Game Mechanics for Cooperative Games

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Abstract. In this paper, we approach the subject of Cooperative Video Games and their Design. We start out by examining Cooperative Game Mechanics - these include common Design Patterns used currently in Cooperative Video Games and how the challenge archetypes are currently used in Cooperative Video Games. We then proceed to examine our experience in designing a cooperative two player video game using the previously mentioned patterns and challenges, and we present some preliminary evaluation data of the game.

1 Introduction

Currently, some of the most successful games offer some sort of cooperative gameplay. In fact, one of the most successful games of the market is an MMORPG[1] a game genre which tends to be very focused on cooperation between different players (we are of course referring to World of Warcraft[2]). Similarly, several other high profile games have a cooperative nature - Counter-Strike[3], one of the most popular Multiplayer FPS[4] games ever, is essentially a game where players cooperate in teams while attempting to defeat the other team; More recently, Valve (the company behind Counter-Strike) has released Team Fortress 2[5], a sequel to one of the most popular QuakeWorld mods, uses a class-based teamplay as one of its core mechanics (much like the original mod). Other games have suddenly returned the focus to the possibility of playing games cooperatively, such as was present on most games during the early ears of the games consoles - Lego Star Wars[6] and its sequel are clear examples of this type, they are games that allow a second player to join in on the fun, despite being able to be played in single-player mode; The latest Mario, Super Mario Galaxy[7], also allows a second player to play cooperatively.

This sudden re-emergence of cooperative play is supported by the fact that studies on the demographics of players suggest that there is a whole group of potential players that currently do not play because games are not made for them[1]. This group favors cooperative experiences and play experiences shared with others in the same physical space. This fact may justify the success of Nintendo's Wii and some titles such as the Buzz[8]series.

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[1] Massive Multiplayer Online Role Playing Games
[2] World of Warcraft official website: www.worldofwarcraft.com
[3] Counter-Strike official website: www.counter-strike.net
[4] First Person Shooter
[5] Team Fortress 2 official website: orange.half-life2.com/tf2.html
[6] Lego Star Wars official website: www.legostarwarsthevideogame.com
[7] Super Mario Galaxy official website: www.supermariogalaxy.com
[8] Buzz official website: www.buzzthegame.com

In this paper we present a list of Challenge Archetypes that are currently used in cooperative games to promote cooperation between players as well Design Patterns currently employed in games that allow for an interesting cooperative experience. This list was based on an analysis of some of the most successful games that, in our opinion, support some form of cooperation between players.

Using this knowledge we developed a game targeting the group of players that seek cooperative co-located play experiences. The game, called Geometry Friends, is a two player game that uses the Wii controls.

The paper is organized into three main sections plus this introduction and the conclusions. The three main sections are entitled: Cooperative Game Mechanics, Designing Geometry Friends and Preliminary Evaluation. The first one of these sections presents several mechanics that can facilitate the development of a cooperative game - Design Patterns and Challenge Archetypes. The second section of these describes a game we developed using these mechanics, and exposes how we used them to try and improve the cooperative experience. The last of these sections shows the preliminary evaluation we have conducted on the game.

2 Cooperative Game Mechanics

Several game mechanics are currently used by cooperative games. These can be separated into two main types - Design Patterns for Cooperative Games and Challenge Archetypes.

2.1 Design Patterns for Cooperative Games

In this section, we describe several Design Patterns that we came across while analyzing several Cooperative Games. The main purpose of these Design Patterns is to be used as guidelines that help the development of Cooperative Games.

Complementarity.

One of the most commonly used design patterns in cooperative games is making sure that there is some complementarity between the characters that players control. This usually leads to several consequences, one is that characters tend to settle better in one type of role, another is that even when you have two different character types for the same role, they will usually be complementary to one another, as they will have different abilities that will complement each other in that role. Most MMORPGs tend to use this pattern (World of Warcraft, City of Heroes[9]), as well as some of the more sophisticated FPS games (Team Fortress 2, Battlefield[10], Enemy Territory[11]).

Synergies between abilities.

Another design that is commonly used, is by making sure that some of the abilities of one character type have some synergy with abilities of another character type. Some examples of this exist in World of Warcraft - a shadow priest (who deals mostly shadow damage) can cause an enemy to become more vulnerable to shadow damage, which also causes an increase of damage that the warlocks are causing (who also deal shadow damage).

Abilities that can only be used on another player.

Sometimes games provide players with abilities that can only be used on another player. This partly because the purpose of these abilities is to encourage cooperation between players. For example, a medic in Team Fortress 2 has a weapon that allows him to heal another player, and

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[9] City of Heroes website: www.cityofheroes.com
[10] Battlefield official website: battlefield.ea.com
[11] Enemy Territory official website: www.enemyterritory.com

if they have managed to charge it to a certain point grant, during a period of time, invulnerability (or a damage boost) to the teammate they are healing.

Shared Goals.

Most games tend to use up a simple design pattern in order to force players to work together, a group of players will have one non-exclusive goal, that can be completed in a group. One of the best examples for this comes in a particular form of World of Warcraft's Quests. The Quests which simply ask you to kill an X amount of enemies or a particular enemy, are pretty easy to achieve in a group. Team FPS (Counter-Strike, Team Fortress 2) also have shared goals across a team of players, the success of a team depends on whether the team can accomplish a certain goal.

Synergies between goals (Interlaced/Intertwined goals).

When players have different goals, one of the design approaches used to force them cooperate together is to have some sort of synergy between their goals. A recent example of this is the way Valve has setup their achievement system with the Pyro and Medic classes in Team Fortress 2. One of the Pyro's achievement is killing three enemies while ubercharged (being made invulnerable by a Medic), while the Medic has an achievement that requires the Medic to ubercharge a Pyro while the Pyro burns five enemies.

Special Rules for Players of the same Team.

Some games have special rules for players of the same team - an action will have a different effect when done on a friendly player. The idea behind these differences is to promote and facilitate cooperation. A good example of this are the special rules for shooting members of your own team in FPS games (also known as Friendly Fire modes).

2.2 Challenge Archetypes used in Cooperative Games

In this section we explore how the challenges defined by Rollings and Adams[2] are used in current cooperative game by exploring the current archetypes for each type of challenge.

Pure Challenges

Physical Challenges.

These challenges involve real-life physical effort. These can be used to promote cooperative play by making the challenges involve physical effort that can't be done by a single player (e.g. : by requiring players to jump in a platform while at the same time kicking a ball that's too far away to be kicked by the same player; or by making the effort required to be too much for one player to handle).

Coordination, Reflex/reaction and Spatial-awareness Challenges.

One of the biggest challenges in cooperative play is the coordination of the members of a team. One could say that the most obvious display of cooperation is the level of coordination one can see in a team of players. Coordinating a team of players usually involves several reflex/reaction and coordination challenges (as long as the game is not turn based) on the part of the individual players as well as some spatial awareness challenges.

Other types of pure challenges.

Logic and Inference, Lateral-Thinking, Memory, Intelligence, Knowledge-based and Pattern-recognition Challenges are a subset of pure challenges that appear to have little

potential for cooperative play. However, adding extra players to these types of challenges makes the challenges easier for the players by either allowing a Divide and Conquer approach to the problem, and in some of the challenges having different players brings different perspectives that will help in coming up with the correct answer.

Like the previously mentioned challenges, Moral Challenges are not particularly suited to promote the cooperation between players. This happens due to difference of personalities that exists between people, and the fact that the choice might cause the crumbling of a group. However, this possible splintering of the group can make for an interesting gameplay challenge.

Applied Challenges

Race.

Sometimes games force players to try and reach a certain goal before their opponents do, while in other situations they must complete a task before a timer expires. This type of challenges usually causes teams of players to focus and work together more tightly due to the additional pressure.

In World of Warcraft, some of the bosses in dungeons have enrage timers, this means that they will have to be defeated before the time is up or the the boss will enrage and kill the players. Counter-Strike bomb maps are also a good example of this, if the bomb doesn't explode before the time is up (or one of the teams is eliminated) the Counter-Terrorist team wins the round.

Exploration.

Exploration needs obstacles in order to be considered a challenge otherwise it is just merely sightseeing. In games where players can cover different areas, exploration becomes an important asset to a team of players (e.g. : due to the presence of fog of war in RTS[12] games, it is important that teams of players cooperate in order to search for the enemy bases and scout the enemies defenses, and so that they can spot incoming enemies; in FPS games, it is important to know where the enemy is so that you don't get ambushed). In other cases, it is required that the players cooperate so that they can progress to other areas.

1. Opening Locked Doors - Some of the exploration aspects that are particularly suited to cooperative gameplay, is the use of certain areas that are locked behind a door. These can be used either in situations where a particular type of character is needed to open the door or they can be opened by using simultaneous switches that require cooperation between players. Lego Star Wars is a good example of all these situations. Some doors need that several characters stand on floor plates in order to open them. Others require simultaneous switches, while others require that a particular type of character opens the door.

2. Trap - Traps are devices that "harm" or disable the player (or players) once triggered. They are a commonly used obstacle for defending important locations. Traps can force players to cooperate by requiring them to work together in order to disable them, or even forcing them to thread carefully while exploring an area (instead of running around like mindless chickens), sometimes cooperation emerges from setting off a trap on purpose as a distraction. As an example, consider World of Warcraft - a class exists that can set traps, and another class exists that can spot them and disable them, it is common for players of the second class to cooperate carefully with their team so that the traps are disabled when the team decides to enter the room.

3. Platforms - Some platforming challenges can be used with complementary abilities so that the progress of group depends on the cooperation of the elements of the group. In certain games, particularly in FPS (First Person Shooters), it is common for players to piggy back on top of each other to reach higher areas. In Dust (a Counter-Strike bomb map) it is

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[12] Real Time Strategy

common for terrorist players to piggyback on top of each other so that they can plant the bomb in a harder to reach location.

Conflict.

These type of challenge relates to games that are won by attacking the opposition directly.

1. Protect - One way that conflict-type challenges have been successfully applied to force players to cooperate together is by making players defend either a location, a character or even an item. This usually causes the players to work together as a team instead of trying to be the "hero of the day".

2. Escorts - Another gameplay archetype that is used to force cooperation through conflict are escorts. These usually involve a team of players escorting another character across from one place to another. Typically the character being escorted is defenseless, but it is not uncommon for escorts to involve accompanying a powerful ally to a location so that it can turn the tides of battle. Another common escort involves escorting an important item from location A to location B, typically these items are important to the victory conditions of the game, or they can just grant powerful bonuses to the team that manages to escort them. The Escort archetype can be viewed as an implementation of the Protect archetype due to the fact that you are protecting another character or a movable item. However, due to the fact that you are protecting a moving thing, that is moving towards a goal, there is one important nuance from the typical Protect archetype - the defense needs to be able to accompany the movement of the thing being escorted. An example of this are the assassination maps in the popular online FPS Counter-strike. In these maps the Counter-Terrorist team will win a round if the VIP can reach an extraction point in the map.

3. Capture - Sometimes games try to force players to work cooperatively by giving them the objective to capture something - it can be an item, a location, sometimes even a character. In fact if one looks at most of the Escort challenges, it is easy to see how it actually has a Capture element to it - you complete the Escort when you successfully deliver the thing being protected to its destination. Several subtypes of capture exist each with its own particularity.

a. Capture The Flag - This mode of play is present in many online games, and it causes players to work together by making them protect their flag (or a similar item), while attempting to capture the enemies' flag. After this disassembly of this archetype it becomes apparent that it is in fact a combination of archetypes, namely the Protect archetype and the Escort archetype - a team needs to protect its flag and needs to escort the player that has grabbed the opposing team's flag until he reaches the capture point. Many examples of this archetype exist in a variety of game genres - FPS, RTS (Starcraft[13]) and MMORPG (World of Warcraft) games all have multiplayer CTF[14] modes. The popularity of CTF dates back to the original Quake and the CTF modification made by Threewave[15], after this modification CTF became an integral part of most FPS.

b. Capture Locations - Another common conflict challenge revolves around capturing and protecting locations. Normally these two modes are mixed together, with both teams being able to capture each other's locations, while in other situations a team defends while the other team attempts to get control of the location. Like some of the other archetypes listed before this archetype is a particular case of the protect archetype. Examples exist in several game types - Team Fortress 2 has several gametypes that revolve around the Capture Locations archetype; and the Arathi Basin Battleground for WoW.

4. Bomb - Some games have a mode where the objective is to plant a bomb at one of several locations (only one of the players carries the bomb from the starting location to the bomb sites) and then defend it from enemies. This is in reality a combination of two of

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[13] Starcraft official website: http://www.blizzard.com/us/starcraft/
[14] Capture The Flag
[15] Threewave official website: http://www.threewavesoftware.com/multiplayergames.html

the archetypes discussed above. During the first part it falls clearly within the Escort archetype, while the second part deals directly with the Protect archetype. A characteristic of this mode is that while one team fights to explode a location the other fights to protect the locations (this overlaps a bit with the Capture Locations archetype). Due to the fact that the bomb is a resource that is needed in order to achieve the goal, if the team defending the bomb sites manages to kill the bomb carrier, it is common that they defend the bomb (this falls within Protecting resources). The best and most known example of this archetype comes from Counter-Strike, though examples of other games that use this archetype exist (Urban Terror for example).

5. Tougher Conflict Challenges - A typical attempt to make players cooperate with each other is by posing tougher challenges than those that they can handle by themselves. By making sure the challenge is practically impossible to be accomplished by a single player, you are effectively forcing them to group together so that they can overcome it. In MMORPGs, it is common for some enemies to be a lot more powerful and tougher than the rest of the enemies. These enemies are practically impossible to kill by yourself, and force players to join up in a group to defeat them.

Economics.

A team of players must work together quite closely in order to manage their resources, and allocate resources to where they are needed.

1. Resources - While in most games the goal is not amassing resources, they are nonetheless an important aspect of gameplay. In FPS games, teams try to protect and adequately manage most powerups, weapons and armors, since they are vital resources that can decide the outcome of the conflict. RTS games since their inception have been tied up with resource collection, and rely on it so that they can produce units. This causes any cooperative play of RTS games to be extremely dependent on the management and protection of resources.

    a. Resource Management - This tends when, due to particularities of the gameplay, a certain resource will be better put to use by a player of a certain type or in a particular situation. As a typical example you examine the typical weapon or armor sharing done by teams in most Team Deathmatch FPS. One of the players has no need (or minimal necessity) for the resource while the other player really needs the item because he is running around defenseless or weaponless.

3 Designing Geometry Friends

Geometry Friends is a two player physics based platform game (that would be controlled with the Wii Remote) we developed with complementarity in mind. We ended up settling on two very simple and basic characters - a green square and a yellow ball. As such, we came up with abilities that made sense from the perspective of our simple geometrical characters, the ball character can jump and change size (increasing its weight), while the square character can deform it self into rectangles allowing it to become taller (which helps it reach higher places) or shorter (which helps it reach narrower places). Another interesting gameplay idea that we came up, was making the ball and square collide with parts of level that had the same color as the character in question.
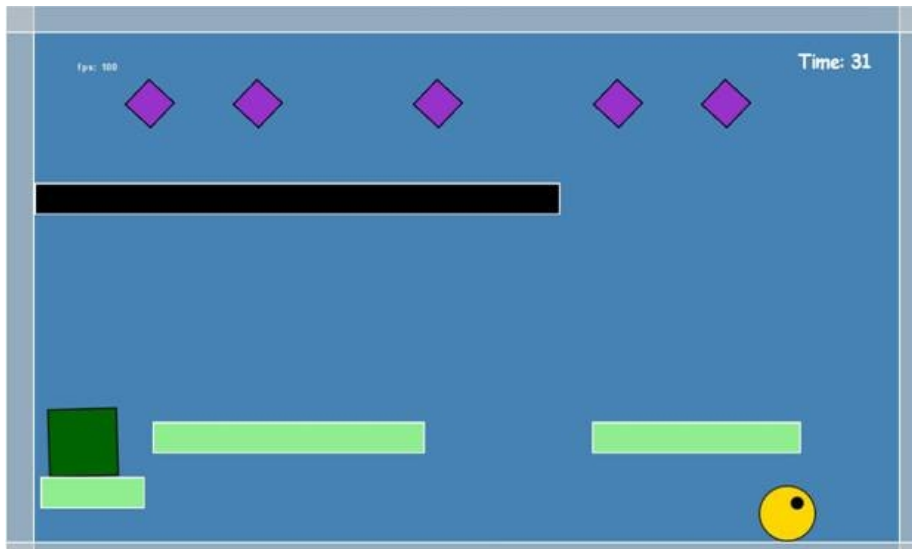
Fig. 1. Geometry Friends Screenshot

The fact that this design is based around complementarity also helped us establish interesting synergies between the abilities. The fact that the square can stretch to become taller, allows the ball to use it to reach a higher place than that which either could reach naturally, whereas the fact that the ball changes weight and size allowed players to use the ball to propel the square up into the air.

One of the most natural design patterns to use on a cooperative game is giving the players a shared goal that is accomplished by the combined efforts of the group and not by a single character. As such we gave players a simple goal of collecting all the purple diamonds in the level in order to progress to the next level. Naturally, the placement of the diamonds on the levels was such that forced players to cooperate in order to get them. This was achieved mainly by making sure that each of the characters by itself could not pickup each and every diamond of the level, and also by making sure that the individual efforts of the characters would not add up to collecting all the diamonds, effectively avoiding a design that allowed a level to be completed by using a Divide and Conquer approach.

In Geometry Friends, due to the type of game that we had set out to create (a two player co-located cooperative puzzle and platform game), we focused on mainly the natural type of challenges for this type of game - Coordination, Reflex/reaction and Spatial-awareness Challenges. These were a natural choice due to the fact that they are intrinsic to the game type that we developed. This was not the only reason for this choice, as these challenges are also an interesting choice for cooperative games, due to the fact that failing these types of challenges results in non-cooperation.

4 Preliminary Evaluation

After completing the development of the game, we evaluated it by allowing players to play the game and fill out a questionnaire concerning their experience with the game. The main focus of the questionnaire was trying to understand if players felt that cooperation was the main focus of the game and vital to complete each level, if any of the players felt they weren't vital to task at hand. This last question came up during our own internal testing - at a certain point during the development we felt that the square was a support character for the ball and not interesting enough by itself. We also tried to understand if the players felt that levels we designed were fun, and if the difficulty level was adequate. This preliminary evaluation was conducted during a game showing at a university (Instituo Superior Técnico - Taguspark), in the context of a games display of the several games made by students. Table 1 presents some characteristics of the participants of the study, while Table 2 presents a brief overview of some of the results of the study, namely the

test subjects were asked to evaluate both the level of fun of the game and the level of cooperation that the game required (the numbers represent a scale from 1 to 6, with 6 being highest).

The preliminary data that we gathered was quite positive - all the players felt the need to cooperate in order to accomplish the goal of each one of the levels. The fun that players extracted from the game was also on the high end of the spectrum, though not as successful as it could be. Our biggest fear, that the square character was a bit passive was dissipated by coming up with ways that allowed the square to take a more active role instead of the typical support role.

Table 1. Sample Characteristics

Sex		Video Game Habits				Previous Geometry Friends Experience	
Male	Female	Never	Rarely	Occasionaly	Frequently	Yes	No
16	0	0	0	6	10	3	13

Table 2. Game Evaluation Overview

Fun	Need For Cooperation
4.5	5.6

5 Conclusions

The work we have presented here has the potential to be of important value when attempting to design a cooperative game. The Design Patterns are particularly helpful for abstract ideas that can transcend a particular game genre, whereas the Gameplay Archetypes are obviously better suited in games where its type of challenge is present. From our limited preliminary data, it is possible to see that these game mechanics are helpful in designing a fun cooperative experience. However, we still need to collect more data in order to analyze the actual impact of using these game mechanics to design a cooperative video game.

As future work, we currently plan on better exploring the area of Game Design Patterns, and the patterns proposed by Björk and Holopainen[3], so that we can examine other patterns and how they help in designing a cooperative game, as well as allowing us to normalize the patterns presented here with the mentioned work. Additionally, we plan on introducing some additional game mechanics to Geometry Friends and conduct further evaluation.

References

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