Cooperative Tetris: The Influence of Social Exertion Gaming on Game Experience and Social Presence

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Abstract. This paper presents the primary results of a study that examined the difference between exertion vs. non-exertion in game experience and social presence. This study aims to gain more insight in the influence of body movement in a cooperative game on social presence and game experience, to be better able to design interactive technology that helps people to adopt a healthy lifestyle and to connect people socially. The study was performed among 336 adults (age range: 16–64 years) who played a two-player exertion (n = 167) or a non-exertion (n = 169) version of cooperative Tetris. Analysis of an extended version of the Gaming Experience Questionnaire showed that although participants who played the exertion version of the game found themselves less competent, there was no significant difference between the two groups (exertion players and non-exertion players) in game experience or social presence.

Keywords: Gaming · Exertion interface · Exertion gaming · Physical interface · Game experience · Body movement · Social interaction · Social presence · Physical activity

1 Introduction

Technology is increasingly becoming part of all aspects of everyday life [1, 16]. This has many consequences, such as an increased inactive lifestyle [5] and decreased and shallower face-to-face social interaction [1, 16]. As researchers and designers of new technology we should study how technology in can help people gain an active lifestyle and stimulate social interactions.

Exertion games and exertion interfaces are increasingly being used to encourage people to be physically active in a fun and accessible way. These games and interfaces focus on individual activities or have a competitive goal, while many sports activities are collective [11] and not necessarily competitive.

Knowledge on the relationship between social and physical exertion play is still limited [4]. If we want to be able to design social exertion interfaces and games that invoke social interaction and encourage physical activity, we need to understand which factors play a role in the relationship between cooperation, exertion, game experience and social interaction.

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2 Related Work

Bianchi-Berthouze et al. found that body movement positively affects engagement when playing Guitar Hero [2, 15] when playing with a guitar-like controller vs. a dual-shock controller. In addition, Lindley et al. have found a relation between body movement, social interaction and game experience when playing Donkey Konga with a conga-controller (requiring more natural body movement) [10]. Segura and Mueller et al. have also shown that physical and exertion interfaces (interfaces that deliberately require physical effort [11]) have a positive influence on game experience and social connection between players [13, 15].

Social and physical forms of play have many similar effects: higher engagement, arousal and positive emotions [15]. Combining both these types of play might increase these effects.

3 Goal

Previous research into the effects of body movement in games and interfaces have mainly addressed multiplayer games in which players are competing against each other [2, 9, 11] while in many traditional sports activities players have to cooperate to achieve a certain goal.

Research into cooperative exertion games [14], where people have to work together to achieve goals is still limited and further research is needed to gain insight into the influence of cooperation in exertion games on game experience and social interaction.

Our study aims to gain more insight in the influence of body movement in a cooperative game on social presence and game experience to be better able to design interactive technology that stimulates people to adopt a healthy lifestyle and interact socially.

4 Research Question

What is the difference in game experience and social presence between playing a cooperative game with and without exertion?

5 Method

In this study, adults were recruited at the 2016 Lowlands festival in the Netherlands (visited by >48.000 people). Bypassers were either randomly invited to participate or volunteered themselves after seeing other people play. All participants played once and voluntarily over a period of three days; the non-exertion and exertion condition were alternately played. Participants did not know in advance which version they would play.

Participants were asked to play a modified version of Tetris that required cooperation of both players to control the game. The left player was responsible for moving the bricks to the left; the right player was responsible for moving the bricks to the right.

An action by both players simultaneously caused the brick to rotate clockwise (Fig. 4). In the non-exertion version the players played by pressing buttons (Figs. 1 and 5), in the exertion version players played by jumping while wearing an accelerometer belt (Figs. 2 and 6).

Fig. 1. Non-exertion

Fig. 2. Exertion

After an explanation of the experiment and game, participants gave their written consent. Next, participants were invited on stage to play. They were told which version of two-player Tetris they were going to play and the controls were explained to them. All duos played for four minutes. When finished playing, the participants were asked to fill in a questionnaire about their game experience and social presence in an area next to the stage were they played the game (Fig. 3).

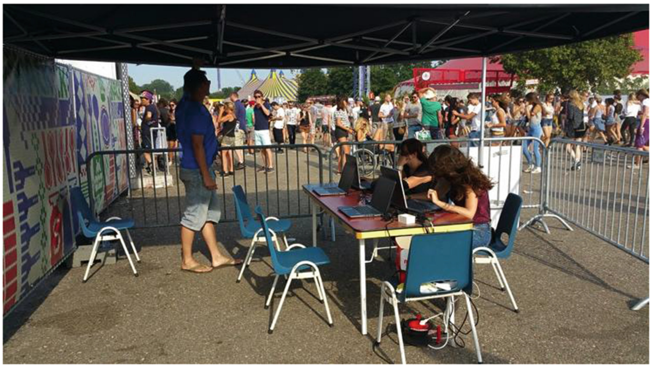

Fig. 3. Participants filling in questionnaires

6 Participants

A convenience sample of 336 adults (180 males, 156 females, mean age: 25,3 years, SD = 7,3) participated in this study. We included all 336 participants who filled in the questionnaire in this study.

Condition 1 – non-Exertion. (Figure 1) The non-exertion version of the game was played by 169 participants (70 females (41,4 %) and 99 males (58,6 %)), with an average age of 24,7 years (SD: 7,0).

Condition 2 – Exertion. (Figure 2) The exertion version of the game was played by 167 participants (86 females (51,5 %) and 81 males (48,5 %)), with an average age of 25,9 years (SD: 7,6).

7 Materials and Measurements

7.1 Game

For this study we developed a multiplayer version of Tetris (based on an existing Tetris game written in Processing [6]). We chose Tetris because it is fun to play, well known and intuitive; we expected most people to have prior experience with and understanding of the mechanics and the goal of the game. Tetris' original gameplay allowed it to be modified into an exertion and non-exertion cooperative two-player version without losing the goal or affordances of the original version. While playing, players can still communicate and it is possible to hold a similar posture in both the exertion and non-exertion condition.

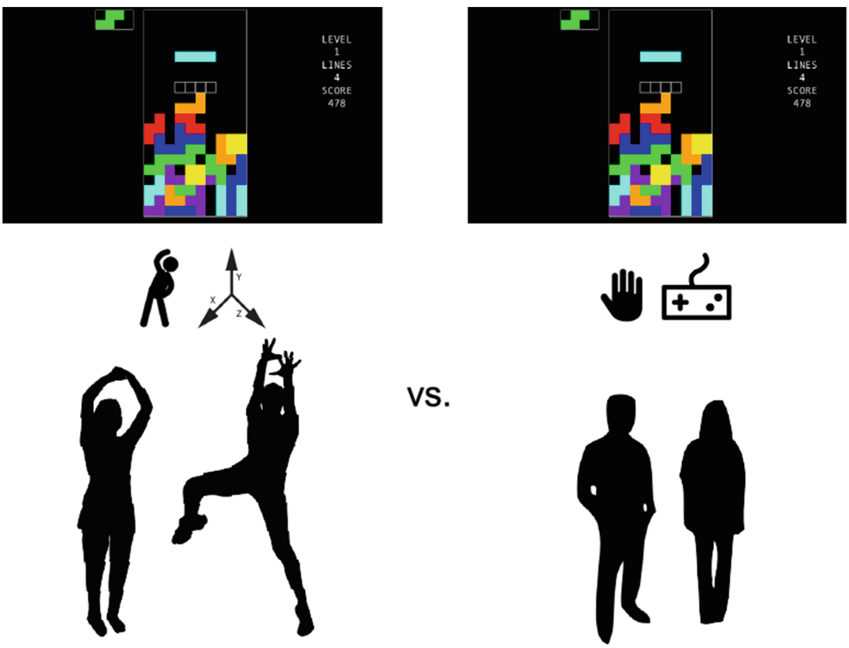

Fig. 4. Exertion vs. Non-exertion cooperative Tetris

7.2 Controllers

Condition 1: Non-exertion. The input device for the non-exertion version of our experiment was a wooden box with two arcade buttons that controlled the game (Fig. 5). This controller was custom made (Arcade buttons connected to a Adafruit 5 V 16 MHz Pro Trinket for keyboard output), avoiding possible effect of familiarity with the input device [1].

Condition 2 – Exertion. The input device for the exertion version of our experiment was a custom-made belt (Fig. 6) (Adafruit MMA8451 Triple-Axis Accelerometer connected to an Adafruit 5 V 16 MHz Pro Trinket) that allowed us to send keyboard input based on the players body movements. Players had to jump to send keyboard output.

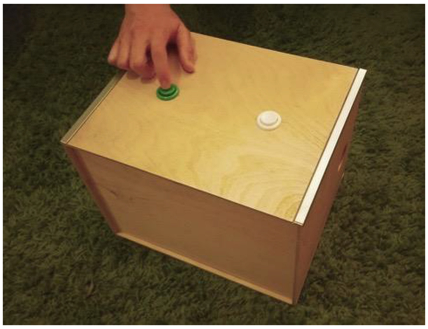

Fig. 5. Button controller for Non-exertion condition

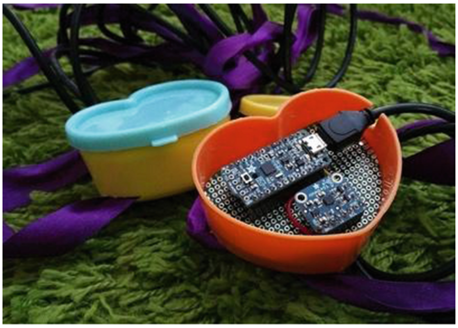

Fig. 6. Accelerometer controller for exertion condition

7.3 Screen and Stage

The game was projected on a large screen in front of the players (Fig. 7). Participants played standing on a slightly elevated stage in front of the screen, visible for other festival-visitors.

Fig. 7. Screen and stage used for gameplay

7.4 Questionnaire

To measure Game Experience and Experienced Social Presence we used revised versions of the Core and Social Presence Modules of the Game Experience Questionnaire by IJsselsteijn et al. [8] and de Kort et al. [9] with a 5-points Likert Scale. Items unrelated to our type of game (Sensory and Imaginative Immersion; Psychological Involvement - Negative Feelings) were removed. We included relevant questions from a previously used social questionnaire [12] to the Social Presence Module to gain more insight into the social interaction between players. In addition, background variables were gathered such as age, gender, how well participants knew the other player, exercise and gaming frequency.

7.5 Video

Besides the questionnaire responses, videos of all games played were gathered. This data will be analyzed in a next phase of this study.

7.6 Analysis

The answers to the Core and Social Presence Module of the Game Experience Questionnaire were coded (Not = 1; a Little Bit = 2; Somewhat = 3; Quite = 4; Very = 5). To compare the exertion and non-exertion condition of our experiment, we checked if the results were normally distributed and calculated the mean scores and standard deviation for each component and individual questions, followed by a t-test (two-tail, two-sample, unequal variance). To avoid the risk of a type-1 error we performed a post hoc Holm-Bonferonni [3, 7] correction.

8 Results

8.1 Game Experience

Participants who played the exertion version ($M = 2.55$, $SD = 0.84$) of cooperative Tetris felt significantly ($t(334) = -4.51$, $p = <0.0001$, Holm-Bonferonni correction: $p' = <0.0001$) less competent than participants who played the non-exertion version ($M = 2.97$ $SD = 0.86$) (Fig. 8). On the other constructs of game experience (Flow, Annoyance, Challenge, Negative Affect, Positive Affect) no significant differences were found.

8.2 Social Presence

The results for the constructs that measure social presence (Empathy and Behavioral) do not show a significant difference between the exertion and non-exertion condition.

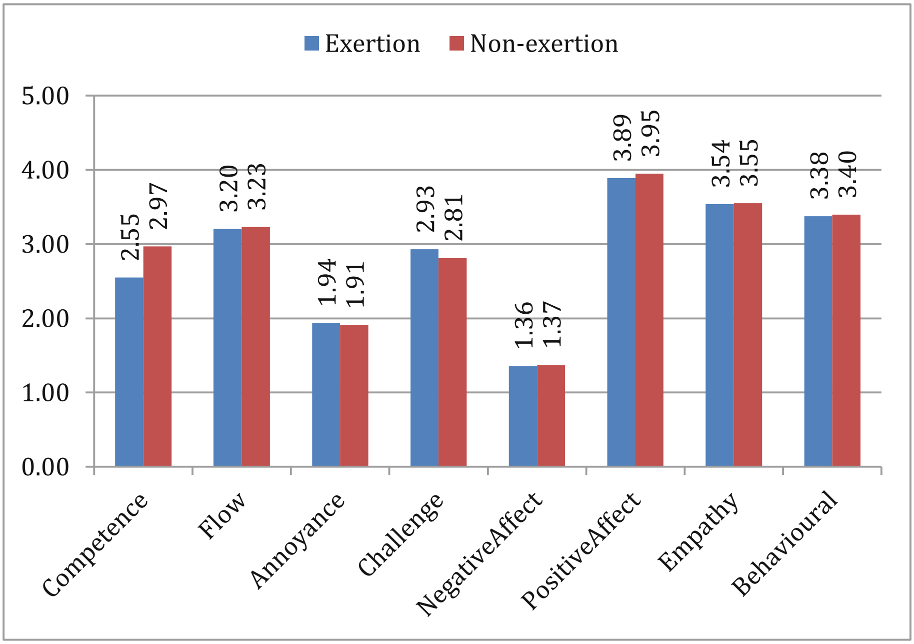

Fig. 8. Means of all components of the core and social presence module of the game experience questionnaire.

9 Conclusion, Discussion and Further Work

Previous work shows a relationship between exertion games, user experience and social play. Our results show a difference in perceived competence between the exertion and non-exertion version of cooperative Tetris. We could however not find a quantifiable difference in other aspects of user experience and in perceived social engagement between the exertion and non-exertion version of two-player cooperative Tetris, even though participants found the exertion version more difficult and challenging to play.

9.1 Gender, Familiarity, Exercise and Gaming Frequency

The exertion condition (86 females (51,5 %)) was played by more women than the non-exertion condition (70 females (41,4 %)). Furthermore, other variables were measured (How well players knew each other, Exercise and Gaming frequency) in our questionnaire, that we did not include in our current analysis. Further analysis will have to show if these variables had an influence on the outcome of our questionnaire.

9.2 Cooperation vs. Competition

Our study compared two conditions where players had to play together to achieve the goals of the game. To gain more insight into the role of cooperation on social engagement and game experience, in future work we will look further into the role of cooperating with or competing against each other when playing.

9.3 Social vs. Individual

To see what the influence is of playing a game together on game experience, we consider extending this study with a one-player exertion version to look into the difference between social vs. individual exertion play.

9.4 Effect of Novelty

What previous research doesn't address well is the novelty value that might play a role in game experience. Is a new type of gameplay more engaging than a familiar game and is a new controller more exciting than a familiar controller? In this study we used two novel controllers to avoid any influence caused by controller-novelty and we designed novel gameplay for both conditions.

9.5 User Research Methods

For this paper we relied on self-report for our analysis. We have however used a mixed-methods data collection (questionnaire and video) and will improve our study with a mixed-methods analysis approach [12]. We will improve this study by including video analysis to be able to keep track of verbalizations, speech, utterances, non-verbal behavior, instrumental gestures and empathic gestures while playing [10].

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