Towards Understanding how to Design for Social Play in Exertion Games

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Abstract

Players invest significant physical effort when playing exertion games. In addition to improving physical health, exertion games are also believed to facilitate social play amongst players. Despite these advantages, our understanding of how to design these games to successfully support social play is limited. In this paper we present a qualitative analysis of player data from "Table Tennis for Three", a mediated exertion game for three players, that contributes to our understanding of how the design of an exertion game facilitates social play. We use the concept of "space" to frame our findings in order to create themes that can be used to analyze existing and to design future exertion games. We hope our work can support researchers gain an understanding of this exciting new field, while also help designers utilize the many benefits of exertion games.

Keywords

Exertion Interface, exergaming, exergames, physical, tangible, sports, exhausting, physical effort, social play, connectedness, ping pong.

Introduction

Recently, a number of computer games have emerged requiring players to use gross-motor movements of the body to interact with the gameplay, rather than the

micro manipulation with fingers to press buttons and keys. These games – *exertion games* – demand intense physical effort from the players (Mueller, Agamanolis, & Picard, 2003) and are at the centre of an increasingly popular genre of computer games. From the early arcade game Dance Dance Revolution through Sony's EyeToy to Nintendo's Wii , these games have created an emerging trend that involves exertion as part of the play mechanics.

A number of benefits have been attributed to exertion games. Exertion games are believed to contribute to physical health by encouraging players to exercise longer and more often, with positive implications for problems such as obesity (Graves, Stratton, Ridgers, & Cable, 2007). It has also been suggested that games that encourage exertion are apt for encouraging social play (Eriksson, Hansen, & Lykke-Olesen, 2007; Strömberg, Väätänen, & Räty, 2002; Wakkary, Hatala, Jiang, Droumeva, & Hosseini, 2008), and the associated social experience is more likely to attract wider user participation (Bianchi-Berthouze, Kim, & Patel, 2007; Lindley, Le Couteur, & Berthouze, 2008). Exertion games are often played with others (Behrenshausen, 2007), and research has suggested that these games can transfer the quality of the game from "hard fun" to "social fun" (Lindley et al., 2008).

When we frame an exertion game as social play, we refer to Salen and Zimmerman's view that the relationships between elements in a game system are social relationships: the players participate in social play, communicating via game play, "in which a game becomes a context for stylized communication, mediated through social interaction" (Salen & Zimmerman, 2003). We agree with the authors that a game's design can contribute to the emergence of social play (Salen & Zimmerman, 2003); a view similar to Dourish's, who, in his writing on embodied interactions, argues for a role of design in facilitating social aspects (Dourish, 2001). However, there is a lack of understanding of how the design of the game affects the link between exertion and social play (de Kort & Ijsselsteijn, 2008; Lindley et al., 2008). The purpose of this paper is to improve our understanding of how the game's design influences social play in exertion games.

Moen has demonstrated that the use of Laban's components of human movement - space, time, energy – can contribute to our understanding of interactive systems that draw on the movement of the human body as input mechanism (Moen, 2006). Laban's work on human movement has originally been used to analyze dance

choreography, but has recently also been applied to exertion games (Larssen, Loke, Robertson, Edwards, & Sydney, 2004), contributing to our understanding of the bodily movements exhibited in exertion games. In this paper, we extend the area of investigation and concentrate on the influence of design to facilitate social play in these games. Nevertheless, as physical exertion results from movement in these games and is believed to contribute to the social facilitation (Lindley et al., 2008), we use this view on human movement to structure our analysis. As this research is part of a phased study, we, for the purpose of this paper, concentrate on one factor, *space*, and propose an extended view that utilizes the physical space of movement, but also the virtual and awareness spaces exertion games can create.

By looking beyond the spatial characteristics of space, we follow Fitzpatrick (2002), who has previously investigated the role of space in socially-situated interactive systems. She was also interested in identifying features that "facilitated or constrained the life of the social world" and found it helpful to focus "on the use of space and its affordances for support of interaction" (Fitzpatrick, 2002). Even though her work resulted on a view on 'locales' as guiding concepts for the support of social actions in interactive systems, the foundation was laid out by the lower-level use of spaces; and we believe this lower-level view can also be helpful in guiding our work on beginning to understand the influence of design on social aspects in exertion games. Furthermore, mediated environments usually re-connect elements of space that are inherently connected, hence we are interested in a view on space that highlights aspects that might be missed when conducting analyses in non-mediated environments.

Our work contributes conceptual themes that can be used to analyze existing exertion games and to improve their design in the future. We hope they will aid researchers gain an understanding of this exciting new field, while also help designers exploit the many benefits of exertion games. In the rest of this paper we will describe prior work that lays the foundations for the investigation of the social aspects of exertion activity.

The contribution of our work is a set of conceptual themes that can be used to analyze existing exertion games and to improve their design in the future. We hope they will aid researchers gain an understanding of this exciting new field, while also help designers exploit the many benefits of exertion games.

In the remainder of this paper we will describe prior work that lays the foundation for the investigation of the social aspects of exertion activity.
We then utilize data from a qualitative user study "Table Tennis for Three" (Mueller & Gibbs, 2007a), a networked exertion game. We introduce the notion of *parallel and non-parallel* activity to highlight a characteristic feature of this genre of games in order to be better able to discuss player experiences, and also show how *anticipation* is a salient theme in exertion games that can facilitate social play.

Related Work

De Kort et al. investigated embodiment and social aspects of games, believing players have an intrinsic need to experience their physical and social environments kinesthetically (de Kort & Ijsselsteijn, 2008). Although the authors propose that social play can be designed for, and exertion can "radically" impact social play (de Kort & Ijsselsteijn, 2008), they do not offer practical examples to demonstrate how an exertion game's design would facilitate a relationship between social play and exertion.
Webb et al. (2006) report on a practical example that promoted social interactions through gross-body movement; in their prototype they focus on bodily controlled buttons in an arts context, and less on exertion. Hoonhout and Fontijn (2008) on the other hand designed a game that demands intense physical effort, and confirm that the "source of fun" for their participants was the social aspect, however, the authors give no further insights into how the game's design facilitated this effect.
Moen (2006) researched the link between body movement and engagement and she selected the concept of space as a featured component to inform her resulting prototypal design. Her work focused on personal space, and although she recommends the artifact's use in a social context, her analysis of use is limited in terms of discussing implications for social aspects. Fogtmann et al. (Fogtmann, Fritsch, & Kortbek, 2008) elaborate on the social aspects touched upon by Moen (Moen, 2006) and suggest that researchers can expect different engagement and social effects in games depending on whether players participate in competitive or collaborative exertion play.
The consideration of social aspects in exertion activities has been investigated in other domains as well. In particular sports research has conducted experiments

regarding interdependencies between physical activity and social interaction to improve performance (Weinberg & Gould, 2006). Such research has found social benefits of exercising with others. Working-out together has been attributed with increased engagement and fun, and it has been described as a facilitator for socializing (O'Brien & Mueller, 2007).

Breakout for Two is an example of an augmented activity that has been empirically investigated (Mueller et al., 2003). It is an exertion game supplemented with a videoconference of a remote location. The evaluation showed that players experienced a closer sense of connectedness compared to playing a keyboard-controlled game. However, the study did not focus on an analysis of which individual aspects of the design contributed to this effect.

In our own prior work with Table Tennis for Three (Mueller & Gibbs, 2007a) we conducted a quantitative analysis (Mueller & Gibbs, 2007b) of player participation and demonstrated that engagement can occur in an exertion game, even if three players play at the same time. Furthermore, we have also shown with a qualitative study that the physicality of game artifacts can contribute an element of uncertainty to exertion activities that in turn facilitates social play (Mueller, Gibbs, & Vetere, 2009). We are now extending this work by investigating how the system's design contributes to the link between exertion and social play, adding to the theoretical understanding of exertion interactions such as those exhibited when engaging with our technological artifact.

Space

The notion of space in games has been used to discuss physical, temporal and technical aspects of play, but also to understand the very nature of games, see for example the metaphor of a "magic circle" to describe the space of play (Salen & Zimmerman, 2003). Nitsche recently proposed to differentiate between various space aspects in games and label them individually, such as the "social space" and the "mediated space" to aid the analysis of games (Nitsche, 2009). He finds space one of the core features of digital media, and although he is particularly interested in 3D games' virtual spaces, his use of conceptual planes for the analysis of game spaces highlights a view on, for example, mediated and social aspects, that extends beyond the spatial characteristics of these spaces. We agree with Nitsche that differentiating between these spaces conceptually can help us understand

games better (Nitsche, 2009), and hence use the concept of space to structure our analysis.

We believe the concept of space is particularly useful in aiding our understanding of exertion games, as the bodily movements characteristic for these types of games have been previously analyzed using an understanding of space (Moen, 2006). Moen investigated space in terms of the physical environment, but also from a player's perception perspective (see for example the use of personal space', highlighting a view on where movement occurs spatially and associated social implications. De Kort et al. propose a theoretical lens on places to understand player experiences in a socio-spatial context (de Kort & Ijsselsteijn, 2008), and, similarly, Fitzpatrick (2002) suggests a theoretical framework aiming to stimulate design thinking that is concerned with spaces to consider approaches that identify more fluid conceptual places to spot affordances for the support of social interaction. We use space as a conceptual construct to aid our analysis from a socio-spatial perspective. We clarify different aspects by labeling three of them specifically, as demonstrated by Nitsche (2009). We use *awareness*, *physical* and *virtual* space in order to frame our discussions, and refer to these spaces' aspects in regards to our game "Table Tennis for Three".

We use the term "awareness space" to describe the space made available to the user by the mediating interactive system, often it is some sort of "tele-" technology that allows access to a remote space. Awareness has been described as a form of social mechanism to facilitate social interaction - people want to know what others are doing and letting others know what is happening (Sharp, Rogers, & Preece, 2007) while it can provide a context for physical activities (Dourish, 2001). In Table Tennis for Three, the mediating technology makes the two remote spaces available to the local user through the video and audio data of the videoconferencing system, such a view on space to describe capture areas has been previously used in camera-based bodily interactions (Eriksson et al., 2007).

We also use the term "physical space", borrowing a concept of performance space in interactive art (Sheridan & Bryan-Kinns, 2008), and define it as the space in which the exertion activity is performed in.

Finally, we use the term "virtual space" to describe the space in which the gameplay occurs. It is concerned with the "displayed virtual" component the players interact with. This virtual space enables a shared space for the players

despite the geographical distance between them: in Table Tennis for Three players share virtual targets.

Research Gap

Prior work suggests that exertion games and social play are linked. Design can facilitate exertion as well as social play in games, however, there is a limited understanding of how a game's design can contribute to the link between exertion and social play. We believe by investigating the role of design in supporting social play in exertion games, we can contribute to an understanding that can aid researchers in analyzing existing and help designers to create new games. Our work therefore aims to investigate the role of design in supporting social play in exertion games.

Table Tennis for Three

Table Tennis for Three (Mueller & Gibbs, 2007a) is an exertion game that can support three players in three geographically distant locations.

Fig. 1. Table Tennis for Three.

Gameplay

Each player has an identical setup, including balls, a paddle and a table tennis table. The table is set up so that the ball can be hit against the vertically positioned opposite half of the table (Figure 1). This setup is familiar to table tennis players who practice on their own by playing the ball against the board. This backboard has projected images of eight large 'bricks' on it. These bricks are identical for all players, i.e. they are synchronized across all three stations. These bricks are semi-

transparent and are projected onto the backboard. In addition to the bricks, there are also two video streams of the other players projected onto the game, so each player can converse with either of the other two individually or with both of them together at any time via the video and audio connection.

The backboard is equipped with sensors mounted on the back that detect which brick the players are hitting (Mueller & Gibbs, 2007a). These bricks 'break' when hit by the ball. All three players see the same brick layout and the same brick status layered on top of their respective videoconferencing streams. If a brick is hit once, it cracks a little. If it is hit again (regardless of by which player), it cracks more. The crack appears on all three stations (Figure 2). If hit three times, the brick 'breaks' and is removed from play. However, only the player that hits the brick the third and final time receives the point.

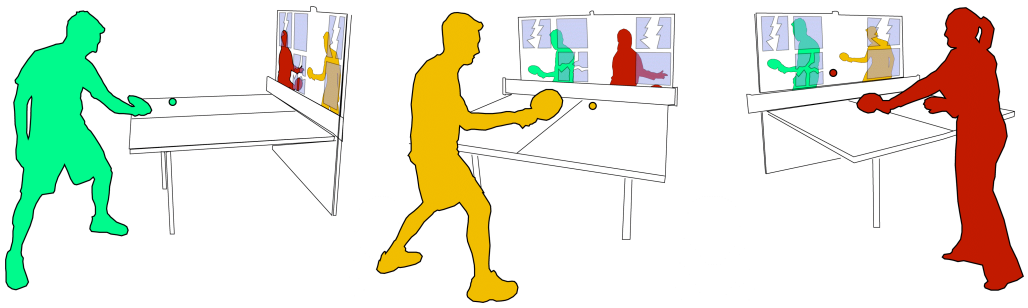


Fig. 2. The blocks are shared across the three stations, a hit is visible to all players.

The players can either try to crack as many bricks as possible by placing the ball quickly or they can wait for the opportunity to snatch away points from other players through hitting bricks that have been already hit twice by the others. Each brick that is completely broken scores one point. Play continues until all bricks have been cracked three times, and at this point the player who has scored the most points is announced as the winner.

Study

We are presenting results from a qualitative analysis of play in Table Tennis for Three. We used video material from playing sessions and from interviews we conducted with the players after the games. Each group played between 30-60 minutes. The players were brought together into one room after the game, where we conducted detailed interviews with all three of them together. The interviews

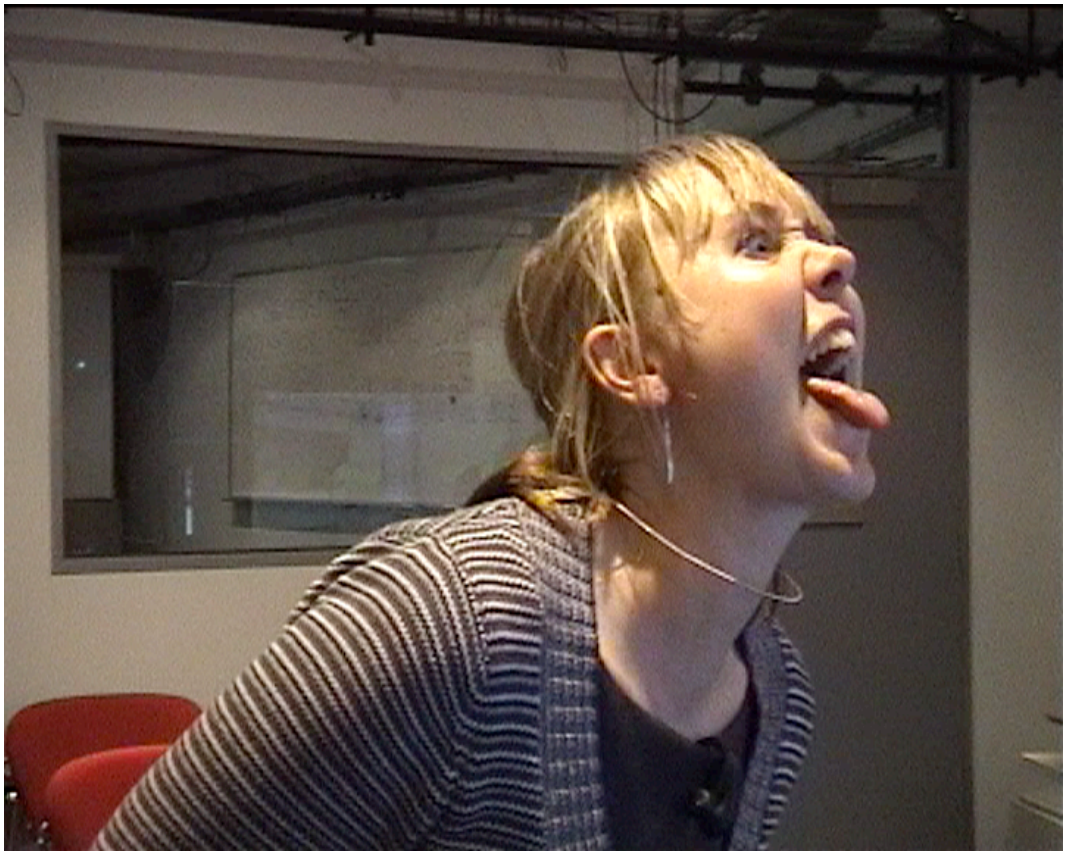
lasted from 20 to 60 minutes and contained open-ended questions about their experiences. We took notes during the interviews as well as videotaped the session.

Our participants were asked to organize themselves in groups of three. If they were unable to do so, we matched them up randomly with other volunteers. In this paper we report on 14 groups. One participant played twice due to a last-minute cancellation (which we considered in the analysis). We therefore had 41 distinct participants. The participants were between 21 and 55 years old (mean 31.6 years), and consisted of 27 males and 14 females. It is acknowledged that prior social relationships between participants can affect the social play interactions within a game (Salen & Zimmerman, 2003), this aspect was therefore considered by asking additional questions about how their relationships affected the way they played. The participants' prior exposure to table tennis was varied. One had never played before, 14 participants played less than 5 times, 18 players between 5 and 100 times and 8 volunteers played more than 100 times before.

The video data was analyzed using a coding process based on grounded theory (Strauss & Corbin, 1998). It is acknowledged that this approach benefits from an open mind towards the data, but as we already had conducted evaluations on related phenomena before (Mueller, 2002), we realize that this is hard to achieve. This predicament has been previously recognized even in generic grounded theory approaches (Neuman, 2006). Researchers therefore often use mixed forms when coding data (Bortz & Doring, 2002). Consequently, we drew on sensitizing concepts that relate to the aspects of space and their use in previous studies and in relevant literature. We used an iterative process with multiple viewings of the video data and also used affinity diagrams to arrive at our themes.

In the following sections we describe two salient themes we identified in the data and discuss their significance.

Parallel and Non-Parallel Gameplay



Player's reaction from playing against another player

During the interviews players stated that they were intrigued by the opportunity of playing physically with another person across a distance. *"If the other person is overseas, it's a good way to interact, rather than just talking on he phone" [P7]*. The players encouraged themselves and each other during the game *("Lets' go for it!"[P3], "P18, come on!" [P20])*. They were not shy of engaging in a competitive aspect, often expressed in statements such as *"I really wanted to beat her."[P13]*. If a player snatched away the last brick, we heard statements such as *"You b***!" [P21]*. Although players interacted verbally with their partners during the game, some players also commented that they felt more like they were playing against blocks, *"not at [sic] each other" [P15]*. P15 said, *"when playing, you are more focusing on the blocks than on the other player"*. When we begun to ask P22 during the interviews if he had a sense of the other players during the game, he completed the sentence *"No. I was just trying to get the blocks. (The player next to him nods.) […] Because it's such a fast game, you don't have time to change your strategy."* P21 described vividly how she recognized that she

could have focused on the bricks, but realized that playing against 'a person' suited her better: in the interviews she made the following comment to the third player P4 in her group: *"...you are playing against yourself, sometimes, because you are very competitive against the screen, whereas I was watching P13, and it was like, when I was telling her off for cheating, then I actually aimed the ball at P13's head, at the screen! (All laughing.)"*

Significance of Parallel and Non-Parallel Gameplay

In order to be able to unpack how social play unfolded between the players and what role the virtual bricks played, we begin by drawing attention to a particular characteristic of Table Tennis for Three, which concerns how participants interacted with one another via the game: Table Tennis for Three facilitates parallel as well as non-parallel play.

In a parallel game each player performs his or her exertion actions independently from one another, the players have no direct influence upon the difficulty of the task faced by their opponents, as they cannot directly interfere with one another (Mueller, Gibbs, & Vetere, 2008) (Vossen, 2004).

In a non-parallel game the opponent creates, or functions as, an obstacle the player is meant to overcome in pursuit of the game's goal. Players interact with one another's activity, and a player can actively prevent the other player from achieving his/her goal. This can also be described in terms of how a player's performance is highly dependant on how the opponent allows him or her to play. An analogy from traditional sports would be a track and field 100 meters race (parallel) in contrast to a wrestling match (non-parallel). Both parallel and non-parallel activities facilitate exertion. While there is currently no research that makes conclusive statements about whether parallel or non-parallel activities facilitate more social play, some authors associate non-parallel games more often with social effects such as team-building and the forming of social bonds (Weinberg & Gould, 2006), indicating that the notion of parallel and non-parallel gameplay can affect social play differently.

In Table Tennis for Three, the players' exertion actions cannot physically interfere with one another, as they are in three separate physical spaces, hence the game is of a parallel nature. However, Table Tennis for Three also includes a virtual space, containing the virtual bricks, which enables an aspect of non-parallel play,

as this virtual space is shared amongst the players. The fact that each brick needs to be hit three times before a point is awarded, and players can snatch away points by hitting them before their opponents do the final hit, making a player's performance highly dependant on how the opponents' allow him or her to play, facilitates an aspect of non-parallel play even though the ball does not travel across the table as in traditional table tennis.

We can therefore say that in Table Tennis for Three, the virtual space enables a non-parallel aspect in a game that is controlled by a parallel activity in the physical space. The technology enables a non-parallel aspect to the game that would otherwise be restricted to a parallel activity due to the geographical distance between the players. In other words, introducing the virtual space to the activity in the exertion space facilitates non-parallel gameplay in Table Tennis for Three.

We now discuss our observations in regards to how people played and interacted with one another.

On the one hand, participants appreciated being able to play with remote partners. They showed signs of playing together despite the mediating technology. On the other hand, players reported that they sometimes felt more like playing against the virtual bricks rather than another person. We also observed incidences where players seemed to experience both, playing against another person and playing against bricks, such as described by the group around P21: they seemed to be able to navigate between these apparently contradicting experiences.

The fact that Table Tennis for Three facilitates parallel as well as non-parallel play explains why players expressed both, that they felt like playing against bricks but also against other players. The virtual bricks enabled a non-parallel game activity, which the players used to challenge each other in order to enhance their experience. Our players used this opportunity to engage with their remote opponents, trying to 'outsmart' them to snatch points and using tactical decisions to gain an advantage. This kind of play led to the utterance of expletives, adding verbal feedback to their opponents' actions.

The main exertion 'action' of the game, however, is the parallel activity in the physical space. This parallel aspect facilitated a sensation of playing against bricks, not other players, affecting social play. Our players described the parallel aspect through expressing they felt like 'racing' the computer bricks.

The affordance of both parallel and non-parallel play was used by some players to enhance their experience. Especially the players who seemed to seamlessly navigate between playing against another person and against virtual bricks demonstrated that the boundaries of the spaces can become fluid in the context of use, and the users made them fit to meet their interactional needs.

Anticipation

During the interview: "…and you just wait for the third one [crack] and try to get in there quick!"

The participants aimed at hitting bricks that have been hit before: *"... and you just wait for the third one [crack] and try to get in there quick (makes a smash arm movement)" [P11]. "...[you] wait for someone to break the blocks and go for it" [P10]*. However, their ability to anticipate which brick will be hit next was limited: *"[you do not] get a sense where the other player is ... [or] where he is playing" [P12]. "... so I didn't know this was where you were throwing the ball" [P13]*. Anticipating the other players' movements mostly only played a role in initiating the game: *P14 said during the interview: "you are waiting, and as soon as you are ready" (both P14 and P1 initiate a gesture for a serve but stop just*

before executing it), P1 interrupts: "You are ready to go" (both finishing their movement) (both smiling).

Significance of Anticipation

As previously described, a key characteristic of exertion games is the involvement of bodily movements, and supporting bodily movements is believed to facilitate social interactions (Lindley et al., 2008). For individual activity, this support of bodily movements is often associated with self-awareness of exertion actions (Consolvo, Everitt, Smith, & Landay, 2006; Moen, 2006), however, in a social setting, awareness of the other bodies and their associated movements becomes also important (Fogtmann et al., 2008): an understanding of the activities of others can provide a context for one's own activities (Rettie, 2003), and so called awareness of other bodies can be an important part of how we make sense of the world through our bodies (Dourish, 2001).

Knowing that awareness is an important element in supporting social aspects, we can now discuss how 'anticipation' was a salient theme in Table Tennis for Three, as it depended on the awareness space facilitated by the videoconferencing component. We have observed players trying to be aware of their opponents' bodily movements to anticipate future play actions. Players used anticipation to play a 'who does the first serve' game, which always resulted in laughter. They played with the notion of anticipating a synchronized start, and initiated and retracted from serving the first ball, provoking witty comments. This extends prior work by de Kort et al. (de Kort & Ijsselsteijn, 2008) who suggested that synchronicity can facilitate a sense of the remote person.

In contrast to the initiation phase, anticipation played out differently during the rest of the game. Players reported that they had less of a sense of the other player during the game, however, they still anticipated future actions in the game: the players used the state of the bricks to anticipate which of them will be hit next and adjusted their actions accordingly. The players anticipated future actions not directly based on movement actions in the awareness space (as done during the synchronized start), but on the results of these movements in the virtual space.

We believe players used anticipation differently during the game because of several reasons. When serving at the beginning of the game, players were not distracted by the need to account for various brick states. Furthermore, the players

started off by being in the middle of the videoconferencing camera's centre, perfectly framed for all to see. During the game, players move around extensively (Mueller et al., 2009), often leaving the video camera's capture area. Also, the conical shape of the camera did not always adequately capture the ball's flight path. In addition to capture issues, the need to account for a third player probably also contributed to the players' decision to focus on the bricks, as they represented both players within one visual representation, rather than two separate videostreams (see comment from P17).

When compared to traditional gamepad controlled games, the notion of anticipation has a particular role in the context of exertion games. Being aware of a player controlling a binary button interaction does not reveal much of that player's intention behind the gamepad pressing action. On the other hand, an exertion action involves movements that include a whole set of motions (Moen, 2006): for our players it was a backswing, a forward swing, the contact with the table tennis ball, and the follow through for one hit. Although only the contact with the ball 'counted' towards the game, all elements form part of play, distributed over time. By considering how movements are constructed over time, they can support awareness and a sense of mutuality, being what Fitzpatrick (2002) calls the "glue of collaborative activity".

In contrast to sports (anticipation occurs based on actions in the physical space) and computer games (anticipation occurs based on actions in the virtual space), anticipation in Table Tennis for Three supported anticipation based on actions in the awareness space as well as actions in the virtual space.

Conclusion

We have presented a qualitative analysis of player observations in an exertion game with a focus on social play to understand the facilitating role of design. We utilized the notion of space to discuss our findings. We have identified salient themes that contributed to the link between exertion and social play and discussed the role of design in facilitating this link. Our results extend prior work on social play and exertion by identifying contributing themes that can help to analyze existing and guide the design of future exertion games. In particular, we have introduced the notion of parallel and non-parallel activity to exertion games to highlight a characteristic feature of this genre of games. We also found

anticipation and accountability key themes for the design of social play specific to exertion games. We have discussed how anticipation can occur across spaces, and how design can facilitate this anticipation by considering the range of motions exhibited in exertion games, quite different to the design of traditional gamepad experiences. We have also argued that accountability can play a heightened role when considering exertion, even though social aspects are also on the rise.

We acknowledge that a focus on only one particular game can be limiting in terms of the findings. However, we are hoping to 'tell a big story through the lens of a small study' while raising questions about the boundaries and defining characteristics (Neuman, 2006).

We hope our work contributes to a better understanding of exertion and social play, resulting in further development of this emerging research area. We hope we have inspired other researchers to foster the associated benefits of social play and exertion and consider their use in the designs of future interactive systems.

Acknowledgments

The development work for Table Tennis for Three was initially supported by The University of Melbourne and CSIRO Collaborative Research Support Scheme. Thanks to Kerin Bryant for taking the pictures and Beryl Plimmer, Chris Wolf, Christine Satchell and Yolanda Rankin for their editing help.

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