Engaged By Boos and Cheers: The Effect of Co-Located Game Audiences on Social Player Experience

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ABSTRACT

Little is currently known about the influence of co-located player audiences on gameplay experience. Social player experiences are important to understand in co-located gaming scenarios, because these experiences relate to player performance. Player-audience relationships have been studied before, but prior research focused on player attributes and typology. In our study, we investigated the effect of different *co-located* audience types (silent, positive, negative) and no audience on player experience. For the study, we contribute a video game specifically developed for two-player, co-located gameplay and findings from questionnaires and semi-structured interviews. Our findings show that both – negative and positive audience activity – drove players to become more engaged in the video game. In contrast, silent audiences made players feel unnerved and less engaged in gameplay. Our paper is the first to study of the relevance of co-located audience influence on player experience, which is important for understanding the design of co-located games.

Author Keywords

Audience Influence; Game Design; Social Interaction; Player Experience; Multiplayer Game; Co-located Gaming

ACM Classification Keywords

H.5.2. Information interfaces and presentation K.8.0 [Personal Computing]: General – Games

INTRODUCTION

The continued success of co-located games, which rely on interaction between players when they play a game, can be seen in the multiplayer focus of top-selling games. In particular, co-located gaming in front of an audience (as often done in co-located games like *Wii Sports* or *Just Dance*) always has a performance aspect to it, where the interaction between players and their audience shapes the overall gameplay experience. However, we currently know very little about the effect of different kinds of audiences on players when playing co-located games. Our ability to design for audience influence (as well as for social interactions) during gameplay would improve, if we had a better understanding of the effect that audiences have on players. A first necessary step towards this is to investigate different audience responses during co-located gameplay.

Audience responses have been studied in different environments before. For example, in art and performance [19] or during multimedia presentations [31]. Prior research has focused on social facilitation and choking effects in gaming on the performance of good players [16] and on the player-onlooker relationship [21]. However, these studies are limited to player attributes and typology [2]. Recently, effects of game physicality on turn anticipation of audience members [8] was studied. However, the player-audience relationship (especially during co-located gameplay in video games) is currently not well studied. Supportive audiences have been shown lead to performance decrements compared to non-supportive audiences in skill-based activities [4] and in sports activities, where skill is learned with higher levels of explicit knowledge [20]. However, both these past studies consider the audience influence on only a *single* performer. In this paper, we are building on and extending this line of research by investigating the influence of an audience presence in a *multiplayer*, *co-located* gaming environment. Hence, we conducted a study to compare the presence and influence of an audience on player experience in a co-located performance-type game to determine how different types of audience activity influence player experience.

To investigate this audience influence, we developed a two-player co-located video game called *Magic Duel* (MD). The game uses *Kinect* input (a camera-based tracker) and facilitates drop-in gameplay. People can walk up to the gaming setup and participate in a quick game with each other. We chose this setup because we believe that these types of multiplayer games naturally get an audience and that the effect of an audience is important for their design.

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We conducted two exploratory studies: an initial pilot study in a co-located space, where the game was put in front of players in an open and co-located environment. We investigated how audience presence influenced gameplay. This informed a follow-up study in a controlled environment within a laboratory setting. In the follow-up study, we aimed to understand the effect of different *audience types* (i.e., none, silent, positive, negative) on player experience.

Our findings present evidence that positive and negative audiences drove players to be more engaged in a game in different ways. In our study, a positive audience led to player distraction, but this in turn forced the player to be more concentrated and engaged in the game. Similarly, a negative audience led players to improve their effort in gameplay and hence also increased player engagement and concentration. In contrast, a silent audience led to less engagement and unnerved players with an uncanny feeling of being watched.

To the best of our knowledge, our paper is the first to show that negative and positive audience activity engages players *more*, while silent audiences engages them *less* in co-located multiplayer games. A better understanding of the influencing role of the audience on co-located gaming can help designers to use this knowledge in their game design to build engaging games. Our paper provides an important first step in understanding player experience in co-located games involving audience participation.

RELATED WORK

Co-located games create engaging social interactions, where players, audience and their level of experience are important for shaping the gameplay experience. Games can encourage play between intergenerational populations [1] and enable players with varying skill levels to play together.

In this section, we provide an overview of prior research in co-located gaming, audience influence and user experience in co-located game settings. The *iGamefloor* [10] was an interactive floor platform that engaged players in a social game involving multiple individual players in a co-located collaborative game environment. The game was specifically designed for school children to track the movement of limb contact points. However, none of these game examples were evaluating the impact of different audience types.

The level of engagement with a game ranges from passive game spectatorship to active – even transformational – play. Innovative interaction paradigms have enabled a freedom of experiences through body movements, gestural controls and social interaction between players within co-located game settings. Games are more often incorporating performance aspects into them, moving from home environments to public settings involving gaming tournaments and exertion games. “Sports over a distance” explored exertion interfaces [24], which helped to connect people socially over distances. Research on full-body experience indicated that body movements led to stronger and affective experiences [3]. Another example is adding an interactive display to a public basketball hoop can motivate players and foster community [6]. Researchers also explored the potential of facilitating social awkwardness to investigate social player experiences during physical co-located gameplay [12].

Video game design often relies on player to system interaction from the personal spaces of players or their interaction with an online community. This leads to players navigating games on their own or collaboratively playing with their friends in a co-located setting or an online environment. Roccetti et al. [27] define *context accessibility* and *player heterogeneity* to be two variables distinguishing between gaming at home versus in a public space. This means that in public-space gaming, the contextual relationship of the game is accessible to any or all players in situ, and anyone can step in and play the game. For example, contemporary city [30] shows how non-instrumental actions are relevant. Spatial opportunities and encounters with strangers were key influencers for play in public spaces.

Player experience is exciting because of the spatial relationship between onlookers and player. Engagement in games stems from encouraging dynamic social interactions [21]. In another study, the precision of player body movement recognition increased players’ immersion levels in exertion games [25]. The emotional content expressed by players [28] added a dynamic and complex context in a body-movement game. *Physicality of an experience* introduces an added dynamic to any play activity that involves players engaged in physical interaction through gameplay. For example, player engagement increased when the game mechanics afforded body movements [22]. However, this physical experience transcends beyond the player into the realm of social presence [18] when the game system is deployed in a co-located space. Furthermore, gestural interactions as studied using a Kinect controller, facilitate the opportunity of fun, laughter and gentle mocking gaze [11] from observers, which influences the participants engagement. This shows that a relationship between players and their audience exists, which contextualises player experience at any given point in time during gameplay.

Spontaneity and fluidity of information sharing between people in a communal space has been compared in physical media and digital media. Designing a spectator experience [26] is a key challenge in a co-located game with audience present. The synergy between spectators and a performer interacting with a computer affords multiple levels of interactions. Previous research proposed design strategies to be secretive, expressive, magical and suspenseful [26] in a taxonomical matrix – four approaches that explained a spectators perception of a performer’s interaction.

One of the main challenges for a game installation in a co-located space with audience presence for us was how to define the desired interaction type. This Social Experience (SX) of play can be defined as the relationship between player, game system and audience; a symbiotic relationship [14] between these domains affecting play in co-located

spaces. We define game interaction in this context: between *players and the game system*, between *players and the audience* and between *the audience and the game system*.

Audience participation and engagement has been a topic of interest to researchers in previous studies. For example, the *WeINteract* [5] system introduced the quantification of audience approval activities in a venue-based game as a measure of athletes' performance, leading to greater audience engagement. There is also a differentiation between passive engagement and active participation of an audience. As such, a study about Starcraft spectators [7] explored the audience relationship with a real-time strategy game being played online. Kimble et al. [16] investigated social facilitation and choking when playing games before an audience. Presence of supportive audiences as opposed to non-supportive audiences has also led to degradation of performance in previous studies [4] of a single player in a skill-based activity. In addition, supportive audiences had a negative effect [20] on performance in single player sporting conditions. Building on these related works, our focus is to explore the effect of audience types on player engagement and experience in a two player co-located gaming situation.

MAGIC DUEL: A FULL-BODY PERFORMANCE GAME

The success of a co-located collaborative game is dependent on the levels of interaction and enjoyment. For our study, we were interested in the influence of audience on player experience. In addition we were also interested in understanding audience effects on the design of co-located games in relation to social play and social affordances (e.g., as discussed by de Kort et al. [18]).

Hence, we focus on answering two research questions here:

1. Does the presence of an audience affect player experience in a multiplayer co-located game?
2. How do different characteristics of an audience's behaviour affect player experience in a multiplayer-co-located game?

To identify the challenges and relationships between players, audiences and the game system, we used the game Magic Duel (MD). MD was designed as a co-located two-player game to entertain and draw an audience in its socio-spatial environment. The relevance of an audience watching players duel in a video game could be similar to an audience watching a sporting arena match between players or teams. We used this game (as a stimulus) to understand the effect of a co-located audience on player experience.

In MD (see Figure 1), players act as magicians that conjure spells with their hand gestures. The game can be played with two people, who are co-located, so that they can see their own gestures and the feedback from their avatar in the game world. Hand movements are used by the players to cast spells at each other and at the same time hand gestures enable blocking spells from the opponent player.

Players duel each other by casting spells back and forth and at the same time dodging each other's attacks. They play until one of the players is completely depleted of magic. Each player – displayed on screen as a sorcerer avatar – can cast spells of three different elemental types (i.e., fire, earth and ice) by changing the orientation of their hands. The spells cast are visualized as either a bolt of an elemental type or a corresponding shield spell that absorbs or blocks incoming bolts. Whenever a sorcerer is unable to block an incoming projectile, the avatar gets hit and loses some of its magic. Magic is used as a health indicator. When one of the sorcerers loses all their health, the player loses the match.

Figure 1. Magic Duel screenshot in the view for one player.

At the top right of the screen, the hand positions are indicated (e.g., metaphorically represented in an east west direction for the fire spell; north-east to south-west hand position for the earth spell and the north-west to south-east hand position for the ice spell). Blocking the spells for fire, earth and ice is done by moving one's hands outwards in the directions mentioned above for corresponding spells.

We conducted two studies with this game; the first (pilot) study was in a public space at a conference in a Toronto, Canada; and the second study was in a controlled environment at our dedicated game research lab.

PILOT STUDY

We deployed MD at a games conference to gauge player reactions and understand audience engagement effects on player performance. Conference attendees were invited to play the game and fill out a brief survey after playing.

Our main goal was to understand whether or not MD was a good candidate for assessing the impact of an audience on player experience. We wanted to find out, if MD's setting naturally gets an audience and to observe the effect of an audience on players' gameplay experience. Moreover, we studied (from a player's perspective), whether the game was easily usable and satisfying, so that these factors would not interfere with their reports in our following exploratory lab study, which we detail later in this paper.

Procedure

People visiting the games conference were invited to play the game with other people watching, often cheering (unguided) and supporting their gameplay. Prior to participating, they were informed about the study and filled out a consent form. Eighteen adults took part in this pilot study (N=18, 16 males, 2 females) aged between 15 and 40 years (M= 25.6, SD=3.1).

All participants were familiar with digital gaming. After playing the game, the participants were asked to fill out an extended version of the usefulness, satisfaction and ease of use (USE) questionnaire [23]. We used this questionnaire, because we wanted to assess how well this game would work as a stimulus in our later experiments. The questionnaire comprised of questions in the categories: ease of learning, ease of use and satisfaction, to which we added additional questions about audience influence. In addition to the USE questionnaire, participants were also rated their experience on a 7-point Likert scale (1= strongly disagree and 7= strongly agree). These questions were about: being conscious of the presence of an audience, nervousness because of an audience, being watched by an audience, inhibitions to play by audience presence, distraction due to noise from audience and effect of audience presence as a distraction to gameplay. We refer to and discuss these questions as *audience influence* in the following sections.

Results

Responses to questions corresponding to each of the three categories *ease of learning*, *ease of use* and *satisfaction* were averaged and the resulting category average values analyzed using Wilcoxon signed-rank tests (using a normal approximation with continuity correction due to ties in the data) to see if they are significantly different from the neutral response (4; "Neither agree nor disagree"). A conservative non-parametric test was chosen because the data was not normally distributed. Box-whisker diagrams of the distributions are shown in Figure 2.

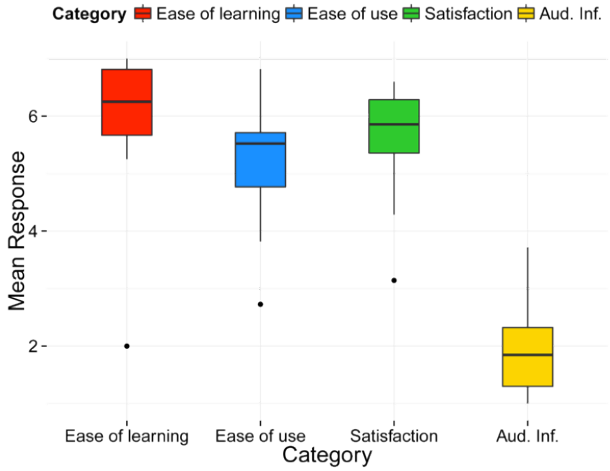

Figure 2. Box-whisker diagrams showing distributions for each of the category scores in the extended USE questionnaire.

Our results show that participants found the game easy to learn (Mdn = 6.25, z = -3.17, p < 0.01, r = 0.79), and also easy to use (Mdn = 5.52, z = -3.35, p < 0.001, r = 0.79). Furthermore, they seemed to be satisfied playing it (Mdn = 5.86, z = -3.62, p < 0.001, r = -0.85). For the *audience influence* category, all questions but one were aimed at negative (e.g., distracting) audience effects. We averaged responses on these questions (inverting answers on one because it had positive wording instead of negative wording like the others), which showed that participants did not feel negatively affected by an audience being present (Mdn = 1.85, z = -3.71, p < 0.001, r = 0.87). Responses on the individual questions show, for example, that players did not feel nervous playing in front of an audience (Mdn = 1, z = -3.70, p < 0.001, r = 0.87). Also, audience was not perceived as a distraction (Mdn = 1, z = -3.98, p < 0.0001, r = 0.94). Responses on a question about positive effects of an audience ("Audience encouragement helped me to play better") were not significant (Mdn = 4, p > 0.05).

Discussion and Take Away

Our pilot study provided us with the initial finding that people playing a game in a public co-located space – surrounded by onlookers – do not seem negatively affected by this fact compared to playing games without an audience. This finding surprised us, because humans are affected by an audience being present in many activities and functions [17][16]. We thought that this could point to gameplay taking a different place in the spectrum of human activities. Following the pilot study, we expanded our research into an exploratory study where we focused on categorizing the audience into *audience types* and studying their influence on player experience.

Our pilot study findings also showed that – from the player's point of view – the MD game was easily usable and satisfying to play (i.e., we continued using it as a stimulus). Based on the pilot study, MD itself being a newly designed game should not be considered a limitation in the exploratory study. One of our main takeaways from this pilot study was that our game setup seemed to work well as a game deployed for performing in front of an audience.

EXPLORATORY STUDY

The layout of the experimental setup is shown in Figure 3.

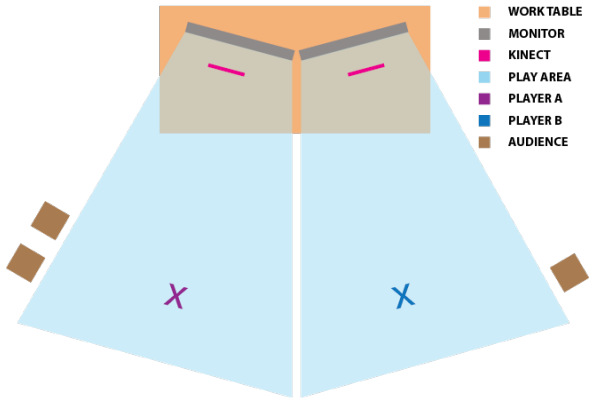

Figure 3. Experimental setup for the exploratory study.

This study was conducted in a University lab. Our leading question was whether positive or negative audience reactions would influence player experience in any way. MD was set up on two Dell computers. The Kinects were placed in front of Dell monitors and the game was started. Players were allowed to interact and talk to each other. We checked for interference of the gestural movements of both players with

their arms extended so that the Kinect did not respond to the other player's movements. The spots marked "X" demarcate the suggested location of players.

We had three audience members who remained a constant throughout the study. Based on prior evidence of scripting responses for supportive (positive) audience and non-supportive (negative) audience [4],[20], the comments for positive and negative audience were scripted. As an example a positive script was: *"You are doing great, keep focusing on the spells"*; and a negative script was: *"Your game is poor, you should quit!"* The intonations and comments order were rehearsed with the audience members to sound authentic.

Research Questions

We were interested in whether the audience excitement level and enthusiasm (or lack thereof), affected the performance of a player while playing a game. After a lack of audience influence on gameplay in our pilot study, we wanted to understand if player experience can be positively or negatively influenced by an audience being present and them being in a certain pre-defined mood.

Based on the pilot study, we modified our exploration to investigate the effects of audience influence on player experience. Following from the contextual relationship between the player and the audience, we established the following exploratory research questions:

RQ1: Would the presence or absence of an audience affect the player experience in the game?
RQ2: Does the presence of a "positive" audience increase the player experience in the game?
RQ3: Does the presence of a "negative" audience decrease the player experience in the game?

Method

Using a repeated-measures (within-subjects) design, audience types corresponded to different levels on a four-level independent variable with the following conditions:

A. No Audience (i.e., Control)
B. Silent Audience
C. Positive (Cheerful) Audience
D. Negative (Booing) Audience

Pairs of participants were asked to play MD in all four conditions, equally balanced using a Latin-square design. All participant pairs played all four conditions of the independent variable. We had a set of questions to determine the demographics of the population. Player experience, as approximated by questionnaires and interviews, was the dependent variable to be studied. To determine factor of player experience for each of the above four conditions, we use the Flow Short Scale (FSS) [9], the Immersion questionnaire [13] and an extended version of our own pre-interview questions to identify players reactions to Audience Influence (AI) (see *Table 1*). These questions had positive and negative questions about audience presence, silent audience, positive audience and negative audience. The questions are shown in the following table.

Item	Audience Influence (AI) Questions
1	Did the presence of an audience make you self-conscious?
2	Did the presence of an audience make you nervous?
3	Did the audience inhibit your play?
4	Was the audience noise distracting?
5	Was the audience a distraction?
6	Did the audience affect your concentration?
7	Did the audience encouragement help you play better?
8	Was the presence of an audience watching you play acceptable?
9	Did you prefer to play the game with audience present?
10	Did the audience motivate you to play better?
11	Did the audience demotivate your gameplay?
12	How engaged were you in the session?

Table 1. Audience Influence (AI) questions on a 5-point Likert scale (1 = strongly disagree; 5= strongly agree)

Additionally, once participants played all four conditions, they were asked to fill in our 5-point Likert scale (1= very poor; 5= very good) Final Game Rating Questions (FGRQ), to evaluate the player's reaction to the game itself. We used these questions to evaluate MD based on the aspects of experience, quality, fun, visuals and sounds.

Participants

Participants were recruited from a pool of University students. The study was run with pairs of participants. Recruitment was done via mailing lists, notices and word of mouth. Sixteen participants, all male students between the ages of 18 and 23, participated in the study. Three audience members were chosen, of which one female and two male persons, and stayed as constants for the study.

Materials

Two Dell workstations were used to run MD – connected to each other via a network switch and assigned a static IP address. The game was displayed on two separate Dell 21 inch monitors. Microsoft Kinect controllers were connected to each workstation and placed in from of the monitors. A Sony HD 250 GB video camera was used to record the player activities. Evernote software was used to record player interviews at the end of the study.

MD was designed for a co-located installation to have the players facing each other separated by a screen. However, in our study setup, the players did not face each other. They faced their individual monitors in a sector formation (see Figure 3). This was done to accommodate the play in a small controlled experimental room as opposed to a larger co-located space. Audience members were positioned around the players within their peripheral vision area.

Procedure

Participant pairs were welcomed. Players were informed that they would be playing four conditions. Details of the type of

four conditions were blinded from the participants. Then, they filled out a consent form and a demographic questionnaire. They were given time to get accustomed with their location in the study area – with reference to the Kinect – to check for their screen avatar's response to their corresponding movements in their own physical space. The participants were given detailed information about the gestures being used in the game to duel each other and block the spells from opposing players. They were allowed to try out these gestures for casting and blocking spells, which enabled the experimenter to check for the responsiveness of the game avatar to gestural movements of players.

Participant pairs played each condition for five minutes and the number of deaths of each player was noted. After each condition, each player independently completed the questionnaires (FSS, Immersion and Audience Influence questions). This also accounted for rest between conditions to accommodate fatigue effects. After playing in all of the conditions, each player filled out our Final Rating Game Questions (FRGQ). Each player was interviewed to gain insight into their individual, subjective gameplay experience.

Interview Protocol

The 16 participants who took part in the study were interviewed independently to elicit responses towards player experience. Interviews were semi-structured and questions were categorized into game experience (game usability, gameplay, game story), motivation to play and audience influence. Participants were asked to elaborate on their experience based on their performance in the game, their ability to navigate the gesture controls, their reactions and feelings towards audience influence, and their motivation to play the game. The verbal data was categorized and documented into an Excel spreadsheet. Additional themes emerging from the iterative process were identified and documented for comparison.

Results

Results of the data from the Immersion questionnaire, FSS, AI questions are discussed first, followed by the results from our Final Game Rating Questions (FGRQ). Finally, we last report qualitative data from player interviews.

Immersion, FSS and AI questions

Responses by the two participants in each pair were averaged as recommended in previous work [15] to achieve independent observations. For each participant and condition, we divided the questionnaire responses into five categories and computed the average category scores.

The scale measures were in particular: Audience influence (Positive), Audience influence (Negative), Immersion and two categories corresponding to the FSS (which uses two different response scales), named FSS10 and FSS3 according to the number of questions in the category. Before averaging, we inversed responses on negatively worded questions. We excluded the *no audience* condition from all audience influence questionnaire analyses.

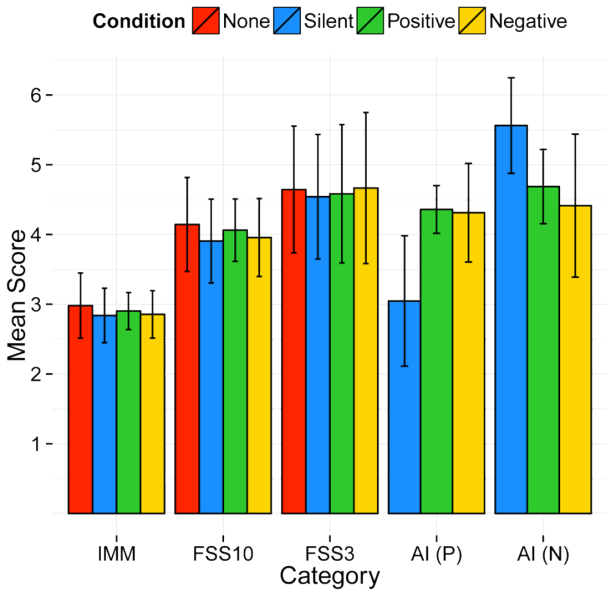

Figure 4. Bar plots showing scale averages for each condition. Error bars indicate 95% confidence intervals of the mean.

Figure 4 shows the means and their 95% confidence intervals for the resulting distribution. For each of the category scores, we compared answers in the four conditions via repeated-measures analyses of variance (ANOVA) after confirming that all assumptions had been met. Significant effects were found for the two categories on audience influence: positive influence, $F(2,14) = 10.45$, $\eta_p^2 = 0.37$ and negative influence, $F(2,14) = 9.78$, $\eta_p^2 = 0.24$ (both $p < 0.01$).

Subsequent pairwise comparisons (dependent t-tests using Holm correction) revealed significant differences between Silent and Negative and Silent and Positive conditions for both types of audience influence, but not between Positive and Negative conditions. For positive influence, means are Silent M: 3.05 Positive M: 4.36, Negative M: 4.31. For negative influence, means are: Silent M: 5.56, Positive M: 4.69, Negative M: 4.41. Note that – because scores for negatively worded questions were inversed – high scores indicated a "good" score for the negative influence category.

Final Game Rating Questions (FGRQ)

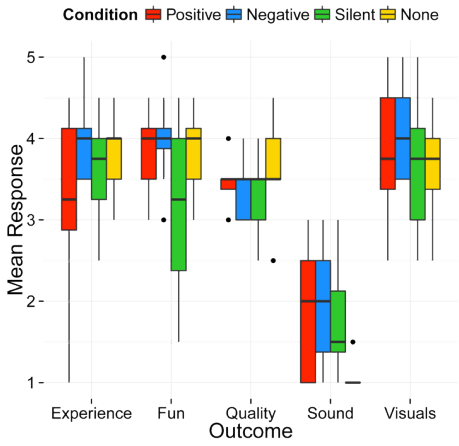

Figure 5. Box plots for Final Game Rating Questions (FGRQ)

Participants rated the five game attributes on a Likert scale of 1 (very poor) to 5 (very good) for each audience influence condition (see Figure 5). Friedman's test was conducted on the data and revealed significant effects of condition (positive, negative, silent, none) for the variables Experience ($\chi^2(3) = 7.84$), Fun ($\chi^2(3) = 12.05$), Visuals ($\chi^2(3) = 9.86$) and Sounds ($\chi^2(3) = 12.77$), all $p<0.05$. The Quality variable was not significant. However, subsequent multiple comparisons only revealed significant differences between Negative and Silent conditions for the variable Fun ($p<0.05$).

Player Interviews

We analyzed the audio interviews using coding techniques based on thematic analysis. Notes from the recorded interviews were analyzed for the categories mentioned in the interview protocol. Additional themes, which originated along the course of data analysis, are further explained in this section. We analyzed categorized audience influence into *audience presence*, *encouragement* and *discouragement*.

Audience Presence. Regarding a silent audience, player P7-1 indicated, *"When they were just watching me play, I felt that it was eerie. An active audience (-ve or +ve) immersed me in the game as opposed to having an audience that was silent."* Player P6-2 indicated *"having people watching me while playing was distracting. From time to time my conscious thought would go to wondering what they are looking at."* Player P2-1 stated, *"I noticed them more that they were around when they were not talking. I am conscious about people watching me play, as it makes me want to do better."* A few participants preferred an active audience over a silent audience as indicated by P7-2, *"Presence of an audience affected my game a bit, because I preferred the audience to be lively watching me game as opposed to be silent as in watching a chess game."*

Audience Encouragement. For the positive audience, many participants indicated that they tended to "tune out" the comments from the positive audience because they felt the comments to be distracting. One player (P7-1) mentioned, *"When the audience was cheering me positively or negatively, […] I felt more immersed. However with the positive audience I felt more distracted"*. On the other hand player (P6-2) mentioned *"from time to time, I did pay attention to the cheers from the audience which gave me some tips and clues to play better."* Player P5-1 indicated regarding the positive audience that *"their comments were distracting hence I was trying to tune them out."* A few participants were affected positively by the positive audience as indicated by participant P7-2 *"I like the cheering audience because I like to entertain people when I game, and I was motivated to play more and better."*

Audience Discouragement. We also noted from the interviews that a greater percentage of players were more in focus of the game with a negative audience as opposed to a positive audience. The negative audience did not bother some players. Player P6-1 indicated *"with the negative audience, I felt more inclined to block them out as opposed to listening to them."* However three participants were affected by the negative comments in that it caused a deterioration of their scores. Participant P2-2 indicated, *"the booing made me a bit conscious that I was not doing well"*. Participant P6-2 stated, *"The negative audience did contribute to the downplay in the game, you do not actually hear what they were saying, but you could feel the negativity in the air."* At-times the comments tended to lower the morale of the player as participant P1-1 indicated, *"The negative comments from the audience pulled the experience in the negative direction, because they are saying nasty things, I was already not feeling good about myself, and I did not need these comments."* Some participants tended to filter the negative comments out of their *"mindspace"* as participant P7-2 said, *"When they were booing, I just pushed them aside from my mental space; I'm playing and I was just filtering them out. At the same time when they were negative, I was trying to get them onto my side by making them laugh."*

Motivation to Play. The positive audience, negative audience and/or silent audience also influenced player motivation. Player P7-1 indicated, *"The negative audience did not demotivate me at all! In fact they were more motivating."* Physical tiredness from playing the game repeatedly also contributed to the players losing interest in playing the game. As stated by participant P1-1 *"I was physically tired after the third game session. Towards the end of each session, I was, when my opponent was about to finish me off, I was more ready to take the final hit rather than trying to defend myself."*

DISCUSSION

Motivated based on the results from the questionnaires, we want to focus our discussion mainly on the rich qualitative insights from our interviews, because we think that we got the most inspiring understandings from this part of our study. Being qualitative in nature, the broad findings from these interviews have the following characteristics:

- **Silent** audience posed an eerie and **uncomfortable** feeling that affected player engagement.
- **Positive** audience was a **distraction** that affected player engagement.
- **Negative** audience afforded player engagement **challenges** from the usage of gesture controls, which affected gameplay experience and player experience.
- **Cognitive load** from the gesture controls because of poor game control design affected gameplay experience.
- **Motivation** to play was also affected by physical **abilities** that also influenced player experience.

When analyzing the results, further classification of the audience into silent, positive and negative audience types helped us to understand the effect of this multi-level independent variable on player engagement. Our results show that an audience as small as three people can influence game players. On average, participants felt that an active audience both posed a distraction and yet influenced them in a good way, pushing them to perform better (RQ1). It should be noted, however, that the quantitative data does not reveal

differences in the influence of a positive or negative audience. In fact, both audience types seem to increase player engagement as measured by the "positive audience influence" category. Our initial research question asking if a negative audience will decrease player engagement (RQ3) seems to have a negative answer. However, our research question about the presence of a positive audience (RQ2) seems to be positively answered for this category. The FSS and Immersion questionnaires did not produce any significant results. Implications are discussed further below.

Relating Subjective Responses and Quantitative Data

The value that an active audience provides compared to a silent or passive audience is an insight that we gathered from our interviews. Comparing the analysis of our subjective interviews to the quantitative data analysis, we were surprised to find that players tended to "tune out" the comments of the negative audience to concentrate better and be more immersed in the game. The fact that some participants mentioned the eerie feeling when the audience was silent can be an important fact for designing games as performances (e.g., a game performance becoming creepier at some points because the audience receives explicit instructions to be quiet). It tells us that not only does an audience need to be present, but also it needs to be active, to have impact in those who take part of the game. Imagining, for example, an artist who is about to play a live piece for the first time, the uneasy feeling of being observed, rather than appreciated, might be due to the same factors. The lack of feedback from those who are watching – the silence in the concert room, or in the play area in our case – reveals itself to be perhaps worse than having an audience cheering negatively, since participants found them easier to block out.

Consequently, for an active audience of positive or negative audience types quantitative results were significant. Comments from the negative audience also forced the players to try and improve their effort in the game, increasing player engagement, to overcome the negative comments, which are contrary to our research question (RQ3) regarding negative audience. The will to succeed, show that the players were able to "tune out" and overcome the negativity to focus on their game. On the other hand the comments from the positive audience was more of a distraction for most of the players and did not do much for the players except help them focus more on playing the game itself. This supports our research question (RQ2) regarding positive audience indirectly, meaning that the presence of a positive audience does increase player engagement. Perhaps because the players were already aware of their success, the positive reinforcement became more of a nuisance. These results support the findings of Butler et al., [4] and Law et al., [20] and further extends the influence of audience types in the context of a two-player co-located game installation.

Social Experience in Relation to Player Experience

From the results we gathered, players seem to perceive the audience as a performance gauge. They benefit from the audience when they are being scolded – pushing harder to success – but do not want too much attention when they are already performing well. Players can use the audience to assess how well they are doing, and that is particularly observable when players report discomfort in front of a silent audience. This same silence indicates the lack of feedback, breaking one of the main domains of the social experience relationship: the audience to player relationship.

Gameplay experience as defined to be a contextual relation between the game system, player experience and socio-spatial condition, provides another dimension in this study of audience influence on player engagement. The challenges with game system usability in reference of the gesture controls; the confusion between the short time intervals between the attacks versus defense gesture controls presented additional cognitive load on the players. Some players discovered a simple method of "spamming" the attack gestures to gain advantage over their opponent.

Prior experience in gaming might have also been a limiting factor in the social experiences in this study. The level of previous experience with games of the participants (skillfulness) might influence different reactions or responses from the audience. Contrary to what we discovered in regards to positive active audiences – instead of becoming a distraction for a more novice player – the audience might increase performance and help enjoy the experience in a co-located space. The fun aspects of the game did facilitate player experience in this study. However, there was a starting inertia to engaging in play because of the need for the players to understand the relationship between the attack and defence mechanisms with their hands. A characteristic that is often taken care of in games by a process called onboarding, where the player learns the controls of a game while the gameplay starts.

From a social interaction perspective, our studies indicate that presence of an audience is the first step towards establishing a socio-spatial interrelationship between the player, audience and the game system in a co-located space gaming installation. However an active audience (positive or negative) is preferred over a silent audience (passive audience). While game controls play an important role in establishing a player to game system interrelationship; audience-player relationship enhances the immersion within the game via social experience.

In our study, our aim was to explore our research questions with a smaller group of audience members. Quite possibly the size of the audience may have been rather small to have a measurable impact on player experience, because the audience may go unnoticed while in play. Spontaneity of the audience, authenticity of the audience's comments and the tone of the comments could influence player engagement from the perspective of immersion and flow within gaming. The participants might assume that the audience was just there for the study's sake. In the end, they might have perceived that the audience might not have been

authentically rooting for them. It is possible they perceived it as fake cheering, which can deter overall performance.

On the other hand, when an audience gathers around someone in a spontaneous manner by accident – for example, when finding a peculiar street musician that is extremely good – cheering is felt as being more authentic and potentially more effective. While critical audience characteristics like audience size and variation in audience demographics were beyond the scope of this study, it is an interesting follow-up opportunity for this study.

Game Design for Multiplayer Co-located Installations

For future designers of multiplayer co-located games, care must be taken to design games that are not too difficult to play. Difficulty might be ideal for seasoned gamers, but for the general population or a novice gamer, it might prevent them from returning to play the game.

In our case, player experience was critically informed by the gesture controls used in MD. Ease of understanding how to use the gesture controls contributed to a greater engagement in the game. Difficulty in using the gesture controls was predominantly due to the Kinect not being able to recognize the location of the players' hand positions quickly. The need for the players to orient their hands rapidly in these positions to cast spells posed challenges for the players to be immersed in the game. Once the Kinect was synchronized with a player's hand positions, they were excited to play the game.

Player P5-1 mentioned *"the gesture control type is good but not reliable, they do not always work, as I still do not understand if I have to move the hands in a specific way, this affected my concentration in the game."* There were three types of hand position for attacks with spells and three types of hand positions for blocking spells. This variety of hand gestures posed additional cognitive load on the participants to remember their gestures correctly, because a fire spell had to be blocked by a fire block and so on. Participant P7-1 indicated, *"the attack and defense was clear, however the types of attacks and the types of blocks for hand orientation posed a mental challenge."*

Even though the game was supposed to be a duelling match, we noticed player-to-player interaction for supporting each other's play in overcoming some of the issues of the gesture controls. Participant P5-1 mentioned *"You need to move your hands wider along the directions of fire, ice or earth to block my spells."* Participant P2-2 indicated to the opponent: *"Perhaps you can try to dodge and jump out of the way to escape being hit by the spells."* This indicates to us that players, who found the best use of the controls, wanted a worthy opponent to duel against.

Designers should leave some room for failure within the game, so that the audience has a good chance to reproach the player. In this manner, the player will, according to our findings, try even harder to overcome the challenges of the game, harder than if they were playing with an audience influencing them positively. Design of games for co-located spaces must be inclusive of the audience allowing for participatory interaction between player-audience and game system. Games with gestural controls and full-body movements afford the possibility of role reversals between the player and the audience [3].

LIMITATIONS AND FUTURE WORK

Our audience characteristics do not fully represent the wide spectrum of all audience characteristics possible. An inquiry into a detailed taxonomical framework of characteristics other than silent, positive and negative types is beyond the scope of our paper. Our exploratory experiment was conducted with an audience sample size of three members. While this might be a low number, studies on audience size and social facilitation attributed to presence of an audience used audience sizes of 2, 4, or 8 people [17]. Other studies, which considered audience size on blushing [29] had audience sizes from 1 to 4. While these references are not necessarily representative of an audience size in a co-located gaming installation, our selection of three audience members is potentially low. In addition, the demographic profile of the audience could also be changed to relate between a younger audience groups to a mature or an older audience group.

Our study used only male participants, and including female participants would help to understand audience influence effects on female gamers in co-located spaces.

The fact that questionnaire data results for the exploratory study were always close to the median "neutral" response (3 for immersion; 4 for FSS10 and audience influence; 5 for FSS3) indicates a need for revising one or several characteristics of the study design for future work in this direction. For example, audience size could be increased.

One could also try measuring audience influence with measures that do not rely on subjective player reports. For example, we could use game performance measures or measure cognitive functioning, both of which can be affected by arousal, flow or immersion experiences [13].

CONCLUSION

In this paper, we presented findings and insights from rich qualitative and quantitative data relating the effects of audience influence on player engagement. Our study contributes to human-computer interaction and game research in the following ways: Firstly, this study helps us understand the effects of silent, positive and negative audience on player engagement. Secondly, we found that positive audience at times tends to be distractive in nature compared to a negative audience that drives player focus. Thirdly, we postulate social experience in the gaming context as connected with player experience. Finally, we identify important criteria of games designed for co-located gaming with audience participation. We presented a study that showed that (positive or negative) audience activity fosters game engagement, while a silent audience makes players feel eerie. It is our hope, based on this contribution, game designers for co-located games are able to understand

some challenges of designing social game interactions.

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REFERENCES

1. Vanden Abeele, V. and Schutter, B. Designing intergenerational play via enactive interaction, competition and acceleration. *Personal and Ubiquitous Computing 14*, 5 (2010), 425–433.
2. Bateman, C., Lowenhaupt, R., and Nacke, L.E. Player Typology in Theory and Practice. *DIGRA'11*, (2011).
3. Bianchi-Berthouze, N., Kim, W.W., and Patel, D. Does Body Movement Engage You More in Digital Game Play ? and Why ? *ACII 2007*, (2007), 102–113.
4. Butler, J.L. and Baumeister, R.F. The trouble with friendly faces: skilled performance with a supportive audience. *J Pers Soc Psychol 75*, 5 (1998), 1213–30.
5. Chandrasekaran, V., Mohan, S., Pathipaka, O., and Saxena, S. WeINteract – A Pervasive Audience Participation System. *CHI '04*, (2004), 1700–1704.
6. Chatham, A. and Mueller, F. "Floyd." Adding an interactive display to a public basketball hoop can motivate players and foster community. *Proc. of UbiComp '13*, ACM (2013), 667–676.
7. Cheung, G. and Jeff, H. Starcraft from the Stands : Understanding the Game Spectator. *Proc. of CHI'11* (2011), 763–772.
8. Downs, J., Vetere, F., Howard, S., Loughnan, S., and Smith, W. Audience Experience in Social Videogaming: Effects of Turn Expectation and Game Physicality. *Proc. of CHI '14* (2014), 3473–3482.
9. Engeser, S. and Rheinberg, F. Flow, performance and moderators of challenge-skill balance. *Motivation and Emotion 32*, 3 (2008), 158–172.
10. Grønbæk, K., Iversen, O.S., Kortbek, K.J., Nielsen, K.R., and Aagaard, L. iGameFloor - A Platform for Co-Located Collaborative Games. *Proc. of ACE '07*, (1907), 64–71.
11. Harper, R. and Mentis, H.M. The Mocking Gaze : The Social Organization of Kinect Use. (2013), 167–180.
12. Huggard, A., Mel, A. De, Garner, J., Toprak, C.C., Chatham, A., and Mueller, F.F. Musical Embrace : Exploring Social Awkwardness in Digital Games. *Proc. of UbiComp '13*, (2013), 725–728.
13. Jennett, C., Cox, A.L., Cairns, P., et al. Measuring and defining the experience of immersion in games. *Int J Hum-Comput St 66*, 9 (2008), 641–661.
14. Kappen, D.L., Gregory, J., Stepchenko, D., Wehbe, R.R., and Nacke, L.E. Exploring Social Interaction in Co-located multiplayer games. *CHI EA'13*, ACM (2013), 1119–1124.
15. Kenny, D.A., Kashy, D., and Cook, W.L. *Dyadic Data Analysis*. Guilford Press, 2006.
16. Kimble, C.E. and Rezabek, J.S. Playing Games Before an Audience: Social Facilitation or Choking. *Social Behaviour and Personality 20*, 2 (1992), 115–120.
17. Knowles, E.S. Social physics and the effects of others: Tests of the effects of audience size and distance on social judgments and behavior. *J Pers Soc Psychol 45*, 6 (1983), 1263–1279.
18. Kort, Y.A.W.D.E. and Ijsselsteijn, W.A. People , Places , and Play : Player Experience in a Socio-Spatial Context. *ACM Comp. in Entertainm. 6*, 2 (2008), 1–11.
19. Latulipe, C., Charlotte, C., Carroll, E.A., and Lottridge, D. Love , Hate , Arousal and Engagement : Exploring Audience Responses to Performing Arts. *Proc. of CHI '11*, (2011), 1845–1854.
20. Law, J., Masters, R., Bray, S.R., Eves, F., and Bardswell, I. Motor Performance as a Function of Audience Affability and Metaknowledge. *Journal of Sport and Exercise Psychology 25*, (2003), 484–500.
21. Lin, H. and Sun, C.-T. The Role of Onlookers in Arcade Gaming: Frame Analysis of Public Behaviours. *Convergence 17*, 2 (2011), 125–137.
22. Lindley, S., Couteur, J. Le, Place, A., and Bianchi-Berthouze, N. Stirring up Experience through Movement in Game Play : Effects on Engagement and Social Behaviour. *Proc. CHI 2008*, (2008), 511–514.
23. Lund, A.M. Measuring usability with the USE questionnaire. *STC Usability SIG Newsletter 8*, 2 (2001).
24. Mueller, F., Agamanolis, S., and Picard, R. Exertion Interfaces : Sports over a Distance for Social Bonding and Fun. *CHI '03*, (2003), 561–568.
25. Nijhar, J., Bianchi-Berthouze, N., and Boguslawski, G. Does Movement Recognition Precision affect the Player Experience in Exertion Games? In *INTETAIN'2011*, *LNICST 78,* 73–82.
26. Reeves, S., Benford, S., O'Malley, C., and Fraser, M. Designing the Spectator Experience. *Proc. of CHI '05*, ACM Press (2005), 741.
27. Roccetti, M., Marfia, G., and Semeraro, A. Playing into the wild: A gesture-based interface for gaming in public spaces. *J Vis Commun Image Represent 23*, 3 (2012), 426–440.
28. Savva, N., Scarinzi, A., and Bianchi-Berthouze, N. Continuous Recognition of Player's Affective Body Expression as Dynamic Quality of Aesthetic Experience. *IEEE Transactions on Computational Intelligence and AI in Games 4*, 3 (2012), 199–212.
29. Shearn, D., Bergman, E., Hill, K., Abel, a, and Hinds, L. Blushing as a function of audience size. *Psychophysiology 29*, 4 (1992), 431–6.
30. Stevens, Q. *The Ludic City: Exploring the Potential of Public Spaces*. Taylor & Francis, 2007.
31. Webster, J. and Ho, H. Audience engagement in multimedia presentations. *ACM SIGMIS Database 28*, 2 (1997), 63–77.