

Games for Virtual Team Building

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ABSTRACT

Distributed teams are increasingly common in today's workplace. For these teams, face-to-face meetings where members can most easily build trust are rare and often cost-prohibitive. 3D virtual worlds and games may provide an alternate means for encouraging team development due to their affordances for facile communication, emotional engagement, and social interaction among participants. Using principles derived from social psychological theory, we have designed and built a collection of team-building games within the popular virtual world Second Life. We detail here the design decisions made in the creation of these games and discuss how they evolved based on early participant observations.

Categories and Subject Descriptors

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

Design, Human Factors.

Keywords

Virtual worlds, distributed work, distributed teams, team-building, games, Second Life.

1. INTRODUCTION

Challenges to distributed work teams have been studied and documented in a variety of arenas [1, 6, 16]. However, most studies cannot adequately capture the phenomenological experience or consequences of working for long periods of time – months and years – on projects initiated and completed within distributed teams. Often when a team member is remote from an otherwise critical mass of collocated colleagues, it is possible to cope using instant messaging and e-mail; nevertheless, valuable opportunities for face-to-face interaction – ad-hoc discussions in the hallway, working in close proximity – are missing. Distance

can mean losing out on significant opportunities for team building that rely on the development of rapport with other team members.

Online games like World of Warcraft and Battlefield provide opportunities for players around the world to work together to achieve in-game goals cooperatively [15]. However, our informal observations reveal that much in-game discussion has nothing to do with the game. Instead, players use the game as an opportunity to connect with friends, share recent events in their lives, and discuss projects they are working on outside the game world [15].

This research is inspired by the following question: Can we bring the kind of distributed team building activities that happen naturally in online games to distributed teams in business?

2. BACKGROUND

Distributed teams are commonplace in today's workplace, reflecting the spread of new forms of communication technology and the increasingly global nature of business [11]. The advent of offshoring as a strategy has also increased and created new challenges for distributed teams [3]. In this section we review literature in three areas that underlie our approach. We begin by discussing some of the key challenges for distributed teams and the theoretical perspectives that have been proposed to account for these. We then turn to possible approaches to address these challenges, and finally discuss the recent emergence of virtual worlds and games as an approach to creating engaging but goal-oriented online group interactions.

2.1 Challenges to Virtual Teams

Virtual teams rely on computer-mediated communication (CMC) as their primary means of communication. Early research on virtual teams focused on differences between face-to-face and virtual interactions, finding a variety of difficulties when teams rely almost exclusively on CMC to communicate. For example, virtual teams have been shown to communicate less effectively than face-to-face teams, even as they communicate more frequently [5]. A greater volume of communication is not necessarily an indication of better communication; on the contrary, it may indicate a lack of clarity. Having more messages and more information to handle can itself lead to confusion and poorer understanding [1], creating a vicious cycle. In addition, conversations in virtual teams have been shown to be more task-focused, to the exclusion of social interaction, although this effect lessens over time [31]. Paradoxically, an extreme task focus may lead to less effective communication, as it results in weaker relational links between team members [2]. A lack of social communication is also associated with lower trust and cohesion in the team [2, 31], and with difficulties in establishing a shared knowledge base. A lack of trust, low group cohesion and

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identification, and difficulties in communication are thus characteristic of virtual groups.

2.2 Proposed Solutions

2.2.1 Social Identity

Social Identity theory [28] proposes that group membership is a vital part of a person's self-concept, and that individuals categorize themselves as members of a variety of groups. These can range from broad categories such as race or gender to smaller groups like a family or project work team. To the extent that a person identifies with their group and that group is salient at any particular moment, the more they will behave in a manner correspondent with the interests of the group, putting their own needs and desires aside. The mechanisms of social identity depend on the individual categorizing themselves as part of the group, identifying with that group, and comparing their group to other groups. Group identification has been shown to occur with a very minimal set of conditions. Simply having two groups with different names, for example, is enough to create a social identity.

When a group is salient to the individual, they will identify more strongly with that group than with others. A female standing amongst a group of male coworkers, therefore, is more likely to have her identity as a female be salient than her identity as an employee of the company, simply because of the context she is in.

Greater identification with a group leads to greater trust and cohesion [7], improved communication [17], improved cooperation [30], greater individual contribution to the common good of the group [30,], and increased group productivity [8]. As such, we believe that increasing individual identification with the team will help alleviate the deficits in trust, cohesion, and cooperation/contribution to the group that are associated with virtual teams. This can be done by increasing the salience of the team to its members, encouraging communication and cooperation, and placing members into contexts in which they are reliant on one another and must trust each other.

2.2.2 Team Building

The question of just what effect team building interventions have on their participants can be only partially answered from the literature. A meta-analysis of team building research found that team building interventions tend to emphasize at least one of four possible components: goal setting, interpersonal relations, problem solving, and role clarification. [21] The authors also found no significant effect of team building on performance [21], although a small effect may be seen in interventions that emphasize role clarification. In contrast, a meta-analysis of "Outward Bound" outdoor adventure team building interventions found small-to-moderate effect sizes across many possible outcomes [6]. The authors concluded that such programs improve interpersonal variables such as social competence, cooperation, and interpersonal communication [6].

Echoing these results, more recent work found that team building exercises can improve the success of a virtual team and could help members develop identification with the group [11]. Thus, team building interventions appear to offer some promise, although the research is inconclusive. Some evidence suggests that role clarification and interpersonal dimensions may be improved by appropriately-designed team building interventions. Our challenge is to identify the features of team building interventions that make them successful and transfer those features to a virtual world.

2.2.3 Social and Emotional Communication

As mentioned previously, virtual teams are often more task focused in the initial stages of their interactions. This deficit in social communication can hamper the development of key factors of a successful team. Increasing the social communication between virtual team members is associated with higher trust and better social and emotional relationships [9, 19]. Social conversations emphasizing the commonalities between team members have been found to be particularly effective in this [21]. According to social identity theory, emphasizing the commonalities between team members will lead to greater identification with the group. In this manner, then, more social communication between team members should lead to greater trust and stronger social relationships between team members. As such, we opted to emphasize fun and engagement in our team-building exercises, in order to increase the probability of more social interactions. To do this, we focused on games instead of work related exercises. Games allow team members to interact with each other in a more playful way, thus enabling them to relax and communicate with each other in a more social manner.

2.2.4 Simulated Face-to-Face Meetings

Another successful strategy for virtual team success is to have face-to-face meetings during the early stages of team formation. This also helps to foster higher trust, improved socialization, and closer interpersonal relationships, [14, 26] all of which serve to improve productivity and performance. However, face-to-face meetings are not always feasible for virtual teams, prompting us to ask how we might improve the likelihood of these outcomes at an early stage of team formation without necessitating them.

One strand of CMC research posits that individuals experience lower trust, cohesion, and less effective communication due to the lack of nonverbal cues when communicating solely by text [18]. Much communication does not involve words but is displayed in our body language, gestures, and other nonverbal cues. With the recent emergence of 3D virtual worlds where individuals create avatars and interact with others in a 3D graphical environment, the possibility of communicating with more than words via the Internet is suddenly a reality. In worlds such as Second Life, avatars have bodies and are able to make gestures such as shrugs and nods. Suddenly, there is a visual aspect to CMC that did not exist before. It is possible then, that communication via avatar in a 3D virtual environment would fall somewhere along the continuum between face-to-face communication and text-based communication. This then implies that some of the difficulties inherent in CMC may not be as problematic in 3D virtual worlds.

2.3 Virtual Worlds and Games

Given the socio-emotional challenges faced by virtual teams and the clear value of face-to-face meetings for team-building, we saw a potential match between these needs and the affordances of games in virtual worlds. Specifically, the kind of social communication that pervades MMOG and virtual world interactions coupled with the idea of games designed specifically to enhance team identification seemed like a promising approach.

2.3.1 Choosing Second Life

We chose Second Life as the environment in which to build our games. Second Life is a 3D multi-user virtual environment (MUVE) offered free of charge to participants. In Second Life, each user's presence in the world is expressed bodily – typically

as a human, although other representations are possible. Although not the first of such environments, Second Life has emerged as the most popular, with over 5 million unique avatars created by users [22]. Second Life is also known for the large amount of user-generated content, ranging from avatar customizations such as custom hair and clothing, to scripted objects in the environment such as dance animations, fireworks, furniture, buildings, and other flora and fauna. Interaction among participants is pervasive, including private and public chats, membership in groups with offline messaging, and such social behaviors including hanging out in friends' virtual homes, going clubbing, and shopping.

2.3.2 Games in Second Life

Games within Second Life are not a new phenomenon. Linden Lab, the creator of Second Life, has sponsored game design competitions to encourage user-created games. Games range from simple puzzles and casino-type games to elaborate worlds within a world. The designers of games in Second Life leverage properties of the world to their own ends. Some have built custom games that are objects within the world, such as Scrabble or slot machines. Others have leveraged the land itself, creating arenas where teams of up to 40 people can build and position robots and engage in a virtual war against other teams. Entire islands have been turned into role playing adventure games like World of Warcraft or Myst, combat games, or tournament style games.

The popularity of Second Life, the ability to customize appearance, build and script objects, and interact with others were all vital to our choice of Second Life as the platform for our team-building games. But what kind of games would be most useful to the globally distributed business teams we were aiming to support? The affordances of an embodied user experience such as that offered by Second Life seemed a particularly good match to some of the socio-emotional issues faced by distributed teams. We thus chose to create games designed to promote a more playful, social environment where team members could have fun while working together on a collaborative task. The ability to simulate face-to-face encounters through avatar-to-avatar encounters also suggested that relationship building and social communication might occur more easily than in the more usual forms of virtual team communication (e.g., text-based chat and email).

3. FINAL GAME DESIGN

Three collaboration games were designed within Second Life. Each game included the common elements that 1) everyone in the group must participate, 2) success is more difficult if the team fails to work together to arrive at a solution, and 3) communication is critical to finding that solution. We used an iterative design approach, beginning by building a prototype game, getting formative feedback, revising the game, and then building additional games. We turn now to a description of each game as it ended up, before discussing in Section 4 how critical decisions evolved during the course of the iterative design process, and how different factors interacted and constrained the final designs.

3.1 Crossing the Ravine

In Crossing the Ravine, a team of five sets out to explore the world but encounters a ravine that seems impassible. Fortunately, 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 properly and cross the ravine.

The ravine is represented as a puzzle board sunk into the ground (Figure 1). There are five colored seats and, for each seat, there is a piece of matching color. When a player sits in a seat, they are able to control the correspondingly colored piece (moving left, right, forward, back, up, down, and rotating about the z-axis). Team members need to communicate to discuss possible solutions to the puzzle and negotiate movement. The puzzle is complete after each team member moves their piece to the appropriate place in the puzzle and moves it down to insert it into the board.

There are currently four puzzles and scoring is based on the speed with which a team completes each puzzle. The high score for each puzzle is presented on a display in the game area.



Figure 1. Crossing the Ravine with five players.

3.2 Tower of Babble

Tower of Babble (Figure 2) is a stacking game. The object is to balance as many differently shaped blocks on top of one another until the stack of blocks (the tower) falls over.



Figure 2. Tower of Babble game in progress.

Tower of Babble is inspired by a board game called Blockhead!. In Blockhead!, two competing teams take turns placing blocks. Thus, strategy involves both making a safe move for oneself and playing a block that makes it hard for the next person to place their block safely. In Tower of Babble, in contrast, all players are part of one team striving to achieve as many points as possible from both the height of their tower and the point value of each block placed. A scoreboard showing the five highest scores and the teams that earned them is located on the game platform.

3.3 Castle Builder

The objective of Castle Builder is to design and build a castle out of the pieces provided. Each castle is designed by one group of players (the "Designers") and built by another group of players (the "Builders"). Builders are not allowed to directly view the design and must rely on information communicated by the Designers, and Designers are not allowed to manipulate the castle pieces during this game. Each castle is given a score for

originality, correctness (to the design), and difficulty, with the ultimate goal of completing the best castle of any team. As with the Tower of Babble game, a scoreboard indicating the five highest scores and the teams that achieved them is on the platform.



Figure 3. Castle Builder game with design in progress.



Figure 4. Castle Builder game with build in progress.

The Castle Builder game consists of two platforms linked through teleportation (a basic affordance of Second Life). The first platform (Figure 3) is the design platform, where only the Designers may go. On this platform is an 8×8 clickable grid. Clicking on a square in the grid results in a pop up box asking the team member what kind of castle piece they would like to place there. In addition, designers receive a heads up display that shows them this grid and the pieces on their screen.

The second platform is the building platform (Figure 4) where the castle will actually be built. At the start of the game, this platform is haphazardly strewn with five types of castle pieces: wall, curved wall, door, tower, and turret.

The first phase of the game is design. Designers move to the design platform and develop a blueprint. At the same time, Builders are encouraged to take stock of the pieces they have available to them. Once the designers have finished, they teleport back to the building platform and use a “heads up” display of the castle design to tell the builders where to place the pieces. The Builders rely on communication from the Designers to build the castle. A possible twist in the game allows the design of the castle to require more pieces than are available to the builders, which will necessitate a renegotiation of the design. The castle is finished when the castle matches the design, and team members then take on the opposite role and play again.

4. EVOLVING DESIGN DECISIONS

When designing the games, we needed to consider a variety of factors: not only the design of the games, but also the affordances and constraints of the world and the purpose for which the games were being built. We detail our design decisions at four levels: the world containing the games, designs to enhance the feeling of

groupness, the games themselves, and the level of player interaction with the games.

4.1 World

A key consideration when doing any project in a virtual world is what the world can and cannot provide you. Both the technical (i.e.: server configuration, lag, design tools provided) and virtual (i.e.: what the virtual world provides, such as customization of avatars, how to interact with the world, communication systems) aspects of the world will affect the design that you ultimately choose. In addition, each user will bring a different set of experiences with them to your designs, such as ability in or familiarity with games, which will affect their ability to interact with the world. A primary concern should therefore be to keep things simple for the users of the games. Users who are not familiar with games or virtual worlds, for example, will particularly need games that take into account the plusses and minuses of the system and world.

Second Life is a system with more than a few barriers to entry. We found that users who were not familiar with game controls or moving around in other virtual environments found the movement controls in Second Life to be unwieldy and frustrating. Each island in the world has physical properties as well, from gravity to mountains to buildings that must be navigated. Therefore, it is important that any design in Second Life take care to avoid adding to this complexity and, if possible, take steps to reduce it. In our design, we created a tutorial with all the Second Life commands that participants would need to know to better interact with the world. To address difficulties in movement, we decided that the simplest answer was to teleport participants to the games.

Moving objects around (key to our designs as each game has pieces which must be manipulated) is also not very obvious as there is no mechanism for moving objects around other than when building them. This led us to design controls for manipulating the pieces of our games in order to make moving game pieces simpler and more obvious for users that were not already familiar with Second Life. As we designed iteratively, it became clear that each game would need a different control mechanism in order to support the desired play dynamics (see section 4.4).

One of the properties of being in an embodied world with other users is the ability to explore new areas with ease, something not as well-supported in the physical world. People also tend to congregate and will naturally gravitate towards areas where they see others (in Second Life, this is made possible with a map that shows other avatars as green dots). To encourage people to come and interact with our games we put the games in areas where they are easily visible. We also made the games visually interesting (e.g., bright blocks, castle pieces) to attract notice and look playful.

4.2 Group

We are designing our games to foster identification with the group, in order to increase trust and cohesion. Designs should thus reinforce commonalities between the members, and de-emphasize those that bring attention to the differences between group members [12]. To do this, we created some initial artificial commonalities and made the presence of other teams more prominent and visible. To this end, each team that enters the world is given a T-shirt that is the same color (every team has a different color). Each team is also given a clubhouse (decorated in the same team color), which serves as a shared collective place

[12] and can be furnished however they see fit. Each team is also directed to choose a name for their team.

A central tenet of Social Identity theory is that the presence of an out-group will increase member identification with the in-group through inter-group comparisons [28]. As our games are all one-team cooperative games, we needed to make the presence of other teams known and foster a competitive atmosphere. This would increase the salience of other teams despite their not being present, and would increase the likelihood of comparison.

Our solution was to emphasize the in-group commonalities with the t-shirts and houses, as described earlier. We also decided to use a scoreboard in each game in order to make the comparison as explicit as possible. When a team completes a game, they earn a score and, if that score is better than all previous scores, it is preserved as a challenge to future players. High scores appear alongside the names of the teams that achieved them.

4.3 Games

As we designed our games, we worked from a number of broad design principles culled from our reading of the relevant literature. We decided that our games would focus on cooperation and collaboration, rely on communication for success, and allow team members to explore different roles.

We also worked to leverage cultural resonance where possible. Specifically, we aimed to build games that allow the player to develop business-relevant skills while placing them in a fantastic, yet recognizable environment (e.g., pieces in *Crossing the Ravine* are shaped like pieces from the well-known game Tetris). In this way, we hope to evoke a kind of reflection similar to that evoked by science fiction. Author Robert Scholes explains science fiction as “fiction that offers us a world clearly and radically discontinuous from the one we know, yet returns to confront that known world in some cognitive way.” [4] We believe games can play a similar role: allowing players to step out of their work environment to engage in a fun activity that provides some distance from the standard work environment such that they can examine that practice more objectively. In a sense, we aim to provide a lens through which players can reflect on their current work practice – particularly in the area of cooperative work.

4.3.1 Cooperation

Cooperation is essential to the success of a group endeavor in which the members are dependent upon each other for success. A team that cooperates with each other as they work towards a common goal will perform better than one that does not [24, 25]. Members of a group that has a common purpose or goal will be more committed to the group and identify more strongly with it, particularly if the members are dependent on one another to accomplish the goal [18]. Achieving this common goal will in turn increase the social identity of the group.

As we designed our games, *Tower of Babble* emerged as the game with the biggest focus on cooperation among team members as they compete with another team. Our initial design mirrored the teaming structure of the real-world game by having two teams compete to cause the tower to fall on another team’s watch. Because being able to see different perspectives is essential to successfully and strategically placing blocks in the game, cooperation among team members with different viewpoints on the tower improves the chances a team will do well.

We soon noticed that Havok, the physics engine governing all physical interactions in *Second Life*, diverged so dramatically from real-world physics that it substantially altered the way the game was played. In the real-world *Blockhead!*, the friction created by the lightweight wooden material of the blocks makes it possible for skilled players to construct surprisingly high stacks. Havok’s physics were less predictable, leading to peculiar situations such as blocks intersecting other blocks in impossible ways, blocks falling through the ground, and a stack of blocks unexpectedly exploding and ending up in all corners of the region. Players reacted to these scenarios more often with laughter than frustration—particularly when the incident occurred during another player’s or team’s turn. A more serious concern was that the competitive structure of the game compelled players to take advantage of these technological breakdowns with reliable frequency. As a consequence, games rarely lasted more than a few turns; the lack of progress mitigated any hope of harnessing the bonding properties that arise out of suspenseful social situations.

The problem with Havok led us to reconsider the directly competitive aspect of the game. We wondered what would happen if, instead of competing with another team to make the stack tumble the least often, players cooperated as a team to build the tallest tower of blocks. In this variation, competition would not be eliminated but simply made indirect; players earn a score for their team at the end of the game that could be compared to the scores of other teams playing at other points in time. Our hope was that this would not only improve the team-building aspect of the game by encouraging cooperation, but make games last longer and be more fun.

In fact, this is what happened. The game’s central activity shifted focus from destruction to construction. Players sought to achieve a high tower of blocks by making the next turn *easy* for their teammates rather than *difficult* for their competitors; in turn, the quirks of the *Second Life* physics engine were exploited less often for malicious purposes. The element of suspense absent from earlier versions of the game finally surfaced, albeit in a markedly different form than what was originally envisioned—success or failure, now shared among all players, hinged on a continuation of incremental progress towards a common goal. Because players shared in the consequences of each teammate’s actions, they had reason to invest themselves in the performance of these actions. Players began offering feedback to other teammates and heeding suggestions provided to them during their own turns; as this type of communication and social support increased, performance in the game followed a similarly positive trend.

The other two games also have cooperation as a central mechanic. In *Crossing the Ravine*, players are asked to cooperatively solve a puzzle. We attempted to encourage cooperation in two distinct ways. First, we assigned control of each puzzle piece to a different player, necessitating discussion about how to move the pieces and where they should go. Second, we provided puzzles where the solution was not immediately obvious, in order to make the goals hard but attainable [13]. Following the principle of “small successes early” [29], we made sure the early puzzles were easy to solve, with increasing difficulty as the game goes on.

Castle Builder requires cooperation between roles as well as individual team members. Not only must designers communicate the design to the builders, but we introduced a compromise goal into the game design: the blueprint created by Designers must, by the end of the game, match the castle constructed by the Builders. This aspect of the game was meant to provide players with a

motivation to resolve their differences and avoid vigilante situations. For example, if Designers learn that their blueprint makes use of more tower components than the Builders have, then Designers must modify the blueprint to reflect a different design that can be realized with the available materials. The hope is that the need for compromise will help conversations to emerge between Designers and Builders and bring to light conflicting intentions that can then be collectively reconciled.

4.3.2 Communication

In order to achieve cooperation, and thus the best team outcomes, teams need to develop good communication strategies. Each of our games is designed with this in mind. The challenges and obstacles of each game aim to necessitate clear and concise communication.

Specifically, *Crossing the Ravine* is designed to encourage communication among team members as they attempt to collectively solve a problem, in this case a puzzle. One way we did this is to build the game such that each piece can only be moved by one team member. Our hope with this design was that the team would have to communicate in order to find the solution but also simply to move the pieces into place.

In feedback sessions, we observed that the players did not communicate at all. Instead, they moved their pieces to the appropriate locations and placed them immediately. When debriefed, each participant stated that they could easily see the solution of the puzzle and did not need to communicate to solve it. In order to address this issue, we created additional puzzles that we believed would be more difficult for players and so would require more communication. We have retained the first puzzle to serve as a tutorial and additional puzzles as a clear challenge.

In each session, we saw a roughly similar pattern of behavior play out. First, players start moving their pieces around with no communication, resulting in many pieces colliding and being unable to move further in the desired direction. Some players perceived this as funny. (One excitedly exclaimed, "Bumper tiles!") Second, players would begin communicating to negotiate passage without collision. Third, several players would place their pieces into the puzzle, but not all the pieces would fit. Fourth, players communicate to determine the correct solution to the puzzle, developing a plan of action. (Sometimes players would leave their piece control chair and walk into the actual puzzle to show another player where they thought a particular piece belonged.) Lastly, players would execute the agreed-upon plan, stopping to renegotiate the solution each time a solution proved nonviable. In this manner, they solved the puzzle. By the third or fourth puzzle, team members found a communication rhythm that enabled them to easily solve the last puzzles regardless of their performance on the first two.

In designing *Tower of Babble*, we also wanted to encourage communication. This proved to be an easier problem to solve, as the perspective issues inherent in a 3D world combined with the lack of experience of the players made placing blocks much more difficult than in the real life game. Placing blocks required a sort of 'magic wand' approach: players were not physically attached to the block as they would be in the physical world, but could move it from anywhere on the platform. This disconnect between the player and the block led to issues with perspective: it became very difficult to know where to drop the block without looking at it from all angles. This meant that team members could be very

helpful if they positioned themselves around the stack and gave information to the player about the position of the block.

The design of *Castle Builder* also began with the goal of encouraging communication among Designers and Builders. To this end, it was important that only Designers would be able to see their blueprint, lest Builders try to circumvent Designers altogether and build the castle based on their own observations of the blueprint. Because of *Second Life*'s powerful camera controls, players can essentially see any part of the surrounding region; thus, hiding the blueprint in an enclosed area to which only Designers have access was not effective. Moreover, this approach would require Designers to return to the blueprint enclosure whenever they wanted to view the blueprint, a time-consuming and tedious process. A different solution was needed that allowed Designers exclusive access to the blueprint but did not require them to leave the castle construction area to see it.

Attachments, and specifically HUDs (for Head-Up Display), provided that solution. HUD contents are only visible to the HUD's wearer; if a Designer's HUD contained a copy of the blueprint, for example, it would be hidden from Builders. By itself, however, the HUD was not enough: how Designers would collaboratively modify the blueprint was still an open question. Two options presented themselves: Designers could modify the blueprint by interacting with their HUD, allowing them to be present anywhere while doing so; or, Designers could be required to return to a separate design area to modify the blueprint, leaving the HUD as a memory aid only. After testing the former option, we saw games conclude too quickly to yield interesting results; Designers could update the blueprint in an instant, responding to issues in the construction area as they occurred. For this reason, there was little in communication between Designers because acting was often faster and easier than discussing potential changes first. In a sense, designing was too easy.

A combination of the HUD and a separate design area bore more fruitful results despite the increased burden on the part of the Designers. We located a design area far enough away from the construction area to make it impossible for Builders to see inside using camera controls; Designers moved instantaneously between these two areas via a teleportation platform. Inside the design area, Designers modified a large blueprint located in the world; changes to the blueprint were instantly reflected on the Designer's HUDs. When the Designers returned to the construction area, the latest version of the design remained as an artifact on their HUDs; however, if additional changes proved to be necessary, Designers would have to return to the design area to make them. In this version, we saw Designers communicating more often while modifying the blueprint because they needed to agree on a solution before leaving the design area. Games lasted longer and provided more opportunities for complex problem solving and negotiation between Designers and Builders.

4.3.3 Roles

Role ambiguity is a problem that arises in virtual teams due to the difficulty in disseminating and interpreting information and forming a shared mental model [27]. Crucial to virtual team success is the ability of a team to determine the abilities of team members, establish the roles they will play on the team, and coordinate these roles. If this is not done adequately, role ambiguity is the result and performance will suffer. If team members are highly interdependent, this task becomes much more difficult and the importance of alleviating role ambiguity within

the group is even more pronounced [27]. A recent study of leadership in online games done by Seriosity in conjunction with IBM [23] found that online games facilitate movement among roles and that they enable leaders to emerge quickly.

The games discussed here are designed to allow the development of leaders and roles in different ways. For instance, each game was designed to require interdependence among team members, where coordination is necessary to play well. In this way, roles become emergent; they come into being through the playing of the game. This helps the team learn how to work together and allows individuals to try out roles and demonstrate their strengths.

Role definition influenced the design of the Castle Builder game more strongly than any other construct. In Castle Builder, we explicitly defined two different types of roles. Our hope was that this would help team members understand the roles that others have in their real-life environments and perhaps help equalize status differences, and allow quieter members to take charge.

Because our games were likely to be tested by teams of IBM employees involved with software and hardware development projects, we wanted to focus on defining the types of roles that would be highly relevant in these contexts. We knew from our own experience with such teams that a recurring tension centered on the often-clashing perspectives of designers (or planners) versus builders (or implementers). The mutability of roles in Second Life suggested that it might be possible to design a game where players who typically took on a design role in the real world could temporarily view the world through the eyes of a builder in a situation of negotiable consequences, and vice-versa for builders. Players could test out strategies for communicating with teammates whose roles differed from their own, seeing the results of their effort far more quickly than is typical in a lengthy real-world development project.

An immediate concern was the problem of empowerment. In situations where planning and implementation are divorced, as was the case in our game, there seems to be a tendency for a power hierarchy to emerge. Designers wield a kind of authority over builders because their plans dictate, to a large extent, the actions of builders. Often the ideas and concerns of builders are either ignored or at least not addressed to the same extent as those of designers. Builders, in turn, may find themselves frustrated at designers' temptation to develop unreasonable plans ungrounded in the realities of available time, resources, and technological feasibility. While these kinds of tensions are important and we hoped, to an extent, to address them in our game, we also wanted to ensure that the game was fun to play and not simply a microcosmic reflection of workplace stresses. Our hope was to provide a low-key, playful context for exploring tensions like the planner-implementer power struggle while avoiding the stilted pseudo-authenticity of a business simulation.

To address this, we made an explicit design decision to try to achieve this balance: to introduce a conflict into the game design in the form of a disparity between the Designers' understanding of resource availability and that of the Builders. Specifically, Designers would be able to plan a castle comprising any combination of walls, turrets, and other components; Builders, however, would be furnished with a finite number of components. The conflict would arise when the team discovers that the plan provided by Designers can not be realized due to the limited selection of components. Here, the game aims to help players reflect on real-world disparities between the intentions of

designers and the feasibility of the plan when executed by builders. It is also meant to encourage negotiation as well as upset power imbalances that might otherwise pervade the game.

In Crossing the Ravine, all players have essentially the same charge: get your piece to the right place in the puzzle. During play, however, we saw two different types of ad-hoc roles develop. In two sessions, we saw the emergence of a clear leader. This person asserted (to the other players) that he or she knew the solution of the puzzle and told them where to place their pieces. This is still a cooperative process (the leader cannot take control of the pieces) but there is less negotiation involved.

In the remainder of our sessions (10 total) we saw a more distributed process play out, with no dominant leader. Instead, one player might have an idea about where another player's piece belongs and would communicate that to them. Other times, a player would figure out the solution to the entire puzzle and place their piece in the correct location, providing an implicit hint to the other players as to the solution of the puzzle.

Another role we saw players take on was that of "helper"; specifically, aiding in the placement of pieces. Our design afforded this role because, when you are moving a piece, your camera is placed in a specific location. In general, this is the best position for playing the game, but there are particular situations where other views are useful. When one is not moving a piece, they are able to move their camera at will. Thus, when a player was having trouble placing their piece, often someone would take the role of a "camera helper" and suggest they nudge the piece right or left a bit before inserting it into the puzzle.

We saw two types of roles emerge in the Tower of Babble game as well. In the first, team members placed their pieces without input from other members of the team. In the second, other members of the team would distribute themselves around the platform and give directions to the person moving the block. In this way, they helped align the block. Generally speaking, as the game went on, more and more helping behavior was observed. In no case was there a clear leader during play of Tower of Babble.

4.4 Interaction Design

Each of the games described here features a different control scheme. These control schemes evolved as a natural part of the design process; through a negotiation between our designs, user needs, and the constraints of the development environment.

In Crossing the Ravine, the avatar sits during the game and the keyboard controls typically used to move the avatar are commandeered for block movement instead. Similarly, the game takes control of the player's camera to enforce a static bird's eye view. This design decision had two chief benefits: players could easily see the entire game area and all of the blocks without having to move the camera themselves (always a tricky procedure for new players), and it ensured that directional commands issued from the keyboard controls would be absolute rather than relative to the avatar's orientation. Consequently, the controls of Crossing the Ravine were easy for players to pick up, but we wondered if there was a way to allow for more avatar and camera freedom-of-movement in another game with a similar premise.

Along these lines, we set out to design a second game that would remain accessible for novices—both Second Life novices and 3D virtual world novices in general. Because our intent in designing these games was to facilitate team-building among virtual teams in a wide variety of communities of practice, we expected many

players to lack technical backgrounds or experience with videogames. This expectation powerfully shaped many of the design decisions that followed. For example, we sought to avoid the use of attachments, a type of Second Life interaction component, having observed them to be a confusion and burden to new players. As a result, all of the interactions that players had in the second game needed to occur with objects in the world that they did not own, bringing the issue of access control into the foreground. But even guidelines as deep-seated as this were subject to change. In designing the third game, we would reverse the decision to avoid attachments as there was apparently no other way to secure the functionality we needed.

The design for Tower of Babble presented a specific challenge: How could we design an interface for block movement that was powerful enough to allow for a complex sculpture or artwork to be created, yet still simple enough to use for novice players to grasp? Crossing the Ravine dealt with the issue by limiting camera movement to a single view and block rotation to a single axis, but these were constraints from which we were hoping to move away. At the other end of the spectrum, Second Life's Build Mode provides powerful tools for manipulating objects, but the interface is complex and the use of Build Mode requires ownership over the objects to be manipulated, making it inappropriate for a shared game context. Neither extreme was optimal, so we realized some experimentation in the middle would be needed. This fundamental tension between power and simplicity would appear often throughout the the design process.

How would the mechanics of a real-world game whose premise was fundamentally rooted in real-world physics transfer to Second Life? We had realized early in the project that designing an effective interface for moving blocks would be central to the success of the game; now, with the decision to replicate Blockhead!, the challenge of providing powerful, simple-to-use block movement controls was more central than ever. We identified at least four reasons why the problem was nontrivial.

First, by allowing players to move their avatars and cameras as they like, we were relinquishing the simplicity of absolute directional commands that made Crossing the Ravine so easy to control. In Crossing the Ravine, each player saw exactly the same game area. Pressing the "up" key, for example, always moved a block in precisely the same direction. In the second game, however, "up" was now a relative concept based on where the player's avatar was standing and facing. A new approach would be needed to deal with this added complexity.

Second, players of the second game needed to be able to move blocks in every possible way—all four cardinal directions, up and down, and all three rotational axes. In Crossing the Ravine, where players could only rotate blocks along a single axis, keyboard commands were sufficient to accomplish this task. With the addition of two more axes, the complexity increased exponentially. The classic HCI problem of designing interfaces for manipulating 3D objects with a 2D pointing device (mouse) and a 2D display was compounded by our desire to keep the controls as straightforward as possible.

Third, Second Life provides limited options with respect to gathering data from input devices. The scripting language permits objects to capture keyboard commands from only eight keys—for better or worse, the same ones used for avatar movement. Mouse support is restricted to recording clicks (but not click locations). As a consequence, interfaces in Second Life must either make use

of the same controls used for other functions (i.e., modes) or avoid key press- and mouse click-based interfaces altogether.

Lastly, because Second Life's novelty defies obvious definition beyond that of a "virtual world," it wasn't obvious to us which control scheme metaphors to leverage from users' potential prior experience. If Second Life was clearly a videogame, for example, the clear approach would be to start with a standard videogame control scheme and work from that. If Second Life mostly resembled a WIMP-based software application, we would know to base our control scheme on that paradigm. If Second Life was, at its core, a virtual reality environment aiming to mimic the physical world, then our control scheme might have pursued similar goals. But we found that Second Life didn't fit neatly into any of these categories, but rather combined elements from all of them. Thus, we couldn't draw exclusively from the existing research literature related to any one of them.

In the face of these four major challenges to designing a simple but powerful interface for moving blocks—dynamic avatar and camera movement, full-featured block movement, input device data capture limitations, and control scheme conflation—we opted for a highly iterative design process based on regular feedback from players. Our starting point and initial goal for this phase of the project was to provide players with a stripped-down, simplified version of Second Life's Build Mode as the interface for moving and rotating blocks. At a basic level, we liked how block movement and rotation controls were implemented in Build Mode, but the interface provided too many unnecessary options to make it feasible for a game targeted at novices. If we could provide a similar level of functionality as Build Mode does with an easy-to-use interface that new players found usable, we would consider ourselves successful.

Our initial forays into solving the problem were naïve in their optimism. It quickly became clear that the ideal interface in our minds, some kind of variation on a direct manipulation, would not be possible due to technical constraints. As these constraints made themselves known, we as designers were forced to revisit our priorities for the second game. What features and kinds of interactions were critical if our goal was to design a game that would facilitate relationship-building among its players? Ultimately, we decided that as long as the game was essentially fun and not frustrating, some compromises with respect to the controls would be acceptable. Our current design is a 3D click-operated remote control that indicates the six cardinal directions and dynamically follows the player whose turn it is.

The control mechanism also differed in the Castle Builder game. Because the goal of the game was to build a castle with the blocks, players still needed the flexibility to move blocks in cardinal directions; however, because we restricted castles to a single story (level) for simplicity, up and down controls were not needed. Additionally, because building components such as walls and doors only provide utility when their tops and bottoms are oriented in a particular way, it was no longer necessary to allow players to rotate blocks along two of the three axes. Finally, in the third game, Builders were allowed to select any block and move it at any time, as opposed to Crossing the Ravine, where each player controlled only one pre-determined block, or Tower of Babble, where only one player at a time controlled any of the blocks. The remote control identified whose turn it was in Tower of Babble; in the third game (not turn based) this approach was not appropriate.

Our answer to these requirements was, perhaps counter-intuitively, to allow Builders to move castle components by riding them, as one might ride a horse or automobile. Land-based vehicles, as it turns out, move in the same ways as castle blocks needed to—cardinal directions, but not up and down, and rotation along a single axis. Moreover, vehicles have the added benefit of identifying who is controlling them; in the third game, Builders sit on the castle component to operate it. An unexpected consequence of our transformation of castle components into vehicles was that players found themselves driving off the game platform fairly regularly. To resolve this issue, we constructed a “pen”—a chain-link fence circumscribing the entire play area—to visually emphasize the borders of the game platform as well as physically keep Builders inside it. This had the added benefit of making the platform look more like a construction zone.

5. DISCUSSION AND CONCLUSION

Crossing the Ravine, Tower of Babble, and Castle Builder were developed in sequence; each was more complex than the last, and each presented new design challenges. However, some lessons were consistent among all three.

First, although Second Life is often read as a highly collaborative environment in terms of communication, gestures, and appearance, the platform’s affordances for building cooperative applications is limited. The issue largely comes down to the permissions structure: objects are either movable by the owner or by everyone, with no options in between. For different reasons, both of these options compromise game rules. Thus, we needed to build a permissions management system from scratch.

Even with this customized system in place, certain functionality was out of reach. For example, direct manipulation of objects (drag and drop) is not supported unless objects rely on the built-in permissions system. While direct manipulation may not have been the right answer for all of our games, it would have been nice to explore the possibility.

Secondly, Second Life provides a remarkable social sandbox. As we built our games, other in-world avatars would notice the activity and stop by to ask questions, play a round, or give feedback. Building in this social environment was largely a boon since it broke down social barriers. We no longer needed to schedule meetings for feedback because our work was on display and feedback was provided regularly and without solicitation.

In addition, there were many occasions when games attracted an audience during play. While these audience members could not join the game immediately, they would often provide thoughtful suggestions to those who were. Once the game concluded, audience members would become players and vice-versa. Virtual worlds in particular afford this kind of active/passive turn-taking because co-presence is a fundamental feature of the environment.

Building “in the open” also has drawbacks. There is a time in many development cycles when work is not quite ready for public consumption. When controls have not been perfected, one may not want folks showing up and manipulating them out of the blue. This is problematic when the creators of the game are not in-world to shoo away would-be players from a game under construction. We partially solved this problem by building new games at high altitudes so they would not be immediately visible to newcomers, but that is a stopgap solution. Providing a notion of “backstage” where content creators can work with some level of privacy is important for future virtual worlds.

Third, developing cooperative games in Second Life is complicated significantly by the dynamicity of the environment. The world is inherently social, the physics engine can be unpredictable, server load can cause serious state problems, and there are regular (weekly) updates to the client and server software that introduce new issues. Each of these is a variable that can affect everything from the responsiveness of the game to enforcing game rules. Taken together, they present a formidable challenge to developing consistently enjoyable, playable games.

We managed this issue in two ways. First, we aimed to make our games as robust as possible by finding a set of world management techniques that keep games from getting into a bad state. In the case that these techniques fail, each game has a user-activated “reset” function that brings the games back into a reasonable state as a failsafe. Secondly, we were surprised to discover that players sometimes enjoy when things do not go quite right. In the preceding sections, we noted several situations where games did not react as designed and players found the resulting “problem state” entertaining. Reflecting on this, a design principle put forth by well-known game designer Will Wright (Sim City, The Sims, Spore) comes to mind: “If you’re going to fail, fail funny.” [32] Thus, while we certainly aim to keep our games from ending up in a state where they need to be “reset,” it’s important to note that the sandbox nature of Second Life and its inherent non-determinism can help both game designers and players find fun in unexpected places. Providing opportunities for players to enjoy the rich, surprising nature of the world, even in the context of a game with well-defined rules, is not to be underestimated.

Lastly, we found it valuable to design games with social science theory in mind. Starting with established social psychological principles enabled us to design games to encourage the aspects of interaction that we wanted to promote. Our observations to date tell us that the games enable role formation, cooperation, and communication between team members. In addition, our games elicit social behaviors from participants. Completion of games, especially when coupled with a high score, was often followed by spontaneous group celebrations such as dancing, drinking (virtual) champagne together, or animations such as cartwheels.

The games discussed here aim to help distributed teams reflect on their work practice and develop deeper ties with their teammates at a distance. The intersection of social science principles, user-centered design, platform constraints, and happy accidents governed their design. The next phase of this project is a detailed evaluation of our games with real-world distributed teams, with the goal of better understanding the impact of virtual team building games on team cohesion in business settings.

6. REFERENCES

- [1] Bordia, P. Face-to-face vs. computer-mediated communication: A synthesis of the experimental literature. *The Journal of Business Communication*, 34(1), 1997.
- [2] Burke, K. and Chidambaram, L. Do mediated contexts differ in information richness? A comparison of collocated and dispersed meetings. In *Proc. of the Twenty-Ninth Annual Hawaii International Conference on Systems Science*, 1996.
- [3] Cherian, S.P. and Olson, J.S. Extending a theory of remote scientific collaboration to corporate contexts. In *Extended Abstracts, Human Factors in Computing Systems (CHI 2007)*. New York: ACM Press.

- [4] Clute, J., and Nicholls, P. "Definitions of SF." In *Encyclopedia of Science Fiction*. London: Orbit/Little, Brown and Company, 1995, 311-314.
- [5] Galegher, J. and Kraut, R.E. Computer-mediated communication for intellectual teamwork: An experiment in group writing. *Information Systems Research*, 5(2), 1994.
- [6] Hattie, J., Marsh, H. W., Neill, J. T., and Richards, G. E. "Adventure Education and Outward Bound: Out-of-Class Experiences that Make a Lasting Difference." *Review of Educational Research* 67(1), 1997, 43-87.
- [7] Herbsleb, J.D., Mockus, A., Finholt, T.A., and Grinter, R.E. Distance dependencies and delay in global collaboration. In *Proceedings of Computer-Supported Cooperative Work*, 2000. New York: ACM Press.
- [8] Hogg, M. A., & Abrams, D. Social identity and social cognition: Historical background and current trends. In D. Abrams & M. A. Hogg (Eds.), *Social identity and social cognition* (pp. 1-25), 1999. Oxford, England:
- [9] James, K. and Greenberg, J. In-Group Salience, Intergroup Comparison, and Individual Performance and Self-Esteem. *Personality and Social Psych. Bulletin*, 15(4), 604-616, 1989.
- [10] Jarvenpaa, S.L. & Leidner, D.E. Communication and trust in global virtual teams. *Organization Science*, 10(6), 1999.
- [11] Paula R. Kaiser, William L. Tullar and Diana McKowen. Student Team Projects by Internet. *Business Communication Quarterly* 63(4), 75-82, 2000.
- [12] Kayworth, T. and Leidner, D. The global virtual manager: A prescription for success. *European Management Journal*, 18(3), 2000.
- [13] Lea, M., Rogers, P. and Postmes, T. SIDE-VIEW: Evaluation of a system to develop team players and improve productivity in Internet collaborative learning groups. *British Journal of Educational Technology*, 33(1), 2002.
- [14] Locke, E. A., N. Cartledge, and C. S. Knerr. "Studies of the Relationship Between Satisfaction, Goal Setting and Performance," *Organizational Behavior and Human Performance*, 5, 135-158, 1970.
- [15] Maznevski, M. and Chudoba, K. Bridging space over time: Global virtual team dynamics and effectiveness. *Organization Science*, 11(5), 2001.
- [16] Nardi, B. Strangers and friends: Collaborative play in World of Warcraft. In *Proceedings of Computer-Supported Cooperative Work*, 2006. New York: ACM Press.
- [17] Olson, G. and Olson, J. Distance matters. *Human Computer Interaction*, 15, 2002.
- [18] Postmes, Tom. A social identity approach to communication in organizations. In A. Haslam, D. van Knippenberg, M. Platow, & N. Ellemers (eds.), *Social identity at work: Developing theory for organizational practice*. Philadelphia, PA: Psychology Press, 2003.
- [19] Ren, Y., Kraut, R., and Kiesler, S. Applying common identity and bond theory to design of online communities. *Organization Studies*, 28(3), 377-408, 2007.
- [20] Robey, D., Khoo, H., and Powers, C. Situated learning in cross-functional virtual teams. *IEEE Transactions on Professional Communications*, 43(1), 2000.
- [21] Salas, E., Rozell, D., Mullen, B., and Driskell, J. E. "The Effect of Team Building on Performance: An Integration." *Small Group Research* 30(3), 1999, 309-329.
- [22] Sarker, S. and Sahay, S. Understanding virtual team development: An interpretive study. *Journal of the Association for Information Systems*, 3, 2002.
- [23] Second Life Statistics, June 2007, http://static.secondlife.com/economy/stats_200707.xls.
- [24] Seriosity. Virtual Worlds, Real Leaders: Online games put the future of business leadership on display. [http://domino.research.ibm.com/comm/www_innovate.nsf/images/gio-gaming/\\$FILE/ibm_gio_gaming_report.pdf](http://domino.research.ibm.com/comm/www_innovate.nsf/images/gio-gaming/$FILE/ibm_gio_gaming_report.pdf)
- [25] Sherif, M., Harvey, OJ, White, BJ, Hood, WR, Sherif, CW. *Intergroup cooperation and competition: The Robbers Cave experiment*. Norman, OK: University Book Exchange, 1961.
- [26] Stanne, M., Johnson, D, & Johnson, R. Does competition enhance or inhibit motor performance: A meta-analysis. *Psychological Bulletin*, 125, 133-154, 1999.
- [27] Suchan, J. and Hayzak, G. The communication characteristics of virtual teams: A case study. *IEEE Transactions on Professional Communication*, 44(3), 2001.
- [28] Sutanto, J., Phang, C.W., Kuan, H.H., Kankanhalli, A. and Tan, B.C.Y. Vicious and Virtuous Cycles in Global Virtual Team Role Coordination, *Proceedings of the Thirty-Eighth Annual Hawaii International Conference on System Sciences*, Hawaii, United States, 3-6 January 2005.
- [29] Tajfel, H. and Turner, J. C. Social identity theory of intergroup behavior. In Worchel and Austin (eds.), *Psychology of Intergroup Relations*. Chicago: Nelson-Hall. 1986.
- [30] Thomas, J.C. http://diac.cpsr.org/cgi-bin/diac02/pattern.cgi/public?pattern_id=79.
- [31] Tyler, T.R. and Blader, S.L. *Cooperation in groups: Procedural justice, social identity, and behavioral engagement*. Philadelphia: Psychology Press, 2000.
- [32] Walther, J.B. Relational aspects of computer-mediated communication: Experimental observations over time. *Organization Science*, 6(2), 1995.
- [33] The Seed of an Idea. (2006, September). *Edge*, 133, 50-57.