivating in-group identification can be a powerful tool for building successful teams across distances. Because of the unique dynamics between local users, remote users, and the MRP system itself, a great deal of further research is required to understand where the boundaries of the relationship between communicative actors lie. We outline a number of these new research questions in the following section.

FUTURE WORK

The nascency of work in the field of embodied–mediated communication and MRP systems offers potential for further research on the topic and deeper investigations into the interaction between the remote pilot, the local user, and the local system. The use of a more realistic task, longer exposure to the pilot, or repeated exposure to the pilot to simulate a real-world work environment may illuminate further differences or uncover changes in behavior toward the pilot or MRP system over time. Our findings may also affect the usage of MRP systems outside of business environments, such as in remote education or medical settings. Understanding the role of verbal framing may contribute to increased motivation and rapport in such settings, leading to better learning outcomes or increased follow-up by patients in treatment plans.

Further studies into how perceptions of the pilot or of the MRP system may be affected by the number of locals present during the interaction, the number of MRP systems in use, or the number of different pilots that share a system would provide a better understanding of the local user's view. From the pilot user's perspective, opportunities for future research include improving MRP system user interfaces, investigating how the perception of the locals by the pilot might change interaction dynamics, and exploring what the impact might be if the pilot personalizes the MRP system instead of the locals.

Future work must also strive to untangle how the physicality of the MRP system changes the local-system and local-pilot dynamic. For example, would visual framing without self-extension have facilitated more trust and cooperation on the local's side toward the pilot? Would visual framing of the system as more human-like or machine-like have created a different relationship between the local and the system, thus affecting the local's perception and attitude toward the pilot? From the pilot's perspective, the MRP system interface is similar to that of a videoconferencing system. How would the dynamic change if both parties were aware of the physical presence of the system? How do other physical characteristics of the MRP system such as height, speed, volume, width, and proportion change behavior toward the system and affect collaborative outcomes? These and many other questions remain to be resolved in future studies and have the potential to not only affect remote collaborators but also to provide mobility challenged individuals with a way to establish spontaneous communication while giving them control over the way that they are perceived.

LIMITATIONS

The relationship between the local user and the remote user and the relationship between the local user and the local MRP system has proven to be complex, imposing limitations on the depth at which these relationships could be examined in our study. We chose to use a confederate pilot to limit the amount of noise in our data that would have been caused by using two naïve participants. However, future work could explore truly dyadic interactions without the use of a confederate.

In the field, we observed that locals decorated the MRP systems with company-specific items (e.g., stickers, hats, expressions of inside jokes), but the current study used a fabricated identity of "the blue team." While limiting participants to pre-supplied decorations was necessary for the purposes of this study, allowing locals to decorate the MRP system with items that have more personal significance might generate a more externally valid understanding of the effects of visual framing through self-extension.

In light of our findings, we have learned that measuring the participant's sense of self-extension toward the MRP system *before* the pilot logged in would have allowed us to better detect whether or not the decoration of the system was the root cause of the negative bias that the locals expressed. In addition, the tasks used for detecting objective differences in team decision-making performance may not have been sensitive enough or of the correct design to successfully measure the manipulation effects.

Other possible limitations include imperfect capture of some of the disclosure tasks due to hardware errors (e.g., pauses in network connectivity), lack of rigorous qualitative analysis, and the difficulty in creating a convincing remote environment for the pilot to be situated in. Field observations suggest that some differences in behavior might occur if the local believes that the pilot is logged into the MRP system from a physically accessible location. A small number of participants voiced suspicions at some point in the interaction that the pilot may have been on-site and had to be reassured otherwise.

CONCLUSION

Research toward facilitating geographically distributed work teams is constantly evolving. One of the newest approaches to supporting distributed work is the mobile remote presence (MRP) system. As an emerging technology, these systems offer new opportunities for improving social and task outcomes in collaborative work. In this paper, we explored how the physical presence of the system affected group identity and collaborative outcomes using two different approaches: visual framing of the system using the placement of decorations on the system to create a sense of self-extension and verbal framing of the pilot with particular emphasis on the interdependence of evaluation. We found that verbal framing was successful in producing more in-group oriented behaviors such as willingness to work together and identification with the pilot and, contrary to our predictions, visual framing of the MRP system had a negative impact on levels of cooperation and feelings of team connectivity. By showcasing the effect that two different approaches have on group cohesion and collaborative task outcomes, we hope to inform designers of future MRP systems, to inspire others to explore research in this growing area of embodied-mediated communication, and to contribute to the direction of its future research.

ACKNOWLEDGMENTS

We would like to thank Bianca Soto for her help in conducting these studies. This research was supported by National Science Foundation award 1117652.

REFERENCES

1. Anybots, Inc. Qb. http://www.anybots.com, 2011.
2. Bailenson, J., Beall, A., Loomis, J., Blascovich, J., and Turk, M. Transformed social interaction: Decoupling representation from behavior and form in collaborative virtual environments. *Presence: Teleoperators & Virtual Environments 13*, 4 (2004), 428–441.
3. Beer, J. M., and Takayama, L. Mobile remote presence systems for older adults: Acceptance, benefits, and concerns. In *Proc HRI '11* (2011).
4. Blauner, R. *Alienation and freedom: The factory worker and his industry*. Chicago U. Press, 1964.
5. Blom, J., and Monk, A. Theory of personalization of appearance: why users personalize their pcs and mobile phones. *Human-Computer Interaction 18*, 3 (2003), 193–228.
6. Collins, N., and Miller, L. Self-disclosure and liking: A meta-analytic review. *Psychological Bulletin 116*, 3 (1994), 457.
7. Cortes, B., Demoulin, S., Rodriguez, R., Rodriguez, A., and Leyens, J. Infrahumanization or familiarity? attribution of uniquely human emotions to the self, the ingroup, and the outgroup. *Personality and Social Psychology Bulletin 31*, 2 (2005), 243.

8. Demoulin, S., Cortes, B., Viki, T., Rodriguez, A., Rodriguez, R., Paladino, M., and Leyens, J. The role of in-group identification in infra-humanization. *International Journal of Psychology 44*, 1 (2009), 4–11.
9. Fels, D. I., Waalen, J. K., Zhai, S., and Weiss, P. Telepresence under exceptional circumstances: Enriching the connection to school for sick children. In *Proc Interact '01* (2001), 617–624.
10. Giraff Technologies AB. Giraff. http://www.giraff.org/, 2010.
11. Groom, V., Takayama, L., Ochi, P., and Nass, C. I am my robot: The impact of robot-building and robot form on operators. In *Proc HRI '09* (2009), 31–36.
12. Jouppi, N. P., Iyer, S., Thomas, S., and Slayden, A. Bireality: Mutually-immersive telepresence. In *Proc ACM Multimedia '04* (2004), 860–867.
13. Kiesler, T., and Kiesler, S. My pet rock and me: An experimental exploration of the self extension concept. *Human-Computer Interaction Institute* (2004), 85.
14. Lafferty, J., Eady, P., and Elmers, J. The desert survival problem. *Experimental Learning Methods* (1974).
15. Lee, M., and Takayama, L. Now, I have a body: Uses and social norms for mobile remote presence in the workplace. In *Proc CHI '11* (2011), 33–42.
16. Luff, P., Yamashita, N., Kuzuoka, H., and Heath, C. Hands on Hitchcock: Embodied reference to a moving scene. In *Proc HCI '11*, ACM (2011), 43–52.
17. Michaud, F., Boissy, P., Labonte, D., Corriveau, H., Grant, A., Lauria, M., Cloutier, R., Route, M., Iannuzzi, D., and Royer, M. Telepresence robot for home care assistance. In *Proc AAAI Spring Symposia '07* (2007).
18. Moon, Y. Intimate exchanges: Using computers to elicit self-disclosure from consumers. *Journal of Consumer Research* (2000), 323–339.
19. Mugge, R., Schifferstein, H., and Schoormans, J. Personalizing product appearance: the effect on product attachment. In *Proc Design & Emotion* (2004).
20. Mutlu, B., Forlizzi, J., and Hodgins, J. A storytelling robot: Modeling and evaluation of human-like gaze behavior. In *Proc HUMANOIDS '06* (2006), 518–523.
21. Nakanishi, H., Kato, K., and Ishiguro, H. Zoom cameras and movable displays enhance social telepresence. In *Proc CHI '11*, ACM (2011), 63–72.
22. Nass, C., Fogg, B., and Moon, Y. Can computers be teammates? *International Journal of Human Computer Studies 45*, 6 (1996), 669–678.
23. Nguyen, D., and Canny, J. Multiview: Improving trust in group video conferencing through spatial faithfulness. In *Proc CHI '07*, ACM (2007), 1465–1474.
24. Olson, G., and Olson, J. Distance matters. *Human-computer interaction 15*, 2 (2000), 139–178.
25. Orcutt, J., and Anderson, R. Social interaction, dehumanization and the "computerized other". *Sociology & Social Research* (1977).
26. Paulos, E., and Canny, J. Delivering real world reality to the world wide web via telerobotics. In *Proc ICRA '96* (1996), 1694–1699.
27. RoboDynamics. Luna. http://robodynamics.com/, 2011.
28. Sears, D. The person-positivity bias. *Journal of Personality and Social Psychology 44*, 2 (1983), 233.
29. Smith, G. A boy and hit bot. *Sports Illustrated* (2011).
30. Suitable Technologies. Texai. https://www.suitabletech.com/, 2012.
31. Sung, J., Grinter, R., and Christensen, H. Pimp my roomba: Designing for personalization. In *Proc CHI '09*, ACM (2009), 193–196.
32. Taylor, D., and Altman, I. Intimacy-scaled stimuli for use in studies of interpersonal relations. *Psychological Reports* (1966).
33. Tsai, T.-C., Hsu, Y.-L., Ma, A.-I., King, T., and Wu, C.-H. Developing a telepresence robot for interpersonal communication with the elderly in a home environment. In *Telemedicine and e-Health*, vol. 13 (2007), 407–424.
34. Tsui, K. M., Desai, M., Yanco, H. A., and Uhlik, C. Exploring use cases for telepresence robots. In *Proc HRI '11* (2011), 11–18.
35. Tversky, A., and Kahneman, D. The framing of decisions and the psychology of choice. In *Science*, vol. 211 (1981), 453–458.
36. Vaes, J., Paladino, M., Castelli, L., Leyens, J., and Giovanazzi, A. On the behavioral consequences of infrahumanization: The implicit role of uniquely human emotions in intergroup relations. *Journal of Personality and Social Psychology 85*, 6 (2003), 1016.
37. VGo Communications, Inc. Vgo. http://www.vgocom.com/.
38. Viki, G., Winchester, L., Titshall, L., Chisango, T., Pina, A., and Russell, R. Beyond secondary emotions: The infrahumanization of outgroups using human-related and animal-related words. *Social Cognition 24*, 6 (2006), 753–775.
39. Wheeless, L. A follow-up study of the relationships among trust, disclosure, and interpersonal solidarity. *Human Communication Research 4*, 2 (1978), 143–157.
40. Whittaker, S. Theories and methods in mediated communication. *The handbook of discourse processes* (2003), 243–286.
41. Yamaoka, F., Kanda, T., Ishiguro, H., and Hagita, N. Interacting with a human or a humanoid robot? In *Proc IROS '07* (2007), 2685–2691.

APPENDIX I: DISCLOSURE INTERVIEW QUESTIONS

The questions used in the disclosure interview are listed below.

Participant Questions to Confederate:

1 How are you?
3 How old are you?
5 Do you have any siblings?
7 What's your favorite book and why?
9 What's your favorite type of food?
11 What's something that you want to accomplish before dying?
13 What's the craziest thing that you've ever done?
15 What's the worst thing that you've ever said to a friend?
17 What's a question that you wouldn't want to have to answer because it would be too embarrassing or personal?

Confederate Questions to Participant:

2 How are you?
4 Where are you from?
6 Do you have any pets?
8 What's your favorite movie and why?
10 What are your favorite things to do in your free time?
12 What are some of the things that make you angry?
14 What's your most negative childhood memory?
16 What is the meanest thing you've ever said to your parents?
18 What's a question that you wouldn't want to have to answer because it would be too embarrassing or personal?

APPENDIX II: DESERT SURVIVAL RANKING ALGORITHM

The confederate used the ranking algorithm below in the Desert Survival Task.

Participant Rank: 1, 2, 3, 4, 5, 6, 7, 8, 9
Confederate Rank: 5, 6, 1, 2, 3, 8, 4, 9, 7