Cooperative Games and Their Effect on Group Collaboration

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Abstract. The potential for multiplayer computer games to serve as activities that can help increase interaction, cooperative tendencies and harmony in groups has been the subject of past research. However, there is still a long way to go before we can understand how positive group behavior and team dynamics in multiplayer games can impact real world collaboration. In our research work, we investigate this relationship further through *Operation Sting*, a cooperative multiplayer game we have designed to serve as an ice-breaker. Our goal is to study how participation in such a game affects collaboration in subsequent group work.

Keywords: Multiplayer games, Collaboration, Ice-breaker, Cooperative work.

1 Introduction and Background

Many online multiplayer games today emphasize teamwork and cooperation. Massively Multiplayer Online Role Playing Games (MMORPG), such as *World of Warcraft*, include significant content that focuses on 'parties' of multiple individuals working together. Such cooperative content may either be in the form of group quests or the inclusion of high level bosses and enemies that can only be defeated when players work together. Several First Person Shooter (FPS) and Real Time Strategy (RTS) games include team-versus-team battle modes in which groups can work together to compete against other teams.

The shared virtual spaces at the core of such games provide a great medium for geographically distributed players to interact with one another and work together, particularly when face-to-face interaction is not feasible. Collaborative play in such environments has been the topic of prior research investigation [7, 12]. Furthermore, the use of game environments as collaborative workspaces for distributed teams to work together has been studied [1, 9, 16]. Ellis, et al. observe that games can be leveraged as team building activities which help mitigate problems associated with distributed teams, such as a lack of trust, low group cohesion and identification, and difficulties in communication [6].

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In our research, we are studying the use of a multiplayer game as an ice breaking activity that occurs before collaborative group work. Ice-breaking games have been shown to help groups work better together [6, 11]. We believe that a cooperative multiplayer game is a suitable ice-breaker because the cooperative elements in a multiplayer game can help develop more cohesive and productive teams, particularly when they have not worked together before. Working together to achieve a common objective in a game has been found to increase likeability among players [4].

There exist several examples of commercial multiplayer games that offer rich cooperative play and might be candidates for ice-breakers. However, many of these commercially available games are too involved for both gamers and non-gamers alike to quickly pick up and engage for a short duration (*World of Warcraft*, *Left4Dead*, *Little Big Planet*, *Starcraft* 2 etc.). At the same time, there also exist simpler games like *Rock Band* and *Rayman's Raving Rabids* (investigated in [11]), but these do not enforce cooperation amongst players beyond the accumulation of points. Many of the commercial games we surveyed did not cater to our unique needs and led us to the design our own ice-breaking game.

2 Game Design

The goal of our research is to investigate how participation in a cooperative ice-breaking game affects collaboration among teammates in subsequent group work. We hypothesize that playing a cooperative ice-breaking game will result in increased collaboration in subsequent group work as measured by improvements in each of three dimensions: I) Interaction among teammates; II) Level of individual participation; and III) Individual satisfaction with work outcomes and the group activity [3, 4, 10].

To our knowledge, no suitable co-operative ice-breaker game exists so we also sought to create such a game, leveraging the properties of cooperative multiplayer games. Such a game should allow participants to immerse themselves into the activity relatively quickly and accomplish a few well-defined objectives within a short timeframe (20-30 minutes). Our investigation leads us to the precise specification of the design requirements for an ice-breaking game (IBG, for short). We then use these requirements to design and implement our own game prototype *(Operation Sting).*

Adopting an approach similar to the one used in the design of learning games [8, 14], we specify the desired characteristics for an IBG, using the properties of multiplayer games as identified in [8] & [17]. We divide these characteristics into two categories: *Game Play* and *Cooperative Play*.

Game Play:

- Moderate complexity
- Easy to use interface
- Moderately easy difficulty
- Appealing theme

Cooperative Play:

- Balanced individual participation
- Uniqueness of roles
- Need for social interaction
- Use of cooperative patterns
- Concurrent play

Moderate complexity: Complexity relates to the intricacy and details surrounding game objectives, the variety of choices a player can make, and the degree of control he/she has over the decisions made. The IBG should incorporate a moderate level of complexity, enough to mentally stimulate the players but not so much that the cognitive effort and time spent on the game has an adverse effect on performance in subsequent collaborative work.

Easy to use interface: The interface is the medium (both software and hardware) through which a player exercises control in the game. In an IBG, the interface should be easy to adapt to for people with varying levels of video game experience. Precise aiming and 3D navigation (as needed in FPS games like *Left4Dead*) or prior knowledge of unit micromanagement techniques (as in *Starcraft 2*) should not be a prerequisite to enjoy the game.

Moderately easy difficulty: Unlike complexity, difficulty relates to the skill, precision and likelihood of failure in carrying out a task, even if its nature and requirements may be explicitly clear [15]. We propose that an IBG should be moderately easy, so as to avoid frustration and allow steady team progress. We believe that this would help create a positive environment for subsequent collaborative work.

Appealing theme: The context of the story, the themes used, and the subject matter of the IBG should try to appeal to a wide variety of players so as to not marginalize certain individuals in the group. For example, games with a heavy emphasis on violence may deter certain players.

Balanced individual participation: The IBG should try to roughly allocate an equal amount of utility for each player to participate in the game, irrespective of their capabilities. It should also try to enforce a minimum level of participation for each player. In the subsequent collaborative group work, we would like to reduce problems such as *social loafing* and the *sucker effect* [13].

Uniqueness of roles: In the IBG, it would be desirable to give players different roles and yet have each player play a critical part in making progress for the group [18]. This would be analogous to real life work teams, where different individuals have different skills and expertise to contribute to the team work in different ways.

Need for social interaction: Actively encouraging players to communicate with each other is an important objective for ice-breaker games. For example, displaying selective information to specific players necessary for task completion may encourage increased communication with others [18]

Use of cooperative patterns: For a multiplayer game to be considered 'cooperative', it must include one or more cooperative gameplay patterns (or mechanisms). These patterns have been discussed in detail in [7]. Some examples include shared goals, shared puzzles, limited resources, and synergies between player abilities.

Concurrent play: A multiplayer game may be classified as *concurrent* (all players play simultaneously at same time), *synchronous* (all players play at the same time but take turns) or *asynchronous* (players make progress in the game without having to

play at the same time) [17]. An asynchronous game would be inappropriate for a 20-30 minute IBG. Taking turns in a synchronous game may allow for better players to 'play for' their teammates while waiting for their turn and encourage *social loafing* in the group. Consequently, a concurrent IBG appears to be most appropriate.

3 Operation Sting – Overview and Implementation

Operation Sting is a 3- or 4-player cooperative game in which team members must work together to pull off a heist in an art museum. Each player is assigned a unique character with special abilities. The Conman character can use a lock pick to open padlocked doors and temporarily distract security guards. The Muscle is able to move around heavy objects and use items such as a crowbar to break down weak walls and windows. The Hacker can access sensitive information from computer terminals and disable cameras and laser detectors. Finally, the Executive has money that can be used to bribe certain individuals to overlook transgressions and is able to gain access to VIP areas of the museum. In the 3-player version, the role of the Executive is eliminated.

Fig. 1. All Characters: (From Left) Conman, Muscle, Hacker and Executive

The game consists of a single heist mission where the 4 characters infiltrate the museum, each from a different location. The players must navigate through areas on the map and overcome different obstacles. As in real project or collaborative work environments, players are put into situations where they need to rely on each other's individual abilities to move forward. For example, access to a padlocked door revealing a new area may be blocked with several wooden containers. The Muscle would need to first move these containers out of the way before the Conman may pick the locked door.

We have incorporated the IBG design considerations recommended in Section 2. *Operation Sting* is a moderately complex, obstacle-solving, concurrent 2D game with easy to use controls (directional arrow keys and spacebar on the keyboard) and easy gameplay. Furthermore, the group heist theme used in the game is quite common in popular culture and should hopefully be familiar to all players. The game assigns each of the players a unique role with special abilities and the levels are designed in a way that allows each player to make a roughly equal contribution to progressing through the mission. Finally, the special abilities granted, the unique information presented to specific players, and the use of shared obstacles require players to interact with one another in many situations to progress through the game.

Operation Sting is implemented in the style of a 2D overhead projected Role Playing Game (RPG). Multiplayer gaming is supported using a client-server architecture. The game client was developed using Adobe Flash and ActionScript 3 and can run on a Desktop computer using either Windows or OSX as the operating system. The server is a Windows executable which was written in C#. Communication between the client and the server relies on a 3rd party library (Player.IO) which makes use of the Transmission Control Protocol (TCP).

Fig. 2. A game in progress (Conman point of view)

4 Study and Evaluation

We designed and conducted a user study to evaluate if playing *Operation Sting* as a cooperative ice-breaking game improves collaboration in subsequent group work. To date, we have conducted an initial experiment in a classroom setting and are currently planning a second experiment in a work environment.

In the first experiment, we invited students enrolled in a project management course in the Faculty of Information at the University of Toronto to participate in our study. Students were assigned by the instructor to teams of 3-4 people to work on a course project. At the start of the course project, each team of students participated in a synchronous computer-mediated activity (for 40-60 minutes) in order to collaboratively identify projects that could implement an organizational strategy. The computer-mediated activity was carried out in two steps: a brainstorming step in which each team brainstormed project ideas; a project identification step in which each team selected a final list from the list of project ideas produced in the brainstorming step. The two-step activity was inspired by the Brainstorming and Fast Focus Thinklets of Briggs et al. [2].

For our study, the teams were randomly placed into 3 groups: a) Five teams (3 of size 3, 2 of size 4) played *Operation Sting* before participating in the computer-mediated project selection activity; b) Four teams (2 of size 3, 2 of size 4) participated in a generic ice-breaker game (Liar, Liar! [5]) before participating in the computer-mediated activity; and, c) Seven teams (4 of size 3, 2 of size 4, 1 of size 5) participated in the computer-mediated activity without first playing *Operation Sting* or the generic ice-breaker (i.e., control groups). Conversations during the computer-mediated project selection activity (Fast Focus) were recorded and analyzed quantitatively to measure Interaction (Dimension I) and Participation (Dimension II). Additionally, students were asked to complete a survey at the end of the activity to measure Individual Satisfaction (Dimension III). In the survey, students rated statements on a 5-point Likert scale such as, "I am glad that I was chosen to be part of this group and not another one", and "My group developed good and useful ideas".

5 Preliminary Results and Future Plans

Thus far, we have carried out a preliminary analysis of the data. In order to measure Interaction, we looked at the cumulative (per group) and individual (per person) number of ideas and comments submitted during the Brainstorming and Fast Focus steps respectively. These numbers are normalized by the time spent during each step. For the Brainstorming step, we normalize the number of ideas to a period of 10 minutes (i.e. {No. of ideas/brainstorming duration in minutes}×10). Similarly, in the Fast Focus step, we normalize the number of comments to a period of 60 minutes. In addition, the number of ideas and comments per group are normalized by group size. Error bars in Figures 3 and 4 indicate +/- 1 standard deviation.

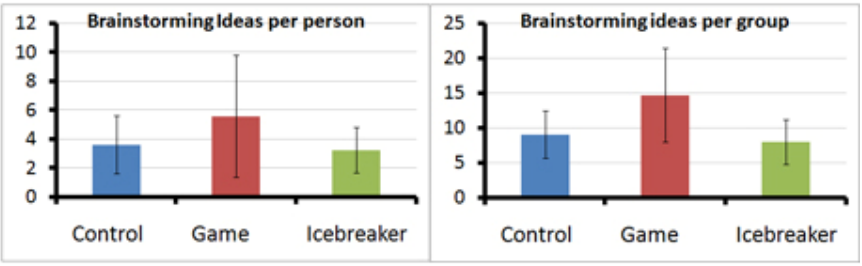

Fig. 3. Mean number of brainstorming ideas per person across each category (left), and mean number of brainstorming ideas per group (right)

For the mean normalized number of individual and total ideas (using a two-tailed t-test), we observe p-values of 0.08 and 0.14 respectively for the Game-Control comparison and 0.05 and 0.10 for the Game-Icebreaker comparison.

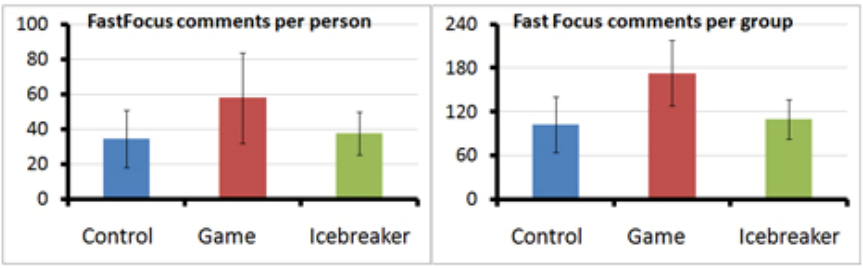

Fig. 4. Mean number of Fast Focus comments per person across each category (left), and mean number of Fast Focus ideas per group (right)

For the mean normalized number of individual and total comments, we observe p-values of 0.002 and 0.02 respectively for the Game-Control comparison and 0.008 and 0.04 respectively for the Game-Icebreaker comparison. Collectively, these results suggest increased Interaction in the Game category compared to the Control and Icebreaker categories. We plan on having an independent reviewer rate each of the ideas and assign them a quality score which we will also take into consideration

Participation was measured by observing the contribution ratios (both Brainstorming ideas and Fast Focus comments) for each user in the group. A Participation Score for each group was calculated by taking the sum of $min(1/GS, N/NG)$ over all users in the group. Here, GS denotes the Group Size, N is the number of comments/ideas contributed by the user and NG is the total number of comments/ideas generated by the group. A higher Participation Score indicates balanced participation of all individuals in the group (with a maximum of 1 when all individuals in the group contribute equally) whereas a lower score indicates otherwise. To measure Individual Satisfaction, the average Likert scores (across individuals) for survey statements were compared for each of the 3 categories. Neither the analysis of the Participation Scores or the results from the survey indicated statistically significant differences.

We are currently planning a second experiment involving several teams of co-workers participating in a planning activity. In the first experiment we found that the game itself encouraged active discussion and dialogue between the players (who were seated side by side) but this model of interaction did not match the subsequent computer-mediated activity which involved typing on screen and no face-to-face interaction. In the second experiment, participants will engage in a face-to-face team-based activity following our ice-breaker video game. We will capture the interaction in the subsequent team activity using video and conduct content analysis of the discussion.

6 Conclusion

The goal of our research was to investigate the effects of using a cooperative ice-breaking game prior to team-based collaborative work. We developed a multiplayer video game designed to be used as a 20-30 minute ice-breaker for teams with mixed levels of gaming experience. We compared teams that carried out a collaborative

activity after playing our game with those that did not participate in any ice-breaking activity and those that participated in a general ice-breaking activity. We found that teams which used our game prior to their group activity experienced increased interac-tion but there were no significant changes measured in participation or satisfaction. A second experiment is planned to further evaluate the impact of the game on subsequent team based work.

References

1. Bartlett, K., Simpson, M.: Using Games as a Means of Collaboration. In: Proc. 2005 International Conference on Multi Media Modeling (MMM). IEEE Press (2005)
2. Briggs, R.O., De Vreede, G., Nunamaker, J.F.: Collaboration engineering with ThinkLets to pursue sustained success with group support systems. Journal of Management and Information Systems 19(4), 31–64 (2003)
3. Costa, A.C.: Work Team Trust and Effectiveness. Personnel Review 32(5), 605–622 (2003)
4. Dabbish, L.A.: Jumpstarting Relationships with Online Games: Evidence from a Laboratory Investigation. In: Proc. 2008 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW), pp. 353–356. ACM Press (2008)
5. Dixon, J.S., Crooks, H., Henry, K.: Breaking the Ice: Supporting Collaboration and Development of Community Online. Canadian Journal of Learning and Technology 32(2) (2006)
6. Ellis, J.B., Luther, K., Bessiere, K., Kellogg, W.A.: Games for Virtual Team Building. In: Proc. 2008 ACM Conference on Designing Interactive Systems (DIS), pp. 25–27. ACM Press (2008)
7. El-Nasr, M., Aghabeigi, B., Milam, D., Erfani, M., Lameman, B., Maygoli, H., Mah, S.: Understanding and Evaluating Cooperative Games. In: Proc. 2010 ACM SIGCHI Conference on Human Factors in Computing Systems (CHI), pp. 253–262. ACM Press (2010)
8. Garris, R., Ahlers, R., Driskell, J.E.: Games, Motivation and Learning: A Research and Practice Model. Simulation and Gaming 33(4), 441–467 (2002)
9. Gurzick, D., White, K.F., Lutters, W.G., Landry, B.M., Dombrowski, C., Kim, J.Y.: Designing the Future of Collaborative Workplace Systems: Lessons Learned from Comparison with Alternate Reality Games. In: Proc. iConference 2011, pp. 174–180. ACM Press (2011)
10. Hathorn, L.G., Ingram, A.L.: Cooperation and Collaboration using Computer-Mediated Communication. Journal of Educational Computing Research 26(3), 325–347 (2002)
11. Lin, Q.T., Wu, J.: The Impact of Virtual Teamwork on Real-world collaboration. In: Proc. 2009 International Conference on Advances in Computer Entertainment Technology (ACE), pp. 44–51. ACM Press (2009)
12. Nardi, B., Harris, J.: Strangers and Friends: Collaborative Play in World of Warcraft. In: Proc. 2006 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW), pp. 149–158. ACM Press (2006)
13. Piezon, S.L., Ferree, W.D.: Perceptions of Social Loafing in Online Learning Groups: A study of Public University and U.S. Naval War College students. The International Review of Research in Open and Distance Learning 9(2) (2008)
14. Reiber, P.: Seriously Considering Play: Designing Interactive Learning Environments Based on the Blend of Microworlds, Simulations and Games. Educational Technology Research and Development 4(2), 43–58 (1996)

15. Robinson, P.: Task Complexity, Task Difficulty, and Task Production: Exploring Interactions in a Componential Framework. Applied Linguistics 22(1), 27–57 (2001)
16. Sharma, G., Shroff, G., Dewan, P.: Workplace Collaboration in a 3D Virtual Office. In: Proc. 2011 International Symposium on Virtual Reality Innovation (ISVRI), pp. 3–10. IEEE Press (2011)
17. Zagal, J.P., Nussbaum, M., Rosas, R.: A Model to Support the Design of Multiplayer Games. Presence 9(5), 448–462 (2000)
18. Zagal, J.P., Rick, J., Hsi, I.: Collaborative games: Lessons learned from board games. Simulation and Gaming 37(24), 24–40 (2006)