Using Virtual Interactions to Explore Leadership and Collaboration in Globally Distributed Teams

Sheena Lewis[†], Jason B. Ellis[*], Wendy A. Kellogg[*]

[†]Northwestern University
2133 Sheridan Road
Evanston, IL 60208 USA
sheena@u.northwestern.edu

[*]IBM T.J. Watson Research Center
P.O. Box 704
Yorktown Heights, NY 10598 USA
{jasone, wkellogg}@us.ibm.com

ABSTRACT

Despite advances in collaboration software, globally distributed teams face significant challenges, including variations in communication style, work behaviors, expectations and establishing common ground. Virtual worlds allow distributed team members to inhabit a shared space and to engage in cooperative activities. We report an exploratory study where newly formed cross-national teams engage in a cooperative game in which one team member has a leadership role. We describe behaviors observed supplemented by survey and interview data in terms of leadership, conflict management, social gaffes, and awareness of diversity. We suggest that cooperative activities under time pressure in a "low stakes" virtual environment may stimulate discussion that can foster greater understanding and effective interaction in real world collaborations.

Author Keywords

Collaboration, virtual worlds, serious games, virtual teams, globally distributed teams, teamwork, leadership

ACM Classification Keywords

H.5 [**Information Interfaces and Presentation**]: H.5.1. Multimedia Information Systems – *artificial, augmented, and virtual realities;* H.5.3 Group and Organizational Interfaces – *collaborative computing, computer-supported cooperative work, synchronous interaction.*

General Terms

Human Factors

INTRODUCTION

The pervasiveness of globalization has become a driving factor in the increase of globally distributed teams. Though there are numerous benefits to globally distributed teams, there are also challenges such as a establishing common ground, organizing work, and overcoming cultural differences [9, 25]. Though many have designed technology to address such challenges, they are still evident [25].

ICIC'10, August 19–20, 2010, Copenhagen, Denmark.

Researchers have examined audio, video, and text-based technologies to explore interactions amongst distributed teams [4, 15, 17]. Though these technologies have features important for remote collaboration that mimic face-to-face interactions, much is still missing [22]. While previous research has emphasized the differences between computer-mediated communication (CMC) and face to face interaction [10, 28], it is important to consider how we can utilize features of other CMC technologies to address these differences and further the understanding of challenges faced by globally distributed teams.

Cooperative virtual world games have potential for team-building among distributed co-workers [13]. Many social affordances of virtual worlds – factors such as embodiment, the sense of co-presence in a physical-like environment, and the ability to support rich behavioral interactions – could be useful in addressing virtual team challenges. For example, the embodiment of people as avatars, which includes personal attributes (e.g., gender, ethnicity, body shape, hair, clothes) may create opportunities for the establishment of common ground and trust [9].

In this paper, we examine how newly formed cross-national teams collaborate in a virtual environment. Specifically, we asked teams to engage in a timed cooperative game. We describe issues surrounding leadership, conflict management, social gaffes, and awareness of diversity that emerged during play. We found that differences in providing leadership were related to the amount of real-world leadership experience a participant had, while acting under leadership seemed to be influenced by nationality. Participants managed and resolved conflicts in a variety of ways ranging from direct confrontation to ignoring the conflict or trying to mitigate it. Teams that experienced what we have termed 'social gaffes' during their sessions reported higher levels of team connectedness. Lastly, Chinese participants were more cognizant of their teammates' nationalities compared to Americans. We present these findings and implications for future work.

RELATED WORK

Challenges to Globally Distributed Teams

Virtual teams rely on computer-mediated communication (CMC) such as email and instant messaging as a primary

means of communication. Early research focused on differences between face-to-face and virtual interactions, documenting difficulties for teams that communicate almost exclusively via CMC. For example, distributed teams communicate less effectively than face-to-face teams, even when they communicate more frequently [16]. The greater number of messages sent by virtual team members can lead to confusion and poorer understanding [3]. Conversations in virtual teams have been shown to be more task-focused, to the exclusion of social interaction, particularly at the beginning of team interactions [30]. An extreme task focus is associated with less effective communication, and reflects weaker relational links between team members [7]. Lack of social communication in distributed teams is associated with lower trust and cohesion [7, 30].

Role of Leadership

Research has considered the role that leadership plays in the success of virtual teams [2]. Some research underscores the importance of leader behavior, which can heavily influence communication and trust [21]. Specifically, leadership has been shown to directly affect team dynamics, work standards, and communication protocols. Weisband [31] found that distributed teams performed better when leaders created pressure and awareness of others' contributions.

Traditionally, leadership has been measured in terms of personality traits (e.g., within psychology and organizational management). In contrast to this view, Avolio and Bass [1] discuss "full-range" leadership, which goes beyond leadership as a set of inherent traits in leaders but also of followers. Zigurs [32] argues that since virtual teams have different needs than collocated teams, leadership must differ accordingly. Her eight recommendations for leadership in virtual teams range from starting with team-building exercises to providing training to virtual team members.

Culture and Computer-Mediated Communication

Fussell and colleagues have carried out an extensive set of studies of computer-mediated communication (CMC) with multinational collaborators [12, 26]. Setlock, Fussell, and Neuwirth showed that compared to American dyads, Chinese dyads worked harder to create a "deeper cognitive agreement" on a task that required reaching consensus [27]. Chinese team members also made more queries as to their partner's thoughts in ways that suggested they were trying to get to a mutually satisfactory solution and perhaps avoid overt disagreement.

Diamant, Fussell, and Lo compared American, Chinese, and mixed dyads on a map navigation task carried out through instant messaging, audio, or video [11]. They found that while American participants were more inclined overall to make dispositional attributions about their partners (accounting for outcomes in terms of their partners' personal characteristics or moods) and Chinese were more likely to make situational attributions (view performance as resulting from task characteristics or technical difficulties), these tendencies varied with the communication medium. One provocative finding was their identification of a 'collaboration factor,' representing skills that people could be trained to develop, as distinct from dispositional factors (e.g., personality) that may be difficult to alter.

Taken together, the research suggests that distributed teams face specific issues in communication and work practices that arise from individual behavioral differences. Additionally, a team leader's behavior may significantly impact a team's success. The technologies used by the team to communicate may affect not only team performance, but also how team members view each other and how easily they come to know each other. The following section describes our study.

STUDY OBJECTIVE

Virtual team challenges can be viewed as a set of critical tasks that must be negotiated throughout the team's life. Establishing common ground, evolving a viable set of communication and work practices, creating shared expectations about leadership and worker roles and responsibilities, and building team skill at recognizing and repairing breakdowns in communication all impact the team's chances for success. A prerequisite for establishing effective practices is for team members to be aware of issues and come to some agreed-upon understanding of how best to handle them. Our thesis is that exposing a newly formed team to a time-pressured cooperative task in a "low stakes" environment where communication and leadership challenges surface will provide common ground and an informative experience for team reflection and discussion. The results of such discussion may better prepare the team to navigate similar issues in their real work. In this study, our objective is to address the first part of the thesis; specifically, we examine the types of interactions that occur during cross-national collaboration in a virtual world.

STUDY DESIGN

We carried out an exploratory qualitative study examining the interaction of newly formed distributed teams in a virtual world (Second Life®). We designed and built a specialized environment for the study, recruited participants from a large, multinational organization, and employed a three-phase protocol for engaging participants in a virtual activity involving collaboration and leadership.

Environment

We modified a puzzle game developed in Second Life® called Crossing the Ravine [13]. In the original game, a team setting out to explore a world encounters an impassable ravine. Each team member has an object that, when connected properly with the others, forms a bridge to the other side. The team must work together to place the pieces appropriately and cross the ravine.

The ravine is represented as a puzzle board sunk into the ground (Figure 1). There are five colored seats. For each seat, there is a puzzle piece of a matching color. When a

player sits in a seat, they are able to control the correspondingly colored piece by using their avatar movement keys (moving left, right, forward, back, up, down, and rotating about the z-axis). Team members communicate to discuss possible solutions to the puzzle and negotiate movement of

Figure 1. Crossing the Ravine with five players.

the pieces. The puzzle is complete once all team members have placed their pieces in the correct place in the puzzle. There are currently six puzzles, one of which is a tutorial.

Though the original game addressed collaboration issues for teams [13], it did not reflect the dynamics of teams where there is a team leader or visionary. For this study, we modified the game to afford two different roles: worker and leader. The rules for workers are the same as those for players in the original game with one key difference: they must take direction from the leader. Leaders sit on a chair that is higher up than workers (Figure 2) and, while they do not have any direct control over the game play, workers are instructed to listen to and consider the direction the leader provides as they move their pieces.

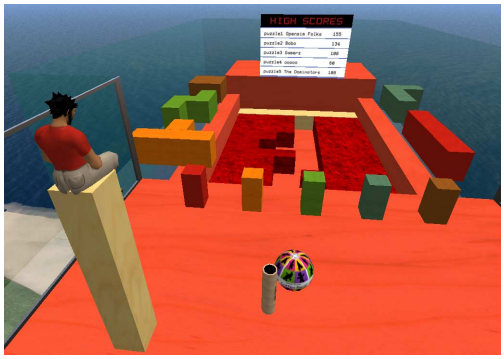

Figure 2. Crossing the Ravine with leader chair.

Because leaders do not have a puzzle-piece manipulation role and (literally) sit above the action, they are potentially able to take a higher-level view of the puzzle and consider alternate solutions. Since workers are immersed in the mechanics of moving pieces and avoiding collisions, they may not have as much capacity to strategize. In this way, we aimed to mirror (in some small way) real-world teams and the distinction between leadership and implementation.

Participants and Teams

36 participants were recruited from a large, multinational company (to which we will refer as GLC for "global corporation"). To reflect the makeup of a global company, we recruited multinational participants. Of the 36 participants, 20 were US citizens living in America and 16 were Chinese citizens living in China. Ages ranged from 21-50 years and experience at GLC ranged from a month to over 20 years. 21 males and 15 females participated. Job titles included software engineer, sales associate, administrative assistant, researcher, and manager. 67% of the participants had prior experience working on globally distributed teams. 32 (of the 36) participants did not have previous experience in Second Life®. All were recruited through email solicitations to take part in a "training session" about virtual worlds. All were fluent in English; all communication and materials were in English.

Participants were assigned to a virtual team depending on their availability for sessions and subject to the constraint of creating multinational teams. This resulted in 12 teams that ranged in size from two to five members (median team size was three; one team had two members). All teams had at least one Chinese and one American member; 42% had either an equal number of Chinese and Americans or one more Chinese than American, while 58% had one more American than Chinese. Team members did not know each other prior to the study, nor did they know the real-life identities of their teammates. Nationality was generally not discernible from a team member's avatar (see Figure 3).

Figure 3. Team avatars (left to right) American male, Chinese female, and American male.

Session Structure

Prior to their session, participants were given instructions and asked to create an avatar and account in Second Life.® Sessions took approximately 1.5 hours and had at least one author present. Throughout the study, participants communicated using in-world text chat only, which was logged. Sessions were organized as follows:

1. Tutorial. Participants were first given a tutorial on the basics of interacting in Second Life® including avatar movement and chat.

2. Game Play. Participants played at least three rounds of the modified Crossing the Ravine game. The first puzzle was for practice and allowed each player to become familiar with moving the puzzle pieces. Each team then played a second and third round with either a Chinese or American player designated as the leader. Leaders, who were randomly selected and alternated nationalities, were charged with helping their team solve the puzzle as quickly as possible; team members were asked to take direction from leaders. In the case of technical failures or other anomalies, teams were asked to play an additional game if time allowed.
3. Debrief. Following the games, participants completed a survey with questions regarding demographic information, previous experience, attitude towards working on global teams, playing the games, and their teammates. Finally, within 24 hours each participant was debriefed and interviewed privately via instant messaging about their experience, team members and team performance.

Data Collection and Analysis

Each session generated the following data: a chat transcript of the team interactions; the puzzles completed and their completion times; survey results for each team member; and transcripts of each post-session interview. In addition, observation notes were kept for each session focusing on noteworthy or unusual interactions that occurred. Over the twelve team sessions, a total of 27 games were started. 9 games were dropped from the dataset: 4 due to network problems or the game malfunctioning; 2 because the player requested to lead refused (discussed in the Leadership section); and 3 because the puzzle was solved by a single player rather than the team. This resulted in a core dataset of 18 completed games with a functioning leader and collaborative game play. There were 10 American and 8 Chinese game leaders; 9 of the leaders were female. Five of the American and three of the Chinese game leaders had real world leadership experience within or outside of GLC.

Survey results and completion times were analyzed quantitatively. Session transcripts, notes, and debrief interviews were analyzed using a thematic approach, where the data was first coded for emerging phenomena [29]. Based on this preliminary analysis, we undertook more detailed analyses of leader and worker verbal behavior from the session transcripts, looking at the amount of words spoken by leaders and workers and the types of utterances. In addition, we identified behavior, events, and attitudes relating to leadership and collaboration issues. We then iteratively coded and refined the initial codes into higher-level groups and categories, which eventually lead to the finalized themes discussed in the Results section.

The next section presents quotes from the chat transcripts as illustrations of the themes that repeatedly emerged from the data. The quotes are literal, with spelling, punctuation, and capitalization unaltered, unless otherwise noted. Lines of chat posted separately are segmented by "|" dividers.

RESULTS

An ANOVA with team (1-12), puzzle (1-5), nationality of game leader (American, Chinese) and gender of game leader (Male, Female) was run on completion times for the 18 completed games. Only the effect of game leader nationality was significant $F(1,17)=6.92$, $p=.019$, with games led by Americans taking longer to complete (945.8 seconds) than those led by Chinese (611.87 seconds). There were no interactions.

Next, we discuss the themes that emerged from our qualitative analysis.

Leadership

Different expectations about leadership have been shown to adversely affect a team's ability to collaborate [24]. We observed differences in how leaders engaged in guidance and instruction-giving to the team and in how workers responded to an active leader or the absence of leadership. Our analysis of leaders' verbal behavior suggests that previous leadership experience played a role in how they gave direction. Our analysis of workers' behavior in the games indicated differences in attitudes towards accepting leadership.

Providing Leadership

One theme that emerged was leaders' behavior in the game – for example, how active they were in providing direction to the team, what tactics or styles they employed to gain cooperation from the team. The statements made by leaders during the game provided detailed insight into this topic [8]. We coded each game transcript for total number of leader posts and type of post, which we categorized into "instructions," "praise," and "other."

Leaders issued 413 posts overall; with a mean of 22.9 posts per game (which took an average of 17 minutes to play). When we coded for type of post, we found that instructions accounted for 52%, praise for 13%, and other kinds of posts (e.g., question responses, greetings, words of encouragement or non-task related conversation) for 35% of the posts.

In order to understand how game leaders provided leadership, we observed how instructions were given to workers. Two main styles emerged during the analysis, imperative and polite statements. Examples of imperative instructions include command-like utterances (e.g., *"move green | down*"). Brown & Levinson [5] introduced politeness theory, which is a speaker's intent to mitigate threatening situations via language usage. In this context, examples of polite instructions included statements such as "*can we rotate the L around and move the T to the other side?*" and the use of phrases such as *"I think"* or *"Let's try."*.

Overall, 59% of the game instructions issued by leaders were imperative, 41% were polite. The percentage of imperative-style instructions made by American (58%) vs. Chinese (61%) leaders suggests that nationality was not a driving factor of this aspect of leadership style.

Real world leadership experience, on the other hand, did seem to influence the style of instruction giving. 32% of total statements made by game leaders without real life leadership experience were imperative utterances as compared to 24% by game leaders with real life leadership experience. An example of this type of leadership style is:

"Go for the left part of the puzzle | with the brown piece | top left | all the way left" [Non-leadership experienced American female]

In contrast, approximately 81% of the polite utterances were from leaders with real world leadership experience. These leaders, both Chinese and American, exhibited a more "gentle" or "open" style, that seemed to allow for or even encourage teammates to share their opinions while making it clear that they were leading:

- "*Team, let's start from the brown one…anyone could sit on green? | good, thanks | now, we tried to put brown one right this time | seems top-right corner is also not correct for the brown one? then let's try to put it on the bottom left | [Name], could you please move the brown one to bottom left corner"* [Leadership experienced Chinese female leader]
- *"So I think the long red strip goes on the top far right | i think we have to move the red strip...maybe the L and the T | I was thinking the yellow needs to be on the other side of the obstacle | let's try the green on the top of the obstacle"* [Leadership experienced American male leader]
- *"It looks like the brown square goes in that corner to the right where the green piece was | No problem | I think the red piece is next | Do you want to take the yellow, [Name]?"* [Leadership experienced American female leader]

Moreover, these game leaders were also more likely to exhibit "contingent reward" verbal behavior [14] such as providing praise to the team for small accomplishments (e.g., placing a puzzle piece in the correct spot) as well as larger accomplishments (e.g., completing the puzzle). Although statements of praise were relatively infrequent in our dataset (13% of total utterances), 61% of the praise utterances were from leaders with real world leadership experience. This suggests that leadership experience affects a leader's style and verbal behavior.

The effect of gender on instructions was less clear as it was confounded with leadership experience. Although men generated 63% of the imperative statements, they also had less leadership experience (only 3 of 9 male game leaders reported such experience). On the other hand, 5 of the 9 female game leaders had real world leadership experience.

It is also unclear if organizational culture had an effect on leadership style, as the more experienced leaders also had spent more time in the organization. Leaders without experience had an average of 2.22 years with the company; leaders with experience had an average of 6.51 years. We identified and removed one outlier among the leaders with experience (a person with 20 years of experience, 13 years more than the next most experienced leader). When excluding this data, leaders with experience still had more time with the organization, averaging 4.82 years with the company. Thus, it remains unclear whether organizational culture influenced leadership style.

Acting under Leadership

A second theme that emerged from the data was how workers responded to leaders' instructions or to a void of leadership (e.g., if the leader was not very active or directive). Our analysis of the workers' corpus of utterances produced four categories: Responses to Instructions (38%), General Inquiries (21%), Instructions (12%), and Other (29%). The Responses to Instructions category consisted of replies workers gave to instructions given by leaders before, during, or after completing a requested action. Most of the responses came before completing an action, confirming that the worker understood the instruction (*"ok sounds good"*). However, there were also occasions where participants disagreed with the leader's instruction and denied their request (*"hmm | i think the key is finding how to place the green without creating dead space | do you see what I mean"*). [We discuss this further in the Conflict Management section.] Additionally, Responses to Instructions included clarification questions (*"you mean put it down | ?"*).

Responses to Instructions were also counted when the worker was attempting to satisfy the leader's request (*"i am moving the red one now").* After completing a request, workers typically indicated that they had completed the request by 1) stating the completion of the task (*"i moved the yellow one"*) or 2) by asking the leader if it was done properly (*"like that? | or centered?"*).

Another way that workers responded to instructions was by using their actions as a form of communication. For instance, during one session, the leader said, *"slide red all the way over to the right."* Instead of the worker answering, he began to perform the task. The leader acknowledged task completion by responding with *"perfect."*

We counted as General Inquiries instances where workers asked their teammates questions about the tasks (*"ok what are we supposed to be doing?"*) or basic game interactions (*"how do we rotate these things?"*). We defined Instructions as those in which workers issued instructions to their fellow workers (*"[name] can you sit on brown"*). Finally, the Other category consisted of greetings, non-task related discussion, etc.

27% of the workers' total utterances seemed to imply that the workers intended to follow the leader's direction and they often solicited the leader's guidance before acting. These utterances demonstrate that the leader's guidance was desired and being heeded:

- *"can I move the other one?"* [Leadership experienced Chinese male]

- *"is that okay?"* [Non-leadership experienced American female]

Other workers, whether they eventually followed the leader's guidance or not, would question the instruction:

- *"i have an idea"* said a Leadership experienced American male who was not the leader. Instead of sharing his idea, he began moving the puzzle pieces to show it.

In addition to questioning leadership, and particularly in the absence of active leadership, some workers were inclined to complete the task without input from the leader or their teammates:

- *"who needs a leader!?!"* stated an Non-leadership experienced American male who completed the entire puzzle without the help of the team leader.

While confrontational responses to leader guidance were relatively rare, of the 11% of responses that did challenge leaders' instructions, less than a quarter originated from Chinese participants.

In addition to verbal dissent, we observed three occasions in which individuals (all American) worked to complete the task without the help of the team.

- In one game, two workers continued to play when their teammate did not take up the leadership role as requested by the experimenter. During the interview, they explained their actions: "*it was simplier to move on with task than communicate as team"* and *"[Name] was kinda trying to solve it himself some of the time | with lack of leadership people do there own thing."*
- In another game, a Leadership experienced Chinese male leader began to have network problems and became unavailable for a short period of time. One of the American workers immediately took charge and began giving orders to the remaining team members. *"[Name], can you rotate the yellow piece and see if we can get the green piece in?"* After the puzzle was completed without input from the leader, the worker stated, *"maybe less people makes things more efficient | I would give you a high five but no clue how to do that"* The other worker [also American] responded: *"thank you | I was thinking the same thing."*

These examples were striking in terms of the task achievement focus and assertiveness workers displayed, even when there seemed to be social impacts on teammates, the leader, or team relationships. In the first example the workers faced an awkward situation (a teammate failed to take the leader role), and they offered justification for their actions. In the second case, it is clear that the workers prided themselves on getting the task done despite the loss of their leader.

The post-study debrief lent some support to the existence of cultural differences in attitudes towards leadership. About half of the Chinese participants (9 of 16) emphasized the importance of the game's leadership role in their view:

- *"I think the leadership role is very essential and necessary. It will mess if without leader, especially for this puzzle game. Leader should be calm and can give clear command to other member."* [Non-leadership experienced Chinese male]
- *"I think the role is the brain of the team. I prefer havieng the leader, it is important."* [Leadership experienced Chinese female]

Similarly, 60% of the American participants (12 of 20) expressed a different view of the role of leaders in the games:

- "*I think it would have been more useful to get everyone involved and providing input | rather than one person telling everyone what to do.*" [Leadership experienced American male]
- "*One game, my partner and I finished the puzzle correctly without much input from the leader, due to her delay in sending commands. We used our knowledge of putting puzzles together (and got lucky I guess).*" [Non-leadership experienced American female]

In summary, our findings suggest there may be national or cultural differences in attitudes towards leadership and accepting leadership; however, leadership experience, as opposed to nationality, seem to be associated with differences in how leadership is provided.

Conflict Management

Research has identified individual differences in how conflict is managed in a variety of situations [18, 23], from expressing dissent, to making difficult requests, to how critical feedback is given, for example by managers to employees [6]. We had a chance to observe how conflict was handled in interactions among teammates and occasionally in interactions between the experimenter and participants – specifically when the experimenter asked a participant to be the game leader. Drawing on session transcripts and experimenter notes, this section focuses on conflicts that arose during the games and how team members approached them. We describe three strategies that we observed – ignore, mitigate, and react directly, and give examples of each.

Team members who employed *ignore* as a strategy chose to disregard or refrain from commenting on situations where the desires of others clearly differed from their own. One example occurred when the experimenter asked a player to lead a game but the player did not want to take the leadership role. Rather than respond to the request, the participant failed to even acknowledge it – instead moving away to sit on one of the puzzle pieces while the game was carried out by his teammates. Eventually one of his teammates confronted him about his lack of responsiveness, "*[name] you need to be on one off the tall posts be hind us | thats not the right spot [name]*". The participant responded *":-)."* When debriefed about the incident, he said, *"I think I would like to be a member to move those objects."* But rather than overtly disagree with the experimenter or his teammate, the participant chose to ignore the conflict and sit the game out.

In another case, two teammates attempted to move the same puzzle piece. They sat on the same colored piece (literally sitting on top of each other). One expressed her dissatisfaction with the situation: *"a little crowded here."* Another team member intervened, saying: *"no need for both of you to sit on the same block :-)."* He then suggested that one of the team members move a different puzzle piece, *"[name]....place the red rectangle."* [Name] responded *"ok"* and stood up to move the red piece. In this example, a team member outside of the conflict attempted to mitigate it by making a suggestion to one of the key participants. The participant complied with the suggestion and the game continued without further conflict. We saw several instances of teammates attempting to mitigate conflict during the games.

Finally, two players reacted directly to conflicts such as not wanting to take the leadership role when asked. These participants refused the request by telling the experimenter they did not want to be the leader, or by offering an alternative to the experimenter that was more to their liking. For example, one player who did not want to be the leader quickly responded, *"I nominate [name] to be the leader."*

Social Gaffes

Almost all (approximately 89%) of the participants were new to virtual worlds and Second Life®, and inevitably mishaps occurred, particularly during the introductory tutorial. In fact, out of twelve sessions, six encompassed such an incident. The nature of these mishaps often had to do with avatar appearance or movement, aspects of virtual embodiment that all new users must come to terms with. We observed a range of reactions to these incidents, varying from amusement to indifference to apparent dismay.

For example, in one case a participant clicked on a "dance ball" that was nearby on the game platform, making his avatar dance while the experimenter was trying to give instructions to the team. Not knowing how to make it stop (by clicking again), the disruption gained the attention of other team members. Despite the fact that the teammates seemed to find his predicament amusing, good-naturedly commenting on his ability to "dance so well," the participant was extremely apologetic.

In another case, a male participant was forced to log in with a female avatar. Without preamble he explained to his teammates: *"First, I borrow this avatar because my own avatar was blocked | I'm a gentleman, not a lady | I will try to resume my original account when I have time."* While the participant seemed to take the mismatch seriously and wanted to be clear that he was not female, his teammates made light of this revelation, complimenting him on having such a nice-looking avatar.

Other mishaps did not provoke much reaction or disruption, even ones that in real life would presumably cause embarrassment. In one session, a male participant accidentally removed his pants and was partially naked. His comment was: *"great, just great."* After getting his pants back on, he made a joke about it and the training session continued.

In another case, a female participant accidentally removed her hair, becoming bald. She displayed humor about the situation, "*my hair left | lol* [laughing out loud]*."* One teammate also expressed humor about the situation, *"lol"*, whereas a second commented *"my god…"*

What do these varied reactions to socially awkward moments mean for the team? Teams reported an average of 3.5 (on a 5-point Likert scale) for their connectedness rating (responses to the statement "How would you describe your connectedness to your Second Life® team members?"). Five of the 6 teams who experienced a social gaffe were equal to or above this average. This suggests that experiencing system "glitches" that provoke social banter may have helped teams build camaraderie and strengthen social bonds.

Awareness of Diversity

As described previously, team members were anonymous in the sense that no one else on the team knew their real name, nationality, gender, or other attributes. Almost all participants created avatars based on default choices that accurately reflected their gender but did not reflect their ethnicity (Figure 3). We asked in the debriefing interview whether the participant thought their team had members from nationalities other than their own and a rather striking difference emerged. 72% of the Chinese participants thought that their team included non-Chinese members. In contrast, only 20% of the Americans said that some of their virtual world teammates were not American.

We wondered whether this result might reflect greater experience or frequency working on globally distributed teams on the part of Chinese participants, but this was not the case: 63% of Chinese participants and 70% of American participants had such experience.

Other possible explanations were discernible in the debriefing comments by Chinese participants. When asked how they were able to recognize that not all teammates were Chinese, teammates' language and behavior were cited as evidence. They noticed the use of colloquial expressions or words and phrases they identified as "native English." They also noticed teammates whose English did not seem to be "native." Others cited behaviors in the games, pointing out that some team members spoke in a very direct manner to their teammates and the experimenter, which led them to believe that they were not Chinese. One Chinese participant said that she thought a team member, who had volunteered to be the leader and debated with the other leader during a game, must be American. Her comment was simply: *"She is very active."*

Other comments from Chinese participants hinted at deeper differences in how problem solving is approached. One said "*the start point of Chinese to think about a question is not so same like American, we always walk around it and not direct to it and think more about the relationship between*

persons | it's a common problem." He went on to say "*I think cultural differences really exist. For example, Chinese people focus on more preciseness, while maybe American focus on more efficiency, just in my opinion.*" These comments are in accord with the findings of Setlock and colleagues that Chinese dyads worked harder to create a deeper cognitive agreement, whereas American dyads focused on getting the task done efficiently [27].

DISCUSSION

Leadership and Collaborative Behaviors Revealed

The interactions observed throughout the leadership games provide evidence that virtual worlds can expose a rich set of leadership and collaboration behaviors to raise awareness and for teams to discuss, including individual differences in leadership and conflict management styles, reactions to awkward situations, both social and task-related, and differences in awareness of the diversity of team member backgrounds. Classic virtual team issues, such as the tension between task performance and relationship building, can be brought to the fore as demonstrated in our time pressure puzzle task. Breakdowns in communication or task performance occur that raise questions about how best to negotiate repair. One participant noted:

> *"In virtual word, you can't judge a keyboard (or lack or response). There were times where I knew how to place the pieces in the game very easily and quickly, but my teammate seemed to be having problems. Since I never knew her personally, I batted within myself, 'do I let her continue to try' (while the clock ticks) or 'do I make some suggestions,' or 'do I tell her to stop and let me do it.' I made suggestions, and finally she gave up, and I finished the task."* [Experienced American male]

There were also differences in how participants provided leadership. Leaders, especially those with the least amount of leadership experience, tended to give the team directions in a more "authoritative" manner that did not afford much room for debate. In contrast, those with the most leadership experience tended to speak to the team in a manner that encouraged members to share their opinions and engage in strategy discussions. Some research has suggested that particular leadership styles are associated with nationality. For example, that Asian cultures tend to employ rigid leadership styles in the sense that leaders rarely expect subordinates to question their authority [19, 20]. Our data, which showed no differences in how leaders gave instructions by nationality, does not support such a conclusion.

We also observed differences in how participants reacted to guidance from leaders. Some followed the leader's instructions without question. During debriefing, participants' comments about leadership were consistent with the idea that attitudes towards leadership differed based on national background. More Chinese participants stated that it was important that the entire team submit to the leader's authority than Americans. In fact, more Americans felt it was critical for team members to voice their concerns to the leader or that the team would be better off without a leader. However, based on the survey data, all participants expressed a preference for collaborative problem solving.

Finally, participants reacted differently when they did not wish to comply with the experimenter's requests. Some were willing to decline requests directly. Others employed strategies of avoiding confrontation by ignoring the experimenter's request, or trying to mitigate the problem by suggesting alternative solutions.

Virtual Worlds and Common Ground

In considering what virtual worlds might have to offer to globally distributed team members with different interaction styles, backgrounds, and levels of experience we are encouraged by the current results. Virtual world interactions are sociable by nature, making them particularly adept at supporting the relationship building demonstrably lacking in many distributed teams, and as evidenced by participants' comments:

> *"I think [virtual worlds] could help because it gets people interacting with each other in a more direct way. They may feel more connected because they can 'see' someone in front of them."* [Leadership experienced American male]

> *"The world gives you a shared artifact with which to interact. That's part of the problem with working with someone remotely – you don't know what they're looking at | they could use the virtual world as a means overcome that 'what are you seeing' hurdle. If they can work on a shared 'thing' in the world like a shared computer screen or document | So it's more like they are sitting next to each other working off the same thing."* [Leadership experienced American female]

Participants also cited the ability for the games to increase not only knowledge of teammates, but social effects, like the desire to not let them down:

- *"I can very much see how SL could be used very effectively to build teams and for training. Teams always gel together better when there is some common goal and you get to now your teammates as people – what's important to them, how they react – so you feel more committed to the success of the project because you don't want to let your teammates down."* [Leadership experienced American female]
- *"theres nothing better that brings 2 (or more) people together from different backgrounds and different ethnic origins than facing a common problem in which we both benefit when solved together…the game was an excellent example of a common problem"* [Non-leadership experienced American male]

Getting to More Effective Globally Distributed Teams

In their seminal paper "Distance Matters," Olson and Olson state: "Possibly the single biggest factor that global teams need to address is cultural differences" [24]. They go on to say:

> "Global companies are being populated by sophisticated internationalists who have taken classes on cultural differences and are more sensitive to differences. But even for such sophisticates their own cultural habits and viewpoints are the natural and automatic ones. It takes effort to maintain culturally neutral behaviors in the midst of intense interactions. Such sophisticates lose track of their culture-spanning turn taking rules in the heat of discussion. Local conventions about work schedules or the importance of non-work time dominate as deadlines approach. Sensitivity to cultural differences will always take more effort, no matter how good the technology." [*ibid*]

These remarks underscore that effective group behaviors must withstand real-world pressures such as deadlines and heated discussions. They also paint a realistic view of the prospects for creating greater sensitivity to differences and enabling teams to establish practices that can overcome diverse interaction styles, backgrounds, and experiences.

In the debriefing interviews, we probed for participants' views of the team exercise and the prospects for virtual worlds as an avenue to greater virtual team effectiveness. Many viewed their Second Life® interactions in a positive light and saw potential in the games, mentioning their low-stakes nature and analogies to real-world collaboration:

- *"It is good because there are not real world situations, but you can learn real world solutions – ways to solve problems – through games like this. I think it is easier also when there is a non-biased 3rd party who can show both sides how things really look – in the real world, you don't get that unless there is real trouble and a higher-up manager steps in."* [Leadership experienced American female]
- *"Yes, to some extent. For example, a global team can learn how to communicate / work with others more effectively thru the game, and apply what they learn into their daily collaboration. Also the game can generate some common interesting topic and experience which can be leveraged to build a team."* [Non-leadership experienced Chinese male]

Others were more reserved or critical in their assessment:

- *"Con 1: anonymity could […] allow for false statements (i.e. people speaking as or 'for' a particular culture). Just the thought of that happening could lessen the trust in the info that's shared. | Con 2: Even though it could increase discussion, it still may not translate into day-to-day sensitivity and practices, which I'm thinking would be the goal of the discussions. I say this because participants really are free to create any avatar they prefer. If they create one that are similar to themselves then the virtual world could be valuable, but if everyone decides to select a Caucasian male avatar, then a disconnect can occur in the association b/n the discussion and mental, visual representation of an individual from that culture."* [Non-leadership experienced American female]
- *"not sure how the game helped w/ global team interaction | maybe something geared to a specific culture and they have to explain it | but don't really see how this helped me as as part of a global team"* [Non-leadership experienced American female]

We debriefed participants individually in an attempt to elicit their candid opinions, so they did not have a chance to experience a *group* debrief after the games. In their comments, participants shared stories about past experiences on global teams and their thoughts on what had unfolded, for good or for ill, during the leadership games. The stories and comments we heard, like the participant who "battled" with himself about how to handle a teammate who seemed to be having trouble when the answer was obvious to him, support our intuition that facilitated group reflection and discussion after the games could be a powerful way for newly formed teams to begin appreciating individual differences and negotiating more effective behaviors. Whether viewed as differences in "culture," or just as behavioral differences that impact team cohesion and performance, being aware that differences exist and learning to understand them are necessary first steps.

The desire to take such steps was clearly there among our participants; 87% of respondents agreed or strongly agreed with the statement "It is important for my global colleagues (whose social customs may differ from my culture's) to understand the social customs of my culture." Over 91% thought that GLC employees should be explicitly trained to interact and collaborate with people whose national culture is unfamiliar. Finally, 95% believed that people could learn more about global teams through virtual interactions.

CONCLUSIONS AND FUTURE WORK

Virtual worlds, and in particular cooperative games, create an opportunity where team dynamics and behavior can be played out on a stage where the stakes are relatively low and the potential for fruitful discussion is relatively high. Based on our results, we suspect that collaborative games in virtual worlds coupled with collective reflection will constitute an engaging way to elicit awareness, debate, and understanding of similarities and differences, fostering explicit conversations about the challenges they present and possible solutions.

ACKNOWLEDGEMENTS

Thanks to our participants and especially to Yingxin Pan for his help recruiting Chinese participants. We would also like to thank Sue Fussell, Andrea Grimes, Francisco Iacobelli, Judy Olson, Brooke Foucault Welles, and our anonymous reviewers for their invaluable comments on previous versions of this paper.

REFERENCES

1. Avolio, B. J. and Bass, B. M. (2002). *Developing Potential Across a Full Range of Leaderships: Cases on Transactional and Transformational Leadership*. Lawrence Erlbaum.
2. Bell, B. and Kozlowski, S. (2002). A typology of virtual teams: Implications for effective leadership. *Group & Organization Management*, 27(1), 14-49.
3. Bordia, P. (1997).Face-to-face versus computer-mediated communication: A synthesis of the experimental literature. *Journal of Business Communication*, 34(1), 99-118.
4. Bos, N., Olson, J., Gergle, D., Olson, G. and Wright, Z. (2002). Effects of four computer-mediated communications channels on trust development. *CHI conference*. ACM, Minneapolis, Minnesota, USA.
5. Brown, P. and Levinson, S. (1987). *Politeness: Some universals in language usage*. Cambridge Univ Press.
6. Browning, E. S.(1994).*Side by Side: Computer Chip Project Brings Rivals Together, but the Cultures Clash*.
7. Burke, K. and Chidambaram, L. (1996). Do Mediated Contexts Differ in Information Richness? A Comparison of Collocated and Dispersed Meetings. *Hawaii International Conference on Systems Science*. Springer, Hawaii.
8. Cassell, J., Huffaker, D., Tversky, D. and Ferriman, K. (2006). The language of online leadership: Gender and youth engagement on the Internet. *Developmental Psychology*, 42(3), 436-449.
9. Clark, H. H. and Brennan, S. E. (1991). Grounding in Communication. In L. B. Resnick, R. M. Levine and S. D. Teasley Eds. Perspectivies on Socially Shared Cognition (APA Press, Washington, DC), pp. 127-149.
10. Daft, R. L. and Lengel, R. H. (1984). Information Richness: A New Approach to Managerial Behavior and Organization Design. In L. L. Cummings and B. Staw Eds. Research in Organizational Behavior (JAI Press, Greenwich, CT), pp. 191-233.
11. Diamant, E. I., Fussell, S. R. and Lo, F.-l. (2008). Where Did We Turn Wrong? Unpacking the Effects of Culture and Technology on Attributions of Team Performance. *Proceedings of CSCW 2008*.
12. Diamant, E. I., Fussell, S. R. and Lo, F.-L. (2009). Collaborating across cultural and technological boundaries: team culture and information use in a map navigation task. *Proceeding of the 2009 international workshop on Intercultural collaboration*. ACM, Palo Alto, California, USA.
13. Ellis, J. B., Luther, K., Bessiere, K. and Kellogg, W. A. (2008). Games for Virtual Team Building. *ACM DIS 2008 Conference on Designing Interactive Systems*.
14. Fu, P. P. and Yukl, G. (2000). Perceived Effectiveness of Influence Tactics in the United States and China. *Leadership Quarterly*, 11(2), 251-266.
15. Fussell, S., Setlock, L. and Kraut, R. (2003). Effects of head-mounted and scene-oriented video systems on remote collaboration on physical tasks. ACM New York, NY, USA,
16. Galegher, J. and Kraut, R. E. (1994). Computer-Mediated Communication for Intellectual Teamwork: An Experiment in Group Writing. *Information Systems Research*, 5(2), 110-138.
17. Gergle, D., Kraut, R. and Fussell, S. (2004). Language efficiency and visual technology: Minimizing collaborative effort with visual information. *Journal of Language and Social Psychology*, 23(4), 491.
18. Hinds, P. and Bailey, D. (2003). Out of sight, out of sync: Understanding conflict in distributed teams. *Organization Science*, 14(6), 615-632.
19. Hofstede, G. (1980). *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*. SAGE Publications, Newbury Park, CA.
20. Hofstede, G. and Hofstede, G. J. (1991). *Cultures and Organizations: Software of the Mind*. McGraw-Hill International, London.
21. Jarvenpaa, S. L. and Leidner, D. E. (1999). Communication and Trust in Global Virtual Teams. *Organization Science*, 10(6),
22. Kraut, R., Fussell, S., Brennan, S. and Siegel, J. (2002). Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. *Distributed work* 137-162.
23. Mortensen, M. and Hinds, P. (2001). Conflict and shared identity in geographically distributed teams. *International Journal of Conflict Management*, 12(3), 212-238.
24. Olson, G. M. and Olson, J. S. (2000). Distance Matters. *Human-Computer Interaction*, 15(2&3), 139-178.
25. Olson, J., Teasley, S., Covi, L. and Olson, G. (2002). The (currently) unique advantages of collocated work. *Distributed work* 113-135.
26. Quinones, P.-A., Fussell, S. R., Soibelman, L. and Akinci, B. (2009). Bridging the gap: discovering mental models in globally collaborative contexts. *Proceeding of the 2009 international workshop on Intercultural collaboration*. ACM, Palo Alto, California, USA.
27. Setlock, L. D., Fussell, S. R. and Neuwirth, C. (2004). Taking it out of context: collaborating within and across cultures in face-to-face settings and via instant messaging. *Proceedings of the 2004 ACM conference on Computer supported cooperative work*. ACM, Chicago, Illinois, USA.
28. Short, J., Williams, E. and Christie, B. (1976). *The Social Psychology of Telecommunications*. John Wiley & Sons, London.
29. Strauss, A. and Corbin, J. (1990). *Basics of qualitative research*. Sage Publ.
30. Tyler, T. R. and Blader, S. L. (2000). *Cooperation in Groups: Procedural Justice, Social Identity, and Behavioral Engagement*. Psychology Press, Philadelphia.
31. Weisband, S. (2002). Maintaining awareness in distributed team collaboration: Implications for leadership and performance. *Distributed work* 311-333.
32. Zigurs, I. (2003). Leadership in Virtual Teams: Oxymoron or Opportunity? *Organization Dynamics*, 31(4), 339 - 351.