Encouraging Teamwork with Cooperative Gameplay Mechanics

Woody Hill
43219238

Final Report

Due: 5:00pm Monday, 16/06/2017

Abstract

This report investigates what components of cooperative games can contribute to the development of teamwork and communication. It reflects on the achievements and shortcomings of the Tricky Multi-Player Multi-Reality Puzzle (TMPMRP) project and highlights how these are related to existing theory's of game design and problem solving exercises.

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1 Introduction

Problem solving and communication skills are considered to be some of the most important attributes across all professions [6], yet students are not being exposed to exercises which challenge these skills [7]. Technology is becoming more prevalent within education and has the potential to provide meaningful challenges which require creative thinking and collaboration to solve [7].

The Tricky Multi-Player Multi-Reality Puzzle (TMPMRP) was developed as a team building experience that could also test problem solving skills within a collaborative interactive environment. Using virtual reality, 3D lifelike puzzles can be designed which force participants to communicate with each other in order to solve them.

In the level we demoed at the edge exhibition, there are two players; the one in virtual reality who holds the camera cube, and the one in physical reality (PR) who holds the lighting cube. The goal was for the players to unlock all three gates by holding their cubes in a trigger area. The player in VR must tell the PR player where to go using verbal communication and with visual cubes using the camera cube to show the environment. The PR player can only see what the camera cube is pointed at and relies on instruction from the VR player.

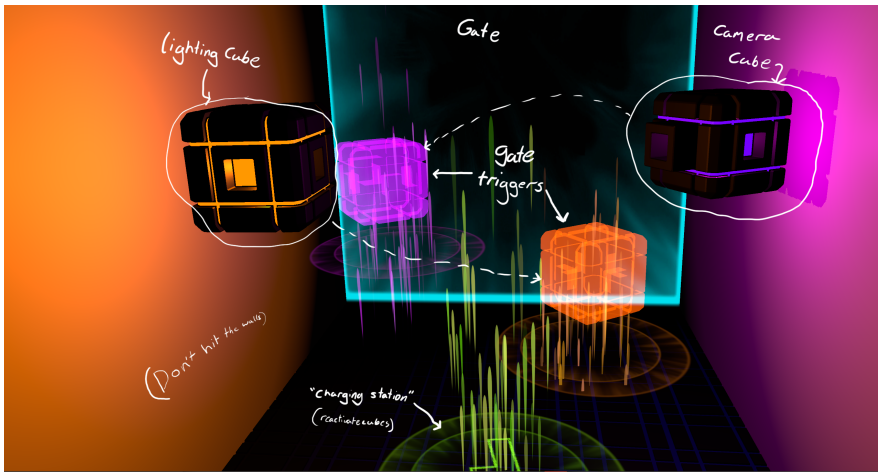

Figure 1: labeled elements in the TMPMRP demo

As a team building exercise it was important to ensure that the cooperative elements were engaging and encouraged positive communication.There were many theoretical considerations for designing cooperative levels that could have a large impact on the participants experience and outcomes.

This report will explore the different elements which contribute to positive cooperative experiences in games and activities. It will analyse what components of the TMPMRP were received positively or negatively, and how they may be reflected in other cooperative experiences such as portal 2 or educational team building exercises.

2 Background Survey

2.1 Negative Effects of Skill Gaps

A difference in skill or knowledge in any cooperative activity where members rely on each other to complete tasks can cause tensions and lead to a negative experience. It could lead to a member blaming others for the team's failures, impatience, or feelings of being inadequate [8]. Having a similar level of skill is extremely important for team based competitive games, and as such matchmaking algorithms have become very important in the E-sports industry.

> *Poor matchmaking has the effect of discouraging less-skilled players from continuing to play, which, in games that are increasingly reliant on multiplayer competition, is detrimental to a game's longevity and, therefore, its profitability. Beyond this problem, though, there exists a more general need to better account for attributes present in team-based games specifically, including the notion of "team chemistry"* [9].

Team building exercises are not competitive however, and the aim is not to win but to work better with team members. Since we want to avoid tensions within the team, situations where members will rely on the skill or knowledge of another member should be avoided.

This theory was observed while demoing the TMPMRP where some participants new to VR would find it too difficult not to touch the virtual walls with the cubes and they would constantly be deactivated. If this happened too often the other team member would grow impatient which had a negative effect on the experience for the whole team. Making the corridors in the level was a simple modification which alleviated these problems, since it took away a spacial skill requirement of individuals. After the modification was made team members no longer became impatient with each other and there was a far greater success rate as well as faster average times for teams to complete the puzzle.

When I was designing the gameplay elements for the TMPMRP I had to make sure that they would not be too difficult so that a single member could cause constant failures, but also challenging enough to be engaging and encourage cooperation between the members.

2.2 Preventing participants from individually completing puzzles

Inversely to a negative experience caused by a team member being less skilled, if an individual member of the team can complete a cooperative task by themselves, the rest of the team may not get to contribute or be left feeling that the individual member is going too fast.

I achieved this in the TMPMRP by requiring multiple cubes to be held in positions that would be physically impossible for a single person to reach by themselves. This forces the team members to communicate and share instructions. I had to be careful however for situations where one player would know exactly what to do and end up just instructing them entirely through the level, as this can remove the satisfaction of helping solve a problem for the other player [8].

Figure 2: A short comic outlining a problem with the cooperative gameplay of the popular game, portal 2. Retrieved from http://indiemegabooth.com/unique-problems-of-cooperative-game-design/

One solution could be to limit how much or what kind of communication is permitted between participants, a strategy found to be effective in games such as *Journey* and *Human and Dog* [11]. This allows players to give each other hints and clues for solving a challenge without giving too much away.

2.3 Dividing information between participants

If applicable, puzzles can be split in to smaller components which require pieces of information to solve. This information can be disseminated among the team members so that no one person would know how to complete the puzzle with the information they have. This forces members to collaborate and bring together what they know in order to move forwards. For this to succeed, all members of the team must at least share and understand the objective of the puzzle [10].

This is done very effectively in the cooperative game *Keep Talking and Nobody Explodes*, where one player can see and interact with a virtual bomb, while the others have instructions on how to diffuse it. The game requires the bomb defuser to communicate what they can see so that the other players can find specific instructions which then have to be communicated back to the bomb defuser. This works well because no one player could know how to complete a level without communicating with the other. It requires two way communication which ensures that no player is left out of the problem solving experience.

This cooperative gameplay component works best when players are not able to see the same things as each other. VR provides a unique advantage in this case, where one player could be in a completely different environment but still be able to communicate with their team close by. The challenge then is ensuring that the different environments puzzles are linked and that the team will be able to relate them to each other.

I initially intended to have a cooperative element in the TMPMRP where only PR player could see the camera cube gate triggers on screen, and only the VR player could see the light cube gate triggers. That would have meant that players were forced to communicate to help each other find their goals with back and forth communication. I did not end up keeping this in the demo for the exhibit since it proved to be a difficult challenge for many users. Looking back I should have kept it as an advanced challenge mode for teams with greater aptitude.

3 Team Roles

Table 1: Team Roles

Member	Role	Responsibilities
Woody Hill	Programmer	Gameplay Design
		Cooperative Elements
		Programming
		Unity Level Editing
		Kickstarter Video and storyboard
Daya Kern	Designer	3D Assets
		Gameplay design advice
		Physical cubes
		Particle systems
		Kickstarter Video and storyboard
Raul Revelo	Hardware	Pressure Pads
Xu Liu	Designer	Pin up materials
		Level Design

4 Individual Contributions

4.1 Initial Concept

I came up with the initial concept for the multi-planar maze during iterative design and brainstorming with the team. We had been discussing projects that would have used the kinect but were running in to issues where we would be limited to a more two dimensional tracking and not being able to use the whole environment. After explaining the concept and how it would work with the htc Vive the team decided to take it on as the project.

4.2 Prototype

With some assistance from Daya learning Unity, I was able to create a functioning prototype. Since the steamVR plugin came with a prefab, it was very easy to set up a virtual reality version of our project. Initially the plan was to have the two planes projected on to the wall and floor, however considering the prototype feedback we decided to go with the full virtual reality experience instead.This meant that we would not have to worry about setting up a projector aiming at the floor and multiple displays of the unity scene.

Feedback also indicated that the experience looked too difficult and frustrating. Whenever the cube collided with a wall the user would have to return to the start and navigate through the maze again. I could tell that this would lead to a negative cooperative experience if one of the participants were less skilled at navigating the maze without touching the walls. My solution to this was to add checkpoints to the game and to have wider corridors which allow more movement and would be less punishing.

4.3 Storyboard

The initial draft storyboard was developed by Raul, however we wanted to take the kickstarter video in a different direction. Daya and I created the final storyboard for the kickstarter taking inspiration from adds for companies such as old spice or dollar shave club. Our goal was to keep the audience engaged with quick humorous scenes while conveying the important information.

I believe that the storyboard may have been too ambitious as it required a high level of cinematography to pull off. A more simple interview style storyboard may have been far easier to film and edit.

4.4 Kickstarter Draft

Daya and I were able to film a draft version of the kickstarter based on the storyboard. We had to use static scenes though since we did not have anyone to help operate the camera. We should have used alternate means for recording audio as the internal microphone on my camera was not able to pick up all of the sound.

We were successful in conveying all the necessary information while keeping the video entertaining, with only a few placeholder scenes that could have been filled in later.

4.5 Gameplay Modifications and Considerations

With the exhibit coming up there were a lot of new considerations for what experience I wanted to show the guests. I wanted to create separate environments for the players that would share puzzle elements. I also needed to be careful that the PR player would stay engaged with the activity as there is a lot less immersion when compared with the VR player's experience.

After some more research and iterative design refinements with Daya we came up with the idea of having a camera cube which shows a viewport of VR to the PR player. This meant that I would not have to modify the current prototype too much but we could still have a situation where information is divided between participants.

We scrapped the idea of having multiple planes as it became irrelevant in VR where you could just use 3D space instead. I turned one of the existing maze planes in to a 3D maze that you could walk through. User testing with course tutors confirmed that this improved the experience immensely.

Since the VR player now had the role of carrying the camera cube, I needed to give a role for the PR player. Considering some ideas from feedback from the prototype, I put a light source in the PR player's cube and removed all other lighting from the level. This meant that The VR player would not be able to see anything without the PR player holding the cube nearby, which added a new cooperative element to the game.

5 Reflection

The overall experience of the project was demonstrated well at the exhibit. The first wave of guests were highschool students which was very fitting as a measure for the projects success since it is aimed at teambuilding in the context of early learning.

I found that it sometimes was difficult to explain the objective of the game while the students were trying on the virtual reality goggles for the first time and with their friends talking and watching next to them. This detracted from the cooperative experience because not all members had a clear idea of the goal. This could have been avoided with an in game tutorial or more clear in game instructions.

Another issue that was encountered was the skill gap. This was more noticable among the students compared to adults participating in the experience. An interesting observation was that the introverted students were more better at giving and receiving instructions and collaborating to complete the challenge than the extroverted students. There were many cases where team members would grow impatient with each other because one of them would keep accidentally disabling their cube by touching a wall or gate. This is an example of how a skill gap can negatively effect cooperative experiences. Changing the level design so that participants had more room to move the cubes around helped with this issue somewhat.

All participants were completely involved and engaged in the activity, and had an important role in completing the puzzle. The camera cube for the VR player acted as a prop and we observed as many players took on the role of *director* and gave instructions in a similar demeanor to a photographer.

An element that could have been improved was the fact that the VR player had all the information needed to complete the level. This became apparent because the VR player was always telling the PR player what to do and it was never the other way around. It did not detract much from the cooperation, however it meant that the overall experience was unequal and would have left the PR players feeling less satisfied than the VR players. Having components that only the PR player can see would have fixed this issue, but may have required more explanation or even a tutorial level to ensure that the participants understood the goals.

6 Conclusion

Showing the project at the exhibit allowed me to reflect on some cooperative components worked well and what didn't. The experience greatly varied depending on the personalities and team dynamics of the participants. This further displays that difference in skill and knowledge can greatly effect the overall experience. Since we cannot depend on any sort of matchmaking for a team building exercises, we must design the activity to have a level playing field.

The TMPMRP was successful in forcing collaboration through requiring consecutive actions and hiding information from the PR players. Most participants from the exhibit agreed that it was a positive team building exercise which got team members thinking from each others perspectives. If more of the cooperative gameplay elements were added in further levels, the TMPMRP would have the potential to become a popular team building activity.

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