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Game Design Patterns for Collaborative Player Interactions

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ABSTRACT
Collaborative (or cooperative) games became very popular over the recent years. Aside from being received well by players, great collaborative games also offer the potential to train their players' ability to work in teams. However, some other games include additional players without adapting their design appropriately, which may lead to games where the players hardly interact with each other and with little to none benefit when another player is present.

This paper aims to improve this situation by introducing game design patterns for collaborative player interactions. Being extracted from well-received games, these patterns can be used as guidance for collaborative game designs fostering interaction between players. The interactions are classified along several dimensions (e.g. spatial and temporal) and can therefore be easily selected for specific situations. An example game design where some of these patterns were applied is also described.

Keywords
multiplayer, collaborative, cooperative, game design patterns, player interactions

INTRODUCTION
In the last few years collaborative (or cooperative[1]) games have become more and more popular, with games like *Left 4 Dead 2* (Turtle Rock Studios / Valve Corporation 2009) being one of the 15 most often played games on the *Steam*[2] platform more than four years after release. This popularity has resulted in a large number of games created with additional collaborative modes or even designed solely for collaboration – sometimes with Artificial Intelligence (AI) controlled players filling in for missing coop partners in singleplayer mode. A similar trend can be observed in regards to board games. While offering the ability for players to have some fun together with their friends and to help each other to overcome difficult sections they might not have solved alone, collaborative games are also training the players' social skills, especially their ability to work in a team (Bay-Hinitz et al. 1994; Greitemeyer and Cox 2013). This makes collaborative games very promising in the context of serious games, which offer benefits such as training or learning in addition to being "fun". In this context collaborative games could be used to specifically train social skills or to enable collaborative learning, which is more effective than learning alone (Johnson and Johnson 1988).

Proceedings of DiGRA 2014: <Verb that ends in 'ing'> the <noun> of Game <plural noun>.

However, not all collaborative games are received well and there are many examples where players and reviewers alike complain about "tacked-on" collaborative modes. In most cases this impression can be linked to a game design which was originally aimed at single players and to which further players have been added without further design changes. In these games the players therefore only interact with the game world as a single player would do and lack the ability to interact with each other in a meaningful way. As a result the additional players feel unnecessary, especially when one player is more skilled than the other. In contrast, designing a game for collaboration poses further challenges and complexity on the development process, since the interaction between the players must be designed and balanced in addition to the players' interactions with the game world. Designing a game for collaboration becomes especially problematic in the context of serious games, which are characterized by smaller budgets and development teams. In most cases these teams also lack designers experienced with designing collaborative games, which makes development of collaborative serious games almost impossible. Accordingly, most serious games are singleplayer games, which do not tap into the potential of collaboration.

In order to address this challenge we analyzed popular collaborative games and extracted game design patterns describing collaborative player interactions. These patterns can serve as an inspiration and guidance for developers working on collaborative games and hopefully enable the development of better collaborative games in general and collaborative serious games in particular.

This paper is organized as follows: After a discussion of the related work on (collaborative) multiplayer game design and (collaborative) game design patterns we provide our definition of collaborative player interactions. We then describe our analysis of well-received collaborative games in order to extract of player interaction and some of the game design patterns they inspired. Lastly, a game design to which some of the patterns were applied is provided as an example.

RELATED WORK

Multiplayer Game Design

The topic of designing games for multiplayer is touched by most standard literature on game design (Salen and Zimmerman 2004; Adams 2010). However, there are also approaches which tailor the whole design process towards multiplayer and the interaction of players with each other as the central element: Zagal et al. (2000) for example provided a model describing the characteristics of multiplayer games including the aspects of social interaction between players, the trade-of between competition and cooperation as well as the synchronicity of gameplay. Based on this model, they described a design process and outlined design decisions that emerge when designing multiplayer games. Garzotto (2007) in turn investigated design heuristics for designing multiplayer games for children with educational content and evaluated their effectiveness when applied to a game. In regards to player interaction, they found that games should foster "connections" between players by making other's actions visible and that they should include competitive as well as collaborative elements for motivation. Konert (2012) chose another perspective, focusing on interactions between players in a (singleplayer) game and their peers in social media applications. Since the latter can actively influence the game, the interaction types they described are similar to the ones in a multiplayer game.

Collaborative games

Collaborative and cooperative games are characterized by players working together instead of competing against each other (their main difference being that in cooperative games these alliances might be temporal only). This adds additional aspects to the game design process, which Zagal et al. (2006) investigated by analyzing board games. They noted several lessons and pitfalls related to creating interesting collaborative games, such as the advice to introduce tension between collaborative and selfish play. Zea et al. (2009) used a different approach by transforming requirements for collaborative learning into general game design guidelines. These guidelines where then applied to a collaborative learning game for small children. Manninen and Korva (2005) described eight collaborative puzzles, including challenges where the players had to work together under tight time constraints or synchronize their actions. They also detailed the design considerations which lead to the puzzles and described how different types of players reacted to them.

Game Design Patterns

The idea of software design patterns was first introduced by Gamma et al. (1993) with the intension of transferring knowledge about common problems and their solutions between programmers. By defining a pattern format and giving them recognizable names, they also aimed for creating a common vocabulary for discussions about them. Björk et al. (2003) adapted this idea for game design in order to create a common language for industry and academia to guide design and analysis of games. They argued that game design patterns, in contrast to software design patterns, cannot be formulated as strict problem-solution pairs since game design as a creative process often has no objectively "right" answer. Often the intended outcome can be achieved with multiple patterns, each imposing different constraints on other design aspects. Therefore they viewed the influences between patterns as an important aspect in their proposed format. They also described different methods of harvesting design patterns, including abstracting and merging mechanics from existing games and expert interviews. Their idea of game design patterns proved very influential, as it resulted in lots of different publications detailing certain subgroups of patterns as well as an online database[3] holding almost 400 patterns at the time of writing. The approach however was criticized by McGee (2007), who argued that their descriptions lack prescriptive information on the context in which the patterns could be used – making them hard to use for non-experts. He proposed his own pattern description which describes patterns as a trade-off between two conflicting forces.

Design patterns for collaborative games

Rocha et al. (2008) informally described six general design patterns for cooperative games as well as challenge archetypes which could be translated into design patterns. Examples included giving players different abilities, having these abilities enhance each other or being only useable on other players and having shared goals or at least synergies between different goals. This work was extended by Seif El-Nasr et al. (2010), who analyzed 14 games and found additional patterns like players interacting with the same object, shared puzzles or characters, enemies specifically targeting separated players, automatic vocalization and limited (shared) resources. They evaluated their patterns by observing play sessions and attributing cooperative behavior (e.g. players helping each other) to instances of the patterns.

COLLABORATIVE PLAYER INTERACTIONS

Definitions

In order to define our understanding of collaborative player interactions, the individual aspects of collaborative actions and player interactions must be defined first.

Collaborative gameplay

"In a collaborative game, all the participants work together as a team, sharing the pay-offs and outcomes; if the team wins or loses, everyone wins or loses." (Zagal et al. 2006)

In other words – when playing collaboratively, players are working towards the same goals. Therefore, the results of their actions may affect every player if they are related to these goals. In contrast, collaborative learning theory defines individual collaborative actions as follows:

"Collaboration is a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem." (Roschelle and Teasley 1995)

This definition describes collaboration via actions, which serve the common understanding of a problem – e.g. the challenges posed by the game. These actions must be coordinated and synchronous in order to count as collaborative.

Player interactions

"Interaction forms are perceivable actions that act as manifestations of the user-user and user-environment interactions. They enable awareness of actions by offering mutually perceivable visualizations […]." (Manninen 2002)

Following this definition, every action inside a game can be viewed as player interactions as long as it is visible to others. This includes purely social interactions with no benefit in relation to the game's goal.

Collaborative player interactions

By combining these definitions, collaborative player interaction can be defined:

Collaborative player interactions are synchronous actions in which multiple players coordinate themselves to reach an outcome which is intended to benefit their shared goals. These interactions may consist of several smaller actions. Each action may be directed upon another player or the game world in general and their distribution may vary between the players.

A *synchronous action* means that all players actively take part in the interaction during the same time span. Since players have to *coordinate themselves*, players cannot act without considering what the other players are doing. Therefore there is always a need for explicit or implicit coordination. Defining the outcome of the interaction as *intended to benefit their shared goals* allows interactions to fail and therefore not benefit their common goals, for example when the players' actions are interrupted by enemies. However, since the action was started in order to serve the common goals, in our opinion it must be still viewed as collaborative. There are also collaborative player interactions in which the players do not act on each other directly. An example would be a player holding a gate open while others move through it. Therefore our definition includes

actions *directed at another player or the game world in general*. It is also important to note that as seen in the examples above the contribution *may vary between the players*, for example when they control characters possessing different skills or tools. When varying greatly, this is often called asymmetric gameplay.

A prime example for such a common interaction would be a player who is keeping his or her allies alive by healing them. Since this action typically requires some kind of proximity, the receiving players must participate by moving towards the healer and in some cases also by standing still during the process. We do not count interactions which cannot be related directly towards the shared goals. The relevance of players talking to each other in relation to their goals for example is highly dependent on the content of the conversation, so we do not count this as in collaborative player interaction itself. However, most interaction types described in this paper require communication between the players as a part of the interaction.

Approach

To find instances of collaborative player interactions, several cooperative video games were analyzed. The selection was based on recommendations from fellow researchers, following an inquiry for games with noteworthy cooperative mechanics as well as multiple online searches for both professional reviews and general articles to find well-received cooperative games. This list of games includes *Army of Two* (Electronic Arts Montreal 2008), *Artemis Spaceship Bridge Simulator 2.0* (Robertson 2013), *Left 4 Dead* (Turtle Rock Studios / Valve Corporation 2008), *Left 4 Dead 2*, *Lego Indiana Jones: The Original Adventures* (Traveller's Tales 2008), *Portal 2 (*Valve Corporation 2011) and *Resident Evil 5* (Capcom 2009).

Since collaborative player interactions may happen in any multiplayer game that allows team based play, strategy games like *Age of Empires 3* (Ensemble Studios 2005) and *StarCraft II* (Blizzard Entertainment 2008), team-based shooter games like *Battlefield 4* (DICE 2013) and *Brink* (Splash Damage 2011), MOBA (Multiplayer Online Battle Arena) games like *League of Legends* (Riot Games 2009) and *Dota 2* (Valve Corporation 2013), sandbox games like *Minecraft* (Mojang 2011) as well as MMORPG (Massive Multiplayer Online Roleplaying Games) like *World of Warcraft* (Blizzard Entertainment 2004) were also included.

Classification

During analysis every observed instance of collaborative player interactions was noted and classified along four dimensions. The *spatial* dimension specifies whether the interactions happen on a fixed location inside the game world and if the players have to be close to each other. The *time* dimension defines the duration of the interactions. This is dependent on the individual actions which it consist of. This category could also contain the synchronicity of individual player's actions. The above definition however limits the selection to synchronous interactions in advance. Therefore, the interactions themselves can be viewed as atomic and can be chained after each other. In regards to the *player* dimension were differentiated between voluntary and obligatory and if a certain player experience could be linked to the interaction (please note that these observations are based on a very small sample size and should therefore only be seen as pointers until validated by appropriate user studies). *Functional* constraints were also documented, i.e. the number of players who could take part in the interaction, if the interaction is possible with fixed or free roles (characters, classes) and the requirements on the player

themselves (coordination and timing). Lastly, the occurrences of the interaction were kept for future reference.

Post-processing

As a next step, these concrete instances were abstracted to more generic interactions, aiming for a level where the core interaction was still clearly defined but contained adaptable variables allowing for a wide variance of applications. During this step functionally identical interactions were merged. For example, restoring other players' health and restoring their ammunition was combined into a generic "Restore"-interaction.

GAME DESIGN PATTERNS

Description

Afterwards the collaborative player interactions were worked into game design patterns based on the format proposed by Björk et al. (2003):

- Name
- Description (and examples)
- Consequences (trade-offs, side effects)
- Using the Pattern (new design decisions emerging from the pattern)
- Relations (with other patterns)

Their original format was extended by adding several subcategories related to the context in which the pattern can be used in order to address the criticism of missing guidance by McGee (2007) while keeping compatibility with the well-known structure. Please note that some patterns can be used for different purposes and therefore offer a range of values or might even be irrelevant in regards to specific categories. Therefore, each aspect could appear in the "consequences" (if it is a fixed effect of the pattern) or the "using the pattern" section (when the designer is able to choose between different characteristics).

Spatial

Spatial relation describes whether the pattern is 'collecting' the players in one location or 'separating' them into smaller subgroups. This may be used to setup a player distribution for future task, for example collecting all players in one location in preparation for a cutscene. *Spatial location* describes whether the interaction described in the pattern happens at a 'specific' location (as defined by applying the pattern) inside the game world or is 'pervasive' for a larger section or even the whole game.

Temporal

Temporal duration describes the typical duration of the interaction pattern. While some tasks like opening a door may be more or less instant, searching for something might keep the players occupied for a much longer time. This category is divided into 'short', 'medium' and 'long'.

Player

Player freedom describes whether a pattern is 'voluntary' or 'obligatory' for the players. While voluntary patterns offer benefits for the players if they decide to take part in a

collaborative action, obligatory ones force the players to work together. This dimension might be especially interesting when working on a game that is meant to teach the potential value of teamwork. *Player experience* holds our observations on how players reacted to the interaction forms described in the pattern. As mentioned before, these should be seen mainly as pointers and not as conclusive results.

Functional

Functional role flexibility describes whether a pattern can be used in combination with 'fixed' player roles (like classes or characters with different skills) or with 'free' roles (there are no functional differences between the players or their abilities can be reassigned during play, for example when bound to an exchangeable item). *Functional role count* describes the number players involved in the interaction. Since interactions do not have to include every player in the game, this number can be less or equal than the number of players the game is designed for. *Functional requirements* describe the requirements put on the players in relation to 'communication' (coordination) and 'timing' difficulty as 'low', 'medium' or 'high'. For example, a game which is designed for children should not include patterns with high requirements in either aspect or games with limited communication tools (e.g. a simple text chat) should not require a great amount of coordination. *Functional genres* describes in which game genres (Arsenault 2009) the pattern typically appears. This is mainly meant for novice designers who want to use the pattern "as is", while experienced designers might be able to adapt the patterns for other genres.

Examples

We would also argue that examples, i.e. references to existing implementations of the pattern should be a mandatory instead of an optional part of the description. These examples could be of great use for designers not familiar with the pattern and offer ideas on how the (purely mechanical) pattern could be worked into a narrative.

Patterns for Collaborative Player Interactions

For this paper we selected nine patterns to be described in detail, including the categories 'General' and 'Gates' because of their universal applicability. The 'Support' category was also added because these interactions are used in most team-based action games and are therefore often the first ones a player describes when asked about team-based actions. The full list containing over 20 patterns can be found in (Reuter et al. 2014), related patterns were taken from the Game Design Patterns Database[3], Rocha et al. (2008) and Seif El-Nasr et al. (2010).

General

This category contains higher-level concepts that can be realized with a variety of different interaction mechanics.

Name	Concurrency
Description	Operating one or more objects simultaneously that could not be operated by a single player alone.
Examples	Genre independent. Moving a heavy object in *Resident Evil 5*, enemies that can only be damaged from behind but continuously

look at the player in *Army of Two*.

Consequences	Obligatory interaction at a specific location. Requires medium communication and high timing. If not properly justified in the game world's logic, using the pattern might be recognized as artificial by players ("Who would build a normal door that is opened by pressing two buttons simultaneously and then put these at opposing sides of the room?").
Using the pattern	Collecting players or separating them depending on the location of the objects with which each player must interact. Depending on the number of interactions and their length (including animations) the pattern interaction can vary between short and long. The pattern can be set up for fixed or free roles, depending on whether the objects to interact with are restricted to certain players / roles. Can be designed for an arbitrary number of players by increasing the number of points to interact with.
Relations	Superior: Multiplayer Games, Cooperation, Collaborative Actions, Symbiotic Player Relations, Team Accomplishment, Synergies between abilities, Interacting with the same object; Subpatterns: Team Combos, Vulnerabilities

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Name	Parallelization
Description	Splitting work that could be done alone in order to speed it up or to make it easier.
Examples	Genre independent. Players splitting up while searching for rare materials in *Minecraft*.
Consequences	Players separating themselves voluntarily, often for a long time. Works only with free roles, because each player must be able to solve any part of the overall task. Since players work relatively independent for the duration of the task, communication and timing requirements are low. Players must notice by themselves that splitting their work is beneficial, but might also learn a valuable lesson for their real life regarding teamwork.
Using the pattern	Depending on the area where the task can be solved, for example where the resources are located, the pattern can appear at a specific (as long as it is relatively large) or pervasive location. It can include an arbitrary number of players, but this is dependent on how many players decide to take part in the activity and cannot be influenced by the designer.
Relations	Superior: Multiplayer Games, Cooperation, Collaborative Actions, Symbiotic Player Relations, Team Accomplishment; Subpatterns: Races

Gates

Gates prevent the players from continuing until a certain requirement is met.

Name	Separation gate
Description	Forcing the players to split up by allowing only a certain number of players to continue while the others need to stay behind.
Examples	Mainly for action and adventure games. Remotely opening a door that closes immediately after the corresponding switch is released in *Portal 2*. Boosting another player onto a ledge or throwing him / her over a chasm in *Resident Evil 5*.
Consequences	This pattern is used to obligatorily separate the players at a specific location. The separating interaction itself is usually short, but the time they remain separated is flexible. Since the fact that the game does not go on until the players are separated is usually conveyed by the game itself, there are low requirements in regards to communication and timing. Some players might feel anxious after being separated from their group and the risk for failure might increase without another player close to help.
Using the pattern	The interaction can use fixed (for example when not every player is strong enough to give a boost) or free roles (when everybody is able to do so). Gates work for any number of players, depending on how many are necessary to maintain the condition which lets other players pass through the gate.
Relations	Counterpart to Gathering gate; Superior: Multiplayer Games, Cooperation, Collaborative Actions, Functional Roles, Abilities that can only be used on another player; Subpatterns: Inaccessible Areas

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Name	Gathering gate
Description	Forcing the players to wait for each other by allowing them only to continue together.
Examples	Mainly for action and adventure games. Level ends with a camera detecting the presence of each player in *Portal 2*, doors with two switches in *Resident Evil 5*.
Consequences	Similar to the Separation gate, this pattern is used to obligatorily collect the players at a specific location for a short interaction (not counting waiting times). It also has low requirements on communication and timing when properly indicated by the game. Since fast players are forced to wait for their slower peers, they might get annoyed.
Using the pattern	The interaction can use fixed (when a specific player is necessary for progression) or free roles. Gates work for any number of players, depending on how many are necessary to maintain the condition which lets the players continue through the gate.

Relations	Counterpart to Separation gate; Superior: Multiplayer Games, Cooperation, Collaborative Actions, Functional Roles, Player-Player Proximity, Interacting with the same object; Subpatterns: Inaccessible Areas

Support

This category contains interactions where one player directly benefits another.

Name	Strengthening
Description	Adding or increasing a positive effect on other players.
Examples	Mainly for action and role-playing games. Applying bonus damage or speed (buffs) in *World of Warcraft* and *League of Legends*, outfitting other players with Kevlar wests in *Brink*.
Consequences	Collecting two players for a voluntary interaction (importance can be increased by raising the difficulty level, but not forced), which is usually available independent of a specific location (pervasive). Since the positive effect is not present by default and therefore constitutes an optional bonus, the interaction requires low communication and timing.
Using the pattern	This pattern can be implemented with fixed or free roles by giving the ability to add the effect to specific or to all players.
Relations	Can be combined with Sacrifice; Superior: Multiplayer Games, Cooperation, Collaborative Actions, Symbiotic Player Relations, Team Accomplishment, Altruistic Actions, Player-Player Proximity, Functional Roles, Team Combos, Complementarity, Abilities that can only be used on another player; Subpatterns: Invulnerabilities

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Name	Resupply
Description	Restore a positive capability for another player. The capability then evaporates over time or is decreased by enemies.
Examples	Mainly for action and role-playing games. Healing other players in *World of Warcraft*, supplying others with ammunition in *Battlefield 4*.
Consequences	Collecting two players for a voluntary interaction (importance can be increased by increasing the evaporation effect, but not forced), which is usually available independent of a specific location they are in (pervasive). Since this interaction restores a capability which the players normally have, the timing of the interaction is of medium importance and requires a medium amount of communication to gather both players.
Using the pattern	This pattern can be implemented with fixed or free roles by giving the ability to restore the capability to specific or to all players.
Relations	Can be combined with Sacrifice; Superior: Multiplayer Games,

	Cooperation, Collaborative Actions, Symbiotic Player Relations, Team Accomplishment, Altruistic Actions, Player-Player Proximity, Functional Roles, Complementarity, Abilities that can only be used on another player

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Name	Protector
Description	Preventing a negative effect on other players.
Examples	Mainly for action and role-playing games. Protecting players who are carrying objects in *Left 4 Dead 2*, conjuring shield effects in *League of Legends*.
Consequences	Collecting two players for a voluntary interaction (importance can be increased by increasing the evaporation effect, but not forced), which is usually available independent of a specific location they are in (pervasive). Since the interaction must happen before negative effects are activated and typically the protection only lasts for a limited time, it has high timing requirements. Communication is low however, since the protecting player usually has to foresee the negative effect by himself.
Using the pattern	This pattern can be implemented with fixed or free roles by giving the ability to protect to specific or to all players.
Relations	Can be combined with Sacrifice; Superior: Multiplayer Games, Cooperation, Collaborative Actions, Symbiotic Player Relations, Team Accomplishment, Altruistic Actions, Player-Player Proximity, Functional Roles, Complementarity, Abilities that can only be used on another player

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Name	Savior
Description	Remove an undesired effect from another player.
Examples	Mainly for action and role-playing games. Pulling helpless players up from a ledge in *Left 4 Dead*, reviving players in *Battlefield 4*, removing sticky bombs in *Brink*.
Consequences	Collecting two players for a voluntary interaction (importance can be increased by increasing the evaporation effect, but not forced), which is usually available independent of a specific location they are in (pervasive). Since the undesired effect is hindering the player and is often combined with a countdown to a more severe punishment (e.g. death of the player character), it has high timing requirements. Communication requirements are medium, since the action itself has to be simple in order to be available under high pressure and therefore the affected player must only call for help, after which no further coordination is necessary.
Using the pattern	This pattern can be implemented with fixed or free roles by giving the ability to protect to specific or to all players.

Relations	Can be combined with Sacrifice; Superior: Multiplayer Games, Cooperation, Collaborative Actions, Symbiotic Player Relations, Team Accomplishment, Altruistic Actions, Player-Player Proximity, Functional Roles, Helplessness, Complementarity, Abilities that can only be used on another player; Subpattern: Rescue

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Name	Sacrifice
Description	Benefitting others while suffering some kind of penalty in the process.
Examples	Mainly for action, role-playing or Strategy games. At the end of the mission "The Sacrifice" in *Left 4 Dead*, one player must sacrifice himself to let the team advance. Other examples include giving some resources to another player, for example food in *Minecraft* or gold in *Age of Empires 3*.
Consequences	Since this pattern is a modification to any other support pattern, it inherits most of its consequences from the pattern it is combined with. The only difference is that there is a trade-off between the interests of both players involved and it requires selflessness in order to happen (which some players might not want to exercise). Using this pattern with fixed roles where only one player would be able to sacrifice him- / herself would diminish the value of the decision he / she must make. Therefore, this pattern should only be used with free roles (concerning the sacrificial action).
Using the pattern	Designers have to decide on the ratio of benefit-to-penalty, which directly impacts the attractiveness of the interaction.
Relations	Can be combined with Strengthening, Resupply, Protector or Savior; Superior: Multiplayer Games, Cooperation, Collaborative Actions, Symbiotic Player Relations, Team Accomplishment, Altruistic Actions, Social Dilemmas

CASE STUDY

To gather first results about their validity and usefulness, preliminary versions of these patterns were used for re-designing the collaborative multiplayer serious game *Escape From Wilson Island* (Wendel et al. 2012), a 3D action adventure. Originally conceived by bachelor students during a lab course, it was refined multiple times. During one re-design the collaborative patterns were used as guidelines to make the players' tasks more interesting by intensifying their interactions. Since the designers responsible for the changes were not the ones who developed the patterns, they were able to provide valuable feedback – e.g. regarding clarity of description. The game is now used as a Serious Game for training and facilitation of soft skills like communication and teamwork.

The narrative setting describes four players who are stranded on a deserted island. Their goal is to survive the harsh conditions and eventually escape from there. In order to achieve this, they need to solve several tasks which require teamwork and close collaboration.

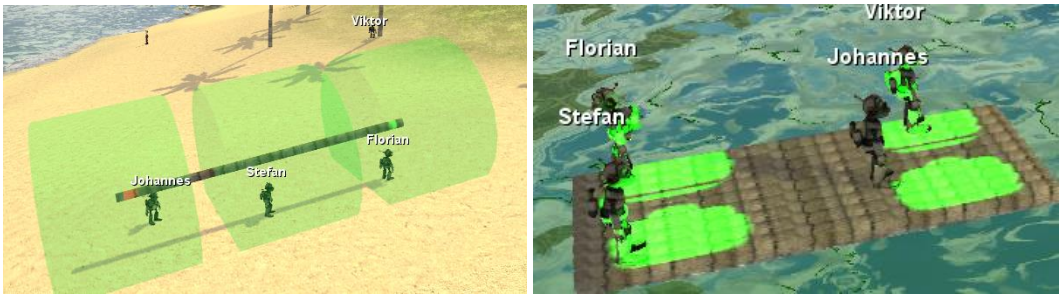

Figure 1: Carrying a palm ('Concurrency' pattern, left) and the raft ('Gathering gate' pattern, right).

First, they need to find food sources, i.e. berry bushes, and make sure that everybody has enough food to survive. Next, the players need to build a shelter for sleep. After that, players will find out by talking to an eremite that they can hunt herons in order to get meat as a better food source. Moreover, he asks them to find a precious item swallowed by a heron. Once the players have a shelter and enough food, they can prepare to build a raft and steer towards a neighboring island. There they can set up a signal fire on a high mountain. As there are no food sources on the second island, players need to make sure they are well prepared before crossing the sea. Once the players ignite the signal fire, the game is won and their rescue is shown in a cutscene.

The game has been fully implemented and tested. A user experience evaluation has been conducted (Wendel et al. 2012), showing that players liked the collaborative gameplay and tasks very much. Overall the game was described as being "fun".

Pattern Usage

The following game design patterns where used for the collaborative tasks. As most of the collaborative tasks require only two of four players, they can be solved simultaneously (applying the 'Parallelization' pattern to their overall progress).

Gathering food

Players need to find bushes first in order to gather edible berries. As it is possible to speed up the search by spreading out into different directions, the 'Parallelization' pattern is used. Berries can then be eaten or given to fellow players. Therefore, this game design element makes use of the 'Resupply' pattern: Players can choose to search for berries not only for themselves but also to supply their team members.

Building the log hut

To build the log hut, players need to fell palms and carry them towards a designated building place on the island. As palms can only be carried by three players (or half palms by two players), the 'Concurrency' pattern is applied (Figure 1, left). Players need to be at specifically defined locations relative to the palm (front, middle, rear) and coordinate their movements in order to move the palm forward. Should they lose their formation the palm is dropped and players have to pick it up again.

Hunting herons

As there are no ranged weapons in the game, players need to surround a heron and push it towards a cliff. They can then gather its meat and swallowed items. This task requires good coordination and communication as players need to synchronize their movements to

surround the heron, using the ‘Concurrency’ pattern. Otherwise the heron will run away through a loophole between them.

Building a raft

Another collaborative task requires players to build a raft, which requires wood for the third time. They later steer it together to reach the neighbored island, which can only be done once all players are sitting on it (Figure 1, right). Thus, it incorporates the ‘Gathering gate’ pattern to make sure all players are always on the same island.

Preparing the fire

Players need to fill an empty bottle with gas to light the signal fire. The gas source can only be seen at night as a blue smoke source. In order to fill the bottle, one player needs to hold the bottle while another one provides light using a flashlight. This applies the ‘Concurrency’ pattern as it is not possible for one player to use both items simultaneously. The second ingredient for the fire is wood, which is gathered in the same way as for the log hut before.

CONCLUSION

In this paper we introduced several game design patterns for collaborative player interactions, which can be used as references when designing collaborative games. Focusing on the interaction between players, the patterns are meant to support more interesting play where the players closely interact with each other instead of playing “besides” each other. We classified the interactions along several dimensions to improve usability, for example whether they separate the players or gather them at a specific location. The applicability of the patterns was tested by incorporating them into the game design of a collaborative multiplayer serious game, which was received well by players.

An important limitation is that even when using the patterns a basic understanding of game design is required in order to achieve good results, for example to introduce variations when using a pattern repeatedly. Another important aspect is to make sure that the interactions provided by the patterns fit into the setting of the game. Aside from that it should be noted that although over 20 different patterns were found, the list cannot be seen as conclusive.

Future work will include further usage of the patterns in future game designs in order to identify possible refinements and extensions. Some of these patterns will also be implemented as templates into our authoring tool for serious games[4], focusing on the ones which are suited for adventure gameplay. These templates can then be used as predefined building blocks for player interactions based on the proven patterns, inspiring inexperienced authors and enabling a guided authoring process. While the variations described will be configurable via variables, the consequences can be used for a search function as desired outcomes of an interaction (e.g. searching for an interaction which splits the players up).

ENDNOTES

1 Although there is a difference between collaborative and cooperative games (Zagal et al. 2006), the term “cooperative” is used almost exclusively to describe games in which players work together.

2 Software distribution and community platform by Valve Corporation, primarily used for games (see http://www.steampowered.com).

3 http://gdp2.tii.se/ (last accessed 20th January 2014).

4 StoryTec (see http://www.storytec.de).

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