Helping Friends or Fighting Foes: The Influence of Collaboration and Competition on Player Experience

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ABSTRACT
Playing digital games comprises a diverse, but holistic experience. Yet it is still unclear how and to what extend certain design elements of a game contribute to specific aspects of player experience. We developed a game as test bed to investigate this question. The casual game Loadstone allows for different social interaction modes while retaining all other game elements. By isolating one single gameplay element we were able to analyze the influence of competition and collaboration on the game experience. The game served as the basis for a study conducted with 58 participants in order to empirically investigate potential differences in player experience induced by collaborative and competitive game design elements. Data regarding player experience, aggression, social presence and performance was assessed in form of questionnaires and observations. Results indicate significant differences between player experiences in both modes: While positive affect and aggression were higher in the competitive mode, empathy was higher in the collaborative mode. However, social presence turns out to be not a sufficient predictor of positive affect. No gender differences were found.

Categories and Subject Descriptors
K.8.0 [**Personal Computing**]: General – *Game.*

General Terms
Measurement, Design, Experimentation, Human Factors.

Keywords
Player experience, game design, multiplayer game, social setting, casual games, empirical evaluation, collaboration, competition

1. INTRODUCTION
Digital games provide a wide range of experiences resulting from active participation. In general, experience does not only mean the mere stimulation of senses but includes complex cognitive, emotional and behavioral processes. Both researchers and practitioners become increasingly interested in assessing the experience provided by digital games, for it can be seen as a determinant of game acceptance and success. This experience is often described by the term player experience or game experience. However, there is little consensus which psychological dimensions constitute the overall experience of players [2]. Furthermore, potential influences of specific game design elements on player experience have not yet been sufficiently investigated. It is still an open research question to what extend certain aspects of games contribute to specific aspects of player experience. Knowledge about the relation between game design elements and the effects on the players is supposed to enable the systematic design of intended experiences.

One important category of game design is the constitution of the social context of playing sessions since playing games becomes an increasingly social activity [6]. As soon as more than one person is involved in the game – as players or spectators – the playing session becomes a social situation. In such situations, player experience is supposed to be strongly influenced not only by the interaction between game system and player, but also by game elements which shape the interaction between the persons who take part in the playing session. The aim of the study presented in this paper is the detailed investigation of the effects which certain social game design elements can induce in players. Evaluation results are supposed to lead to a better understanding of player experience and the underlying effects, thus they might be used in the design process of future games in order to systematically induce intended player experiences and to achieve a better adaptation to special target groups.

2. RELATED WORK
2.1 Dimensions of Player Experience
Looking at the subcomponents of player experience is supposed to help understand and describe the effects digital games can have on players' feelings, thoughts and behavior. Current approaches in this context present a wide range of assumptions as to what players experience while playing (e.g. [17, 20]). Addressing the lack of a common understanding regarding the dimensions of player experience, Poels et al. [17] conducted a study based on focus group methodology in order to develop a comprehensive categorization of player experience and identified nine main dimensions: enjoyment, flow, imaginative immersion, sensory immersion, suspense, competence, negative affect, control and social presence. This and similar empirically grounded comprehensive models, e.g. the Presence-Involvement-Flow Framework [20], indicate that player experience has many facets and thus cannot be fully understood by just concentrating on single aspects such as fun or flow.

The last aspect mentioned by Poels et al., social presence, has often been neglected in theories and studies about player experience. It is defined as the degree to which two (or more) persons are aware of each other and feel psychologically and behaviorally involved [3, 6]. As it comprises both emotional and behavioral aspects, social presence is likely to be part of the overall player experience. Therefore, de Kort and colleagues emphasized its importance and identified three subscales of social presence in digital games [6]: empathy, negative feelings and behavioral engagement. These scales account for awareness, behavior as well as positive and negative feelings provoked by the social presence and behavior of the other player. Social presence can serve as a basis for considering social effects on player experience in terms of three aspects: arousal, performance and emotion. The level of arousal is supposed to be highly influenced by social presence due to mechanisms like evaluation apprehension, social facilitation or inhibitory effects [7]. Regarding emotions, it is suggested that high social presence can lead to more positive feelings by supplying the basic human need to belong [7] or due to emotional contagion (mood transfer among interaction partners) [12]. Overall, these social processes indicate that the social setting of playing may have great impact on the resulting experience. Thus, a closer look on the constituents of social playing settings and their effects is supposed to provide valuable insight into the emergence of player experience.

2.2 Player Experience in Social Settings

Social interaction in games can take various forms, thus several aspects have to be considered when investigating it. While the social context of gaming is a complex, multidimensional construct, we argue that there are six main components of social play: the number of players, their real-world relationship, the interaction mode within the game world (which is constituted by the conflict structure), the presence of other players, the presence of spectators, and communication channels of the game system. Design decisions on each of the dimensional levels of social play are supposed to influence the overall player experience due to their potential effects on the constitution of social presence, arousal, evaluative processes and the satisfaction of needs [7, 12].

Several studies indicate that playing with another human player induces significantly different experiences compared to playing alone: Players experienced higher physiological arousal [15], as well as higher spatial presence, engagement, positive affect and anticipated threat when a second human player is involved [11, 18]. Furthermore, multiplayer modes were often preferred compared to single-player modes [15], indicating that the presence of other players can be conducive to a positive experience. The presence of observers is supposed to have a similar effect due to similar processes like evaluation apprehension and effects of social presence. However, yet little research has focused explicitly on the influence of spectators on player experience. Besides, other studies indicate that a higher group size is especially associated with competition [1] and that an increase of group size fosters competitive behavior in competitive game settings while at the same time it decreases competition and intensifies cooperation in collaborative settings [1, 8]. Overall, a higher number of players seems to intensify the player experience.

Other results emphasize the influence of the players' real-world relationships in terms of closeness: Playing against a friend resulted in higher degrees of spatial presence, engagement, physiological and self-reported arousal than playing against a stranger [18]. It was also shown that both social presence and aggression are higher for friends than for strangers both in mediated and co-located playing settings [10]. Regarding potential differences between mediated and co-located play, it was found that co-located play resulted in more positive affect, more competence, less tension and less aggression as opposed to mediated play or playing against the computer [10, 11]. However, no significant differences between mediated play against another human and against the computer were found. Thus, it is concluded that not perceived human agency but rather perceived social presence – which is particularly high in co-located settings – is the influencing parameter [11].

The difference between the influence of cooperative and competitive game modes on player experience has also been the subject matter of several studies. For instance, results indicate that individuals who compete against a group of other players show more aggression and hostility compared to players who collaborate within a team [8, 9]. There seems to be a positive correlation between competition and aggression, while cooperative elements, in contrast, are supposed to negatively correlate with aggression and to rather arouse empathy [8]. Furthermore, it was found that positive affect is higher the more competitive a game is. At the same time, arousal and negative affect decrease with rising competitiveness [14]. In this context, gender differences were found in one study, as the increase of positive affect was much stronger for males than for females. However, this difference as well as the decrease of arousal and negative affect could not be replicated in another study, and thus require further investigation [14]. As gender differences regarding cooperation and competition are frequently reported in several contexts (cf. [1]), it can be assumed that females may prefer cooperative modes while males are more likely to engage in competitive games.

All these studies provide strong evidence that the constitution of social context shapes the experience of players. However, there are still open questions and contradictory results regarding some aspects. This paper is focused on evaluating social interaction modes, as conflicting findings and a lack of clarifying studies indicate that further research is needed in order to be able to make well-grounded predictions on the influence of cooperative and competitive game modes.

3. LOADSTONE: A TEST BED FOR GAME DESIGN

The goal of our study was to investigate the influence of collaboration and competition on player experience by conducting an empirical study with a digital game which features both a completely collaborative and a completely competitive mode while keeping all other game aspects that are not related to the interaction mode constant. Therefore the casual game *Loadstone* was developed, which can be played collaboratively or competitively by two players in a co-located setting. The setting is kept simple and straightforward: Players are challenged to collect as many gems as possible in a given time with the aid of two magnets. *Loadstone* consists of a couple of single levels which vary in complexity and difficulty but all are constructed

according to the same pattern. In each level, a conveyor belt runs from the upper border to the bottom in the middle of the screen and thus separates the screen into a left and a right part (see Figure 1).

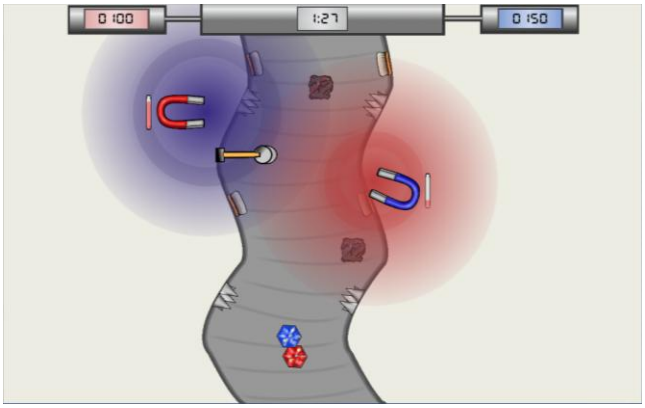

Figure 1. Screenshot of the competitive mode of Loadstone. The collaborative mode looks exactly the same (except for the score bar) in order to keep unwanted side effects on gameplay experience as minimal as possible.

The main objective of players is to earn points by collecting and purifying gems of their color using the energy of their magnet. Being covered with grey rock, gems have to be extracted with the aid of brushes along the conveyor belt. The longer a stone is polished, the more it transforms into a twinkling jewel, yielding more points to the corresponding player. Gem purification is hindered by obstacles on the conveyor belt. Thus, besides trying to navigate their gems into the brushes, players also have to avoid contact between their gems and obstacles. Player actions are few and thus easy to learn: Players can move their magnet in every position along the conveyor belt (but cannot cross it) and manipulate the position of the magnetic gems on the conveyor belt by repelling or attracting them. So, players try to avoid contact between their gems and obstacles and move their gems closer to the brushes. Each level lasts two-and-a-half minutes.

The aforementioned features of the game define its general rules, mechanics and content and serve as a frame for the design of the two concrete game modes. This accounts for the requirement that the main aspects of the game must not differ between the collaborative and the competitive mode in order to maintain comparability of player experience. The design of collaboration and competition is based on several established collaborative and competitive game design patterns [4, 19, 23]. In general, competition and collaboration in digital games can be defined as "differing goal structures" [8, p.452] and thus manifest in rules of winning and losing. Accordingly, differences between both modes are focused on three main design aspects: the goal structure, the distribution of rewards and the use of penalties.

The main objective in both game modes is – generally speaking – to collect as much points as possible in the time given. Nevertheless, this goal is framed twofold: In the competitive mode, a player has to achieve a higher score than his competitor in order to win. In the collaborative mode a score comparison between the two players would foster competition. Instead, successful player actions contribute to one joint score which has to reach certain goals to win each level. In order to be able to differentiate between the players in the competitive mode, gems are introduced in the two player colors (red and blue), indicating their belonging to one player or the other. By reaching the bottom of the conveyor belt, red gems account to the score of player red, blue ones for player blue, respectively. Thus, players are rewarded strictly individually and fostered to concentrate on their personal gems. Furthermore, they can hinder their competitor to gain points by pushing and pulling the other's gems into the obstacles. The opportunity to destroy objects that belong to the other player was implemented to foster the competition.

Regarding the collaborative mode, there is per se no need to introduce two different gem types, as players share the same score and thus receive points for the same gems. Furthermore, interacting with the same objects (the gems) is supposed to foster collaboration. However, players in the competitive mode may interact with the gems for two different reasons: purifying and saving own gems or destroying gems of the competitor. In order to address this difference and to integrate the motivation of destroying also into the collaborative mode, a second gem type was introduced: Golden gems are valuable and yield points, dark grey stones do not feature any color and are worthless. Providing a reason for destroying the grey gems (otherwise they would most probably just be ignored), they count as negative points. Each time a dark grey gem reaches the bottom, the players' score is decreased. This matches the pattern of shared penalties and thus is also considered to enhance collaboration [4].

The last difference designed between the two modes refers to the size of the magnetic field. While in the competitive mode both players should be able to reach and manipulate all gems on the conveyor belt, in the collaborative mode the decrease of magnetic field size is a possibility of creating complementarity of player abilities: The radius of the field is reduced so that it is smaller than the width of the conveyor belt. Thus, a player is not able to reach the gems at the opposite border. This design forces players to coordinate their actions and to work together, as one player alone is hardly able to succeed without help from the other side of the conveyor belt.

4. EVALUATION

4.1 Hypotheses

The study focuses on the comparison of player experience induced by the collaborative game mode as opposed to the competitive game mode. With reference to previous findings, it is presumed that player experience will differ regarding the dimensions positive affect, negative affect, empathy and aggression. Accordingly, the following hypotheses are formulated:

H1: Player experience differs significantly between the competitive and the collaborative game mode.

a) Positive affect is higher in the competitive mode compared to the collaborative mode.
b) Negative affect is lower in the competitive mode compared to the collaborative mode.
c) Aggression is higher in the competitive mode compared to the collaborative mode.
d) The degree of empathy is lower in the competitive mode compared to the collaborative mode.

Previous findings about competition and collaboration both in general and with reference to digital games indicate that males tend to prefer competitive situations while females do not. Thus,

gender will be accounted for in order to investigate potential effects on the assumed differences between the competitive and the collaborative mode. It is hypothesized that:

> H2: Gender accounts for the differences in positive affect and aggression between the two game modes, as the difference is significantly higher for males than for females.

As there are no previous studies reporting on differences between collaborative and competitive games regarding the other dimensions of player experience, it is assumed that there will be no significant differences:

> H3: Player experience in terms of flow, immersion, tension, competence and challenge does not differ significantly between the competitive and the collaborative game mode.

Additionally, this study also aims to explore the correlations of competitive attitude with the dimensions of player experience in the two game modes. This exploration may indicate whether this construct also influences the way a player experiences gameplay and thus whether it should be subject of future studies.

In order to test the hypotheses, a within-subject-design was selected: The two game versions of the game *Loadstone* served as the independent variable and each participant had to play both game modes. Several indicators of player experience and performance were repeatedly measured after each playing session as dependent variables. Furthermore, potential sequence effects were controlled by randomly assigning the order of the two game modes, resulting in a randomized cross-over design.

4.2 Participants

Participants were recruited in pairs. They were asked to bring along a person of the same sex they are acquainted with (friend, family member or study colleague). A total of 58 participants (36 females, 22 males) took part in the experiment, resulting in 29 same-sex dyads. The average age was 22, with a range from 18 to 32 (*SD* = 3.38). Most participants (91.4%) were students and all participants had played digital games before.

4.3 Applied measures

Positive and negative affect were assessed by the Positive and Negative Affect schedule (PANAS) [22]. Main dimensions of player experience were measured by the Game Experience Questionnaire (GEQ), which is based on the player experience model by Poels et al. [17]. The core module is supposed to measure player experience in terms of seven sub-components: immersion, tension, competence, flow, negative affect, positive affect and challenge. Additionally, its social presence module (Social Presence in Gaming Questionnaire (SPGQ) [6,]) was administered, including questions referring to the three subscales empathy, negative feelings and behavioral engagement. Besides, state aggression was measured with an adapted version of the Aggression Questionnaire by Buss and Perry [5], comprising the four subscales physical aggression, verbal aggression, anger and hostility. Items were reworded following the example of [10] so that they referred to the playing situation in order to assess state aggression rather than trait aggression. Finally, the Competitive-Cooperative Attitude Scale [16] was used in order to assess a person's general social attitudes towards cooperation and competition. All questionnaires had to be answered on a five-point Likert scale. Besides questionnaires, players' social interactions during playing sessions were observed by the experimenter. The observation was structured by means of Cooperative Performance Metrics (CPMs) defined by [19]. They describe interaction patterns which indicate that players pay attention to each other, directly interact and work together rather than concentrate just on their individual performance. Additionally, these CPMs were complemented by particular gaming practice patterns identified by Voida et al. [21], which emphasize either the gaming group or the individual player. Group-oriented gaming practices are characterized by teamwork and shared awareness and are indicators of cooperation. Individual-oriented practices indicate that players focus on their own success and compete.

4.4 Procedure

The study was conducted over a period of two weeks in a laboratory at the University of Duisburg-Essen. The room was equipped with three laptops. One laptop was connected to a 19" display as well as to two Xbox 360 controllers and served as the platform for the game *Loadstone*. Participants sat next to each other during play sessions on two chairs right in front of the main display (cf. Figure 2). The two other computers were used to present the online questionnaires. They were placed on two additional tables, spatially separated by room dividers assuring participants answer the questions independent from each other.

Figure 2. The experimental set-up: One monitor in the middle of the room on which the game was presented (left) and two separated laptops for administering the questionnaires (right).

The female experimenter welcomed participants and explained the general test procedure and the purpose of the study. Every participant had to sign a consent form to express the willingness to voluntarily take part in the study. The following schedule of the study consisted of five main parts: three questionnaire blocks and two playing sessions. Starting with the first block of questionnaires, participants had to answer questions about their demographics, prior game experience, gaming behavior, and their competitive-cooperative attitude. Questionnaires were administered online on the two separated laptops. Subsequently, each participant received an Xbox360 controller and, a short introduction how to handle it (if necessary). Then the rules and goals of the game *Loadstone* were explained by showing pictures of all game objects and an example level screen. Players were allowed to practice the controls in a separate training screen of the game for two minutes to become acquainted with the game. Subsequently, the first game session was started. Players were instructed to play three levels (each lasting two-and-a-half minutes) in a row as if they were at home. The experimenter observed both players inconspicuously and made notes about occurring interaction events according to the predefined observation categories. After playing one version of the game, participants were asked to get back to the separated PCs and the second block of questionnaires including PANAS, GEQ and the Aggression Questionnaire was presented. After that, the procedure was repeated with the other version of the game.

5. RESULTS AND ANALYSIS

Due to the dyadic nature of data, single persons cannot be used as the unit of analysis without testing whether the scores of outcome variables of dyads are actually independent. Intraclass correlations of almost half of the variables under examination are significantly nonindependent ($p < .20$). Thus, dyads were used as the units of analysis by averaging the scores of the two members of each dyad as recommended in [13], resulting in a sample size of $n = 29$ for the following analyses of variance. According to the Kolmogorov-Smirnov-Test, all investigated parameters show a normal curve of distribution. Thus, data is analyzed by using the one-way repeated measures ANOVA comparing measurements of the collaborative and the competitive mode while controlling for the order of game versions as between-subjects factor.

5.1 Game Experience (GEQ)

On average, both game versions show relatively high scores ($M > 3.0$) on the subscales challenge, positive affect and flow. Medium values were measured for immersion and competence ($1.8 < M < 2.5$), while negative affect and tension are rated rather low ($M < 1.8$). Results of the ANOVA reveal that differences between both game modes are only significant regarding the scores of competence and positive affect: Positive affect is higher in the competitive mode (F (1, 27) = 9.682, p = .004) just like competence (F (1, 27) = 26.622, $p < .001$). Furthermore, a highly significant sequence effect is found for the competence scale (F (1, 27) = 10.046, p = .004): While on both sequence conditions competence scales are higher in the competitive mode, the difference between both modes is much higher for sequence 2 (when the collaborative game mode is played first). Moreover, mean values within both game modes indicate that the competence for one mode is by trend higher if the mode is the second to be played. None of the other GEQ scales shows significant sequence effects. Similarly, no significant differences between males and females can be found.

5.2 Social Presence (SPGQ)

Overall, the sense of social presence is relatively high in both game modes. Participants experienced particularly high empathy ($M > 2.7$) and behavioral engagement ($M > 3.0$). All subscales of the SPGQ differ significantly between both game modes. Empathy is higher in the collaborative mode and the difference is highly significant (F (1, 27) = 72.769, $p < .001$). In contrast, scores on the negative feelings subscale are significantly higher on the competitive condition (F (1, 27) = 17.510, p = .001). Behavioral engagement is higher in the collaborative mode (F (1, 27) = 9.132, $p < .005$), but while empathy and negative feelings are not significantly influenced by sequence condition, the ANOVA reveals a sequence effect on the behavioral engagement subscale (F (1, 27) = 15.012, p = .001). Though the comparison of the overall means suggests that behavioral engagement is higher in the collaborative mode, the differentiation between the two sequence conditions shows that, in fact, behavioral engagement is slightly higher in the competitive mode when competition is the second game mode to be played (second sequence condition). Thus, behavioral engagement seems to be higher in the second playing session irrespective of game mode. Regarding gender there are no significant differences between males and females for SPGQ scales.

5.3 Affect (PANAS)

Regarding the positive and negative affect measured by means of the PANAS, both game modes show similar tendencies: The mean scores of the positive affect scale are slightly above the half of all possible points ($M > 2$), whereas negative affect is very low in both game modes ($M < 0.5$). Positive affect is significantly higher in the competitive mode (F (1, 27) = 9.997, p = .004), while scores on the negative affect subscale do not differ significantly. There are neither significant sequence effects nor gender effects on the PANAS subscales.

5.4 Aggression

Mean scores of the aggression scales indicate moderate aggression in both game modes. The difference between game modes regarding verbal aggression is just marginally significant (F (1, 27) = 3.725, p = .064), suggesting higher aggression in the competitive mode. The scores of the anger subscale affirm this finding, as they are significantly higher in the competitive mode (F (1, 27) = 9.120, p = .005), just like the scores of hostility (F (1, 27) = 20.697, $p < .001$). No significant influences of the sequence of game modes or gender were revealed.

5.5 Observation: Social Performance Metrics

The most prominent interaction pattern observed is the creation of shared awareness, especially in the collaborative mode. Participants very often called each other's attention to specific

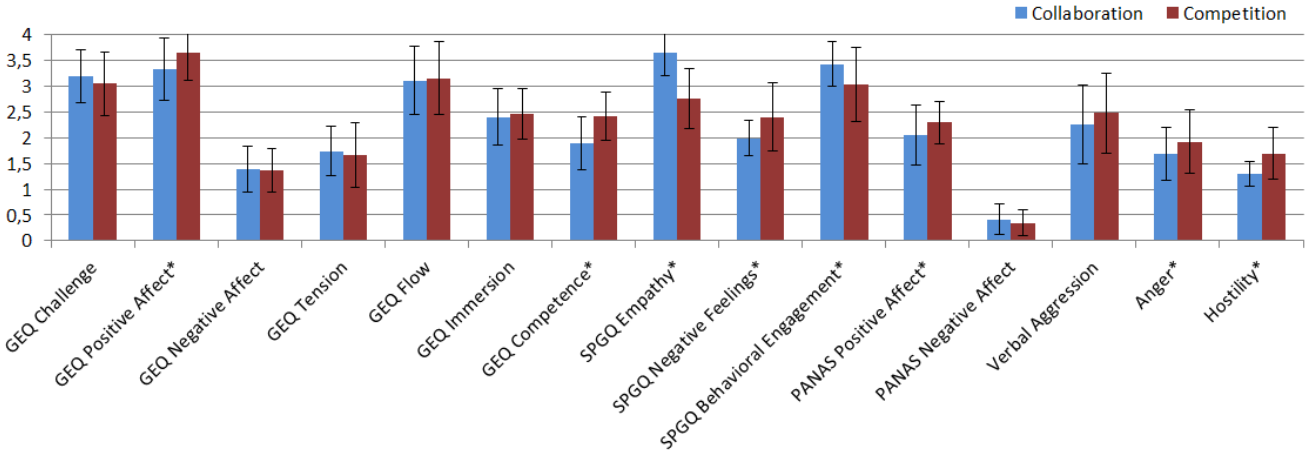

Figure 3. Comparison of values of GEQ, SPGQ, PANAS and Aggression in the collaborative and the competitive mode (SD indicated in graph; *p < .05).

gems or obstacles and explained what they were planning to do next. This pattern also occurred in the competitive mode, but much less than during collaboration (F (1, 27) = 153.140, p <= .001). Shared laughter could be observed in both playing sessions as well, while it also aroused significantly more often during collaborative play (F (1, 27) = 4.285, p = .048). Similarly, sharing in outcome by celebrating success together or finding excuses for common failure predominantly occurred in the collaborative mode (F (1, 27) = 15.420, p = .001). Nevertheless, sometimes winners also encouraged their opponent in the competitive mode. Strategic planning and the development of global strategies were only observed in the collaborative game mode, while players in the competitive mode did expectedly not work out common strategies. Performance patterns which, in contrast, appeared significantly more often in the competitive mode were talking trash (F (1, 27) = 39.157, p < .001) and interference of the other player (F (1, 27) = 51.815, p < .001). As interference of the other player is part of the objective in the competitive mode, players intentionally tried to hinder each other under this condition, whereas all obstructive actions in the collaborative mode could be identified as unintended.

5.6 Correlations of Competitive Attitude

Pearson product-moment correlation coefficients of competitive attitude and the scales of player experience and aggression show significant correlations. Competitive attitude significantly positively correlates with all subscales of state aggression irrespective of social game mode: anger (collaboration: r= .342, p= .009; competition: r= .435, p= .001), verbal aggression (collaboration: r= .255, p= .002; competition: r= .276, p= .036), and hostility (collaboration: r= .329, p= .012; competition: r= .339, p= .009). Furthermore, competitive attitude is positively correlated with tension in both game modes (collaboration: r= .498, p < .001; competition: r= .398, p= .002) and with PANAS negative affect in the competitive mode (r= .391, p= .002). In addition, marginally positive correlations can be found with competence (r= .243, p= .066) and GEQ negative affect (r= .221, p= .095) in the competitive mode as well as with challenge in the collaborative mode (r= .245, p= .064). The only significant negative correlation exists between competitive attitude and positive affect in the collaborative mode (r= -.301, p= .022).

6. DISCUSSION

The study at hand was conducted in order to investigate the influence of different interaction modes on player experience. Data analyses deliver valuable insight into the experiences evoked by collaboration and competition. First of all, results of the observation of the social performance metrics provide evidence that collaboration and competition were successfully triggered by the two game modes of the test bed. In the collaborative mode, people were particularly keen on constituting shared awareness, trace each other's actions and develop common strategies. In contrast, players show little cooperative performances in the competitive mode while trash talking and instances of interference were significantly more often observed. Thus, the manipulation of the social interaction mode was implemented as intended.

Most hypotheses are confirmed by the results, while there are also some contradictory findings. Assumed differences in player experience between both game modes (H1) were corroborated for most parts except that there is no significant difference in negative affect between the two game modes (H1-b). As expected, there are no differences in flow, immersion, tension and challenge (H3), but in competence (contradictory to H3). Hypothesized effects of gender (H2) could not be confirmed as no gender differences that account for the differences between player experiences in both game modes were found.

The comparison of several aspects of player experience between the collaborative and the competitive mode shows a couple of similarities as well as significant differences. Regarding tension, immersion, flow and challenge no significant differences can be found, confirming hypothesis H3 with respect to these aspects. This result can be attributed to the consistently similar design and configurations of both game modes (same assets, level design, procedures and pace). The interaction mode per se seems to have no impact on these dimensions of player experience. Notably, concerns that the presence of other players may interfere with game immersion (cf. [7]) can be refuted as participants show high average values on immersion and flow in both modes. Negative affect (assessed by both GEQ and PANAS) is not significantly different in both game modes and since all average scores on negative affect are rather low, none of the game modes seems to feature aspects which annoyed the players.

Though most dimensions of the GEQ tend to feature similar scores for collaboration and competition, nevertheless significant differences regarding the degree of competence, positive affect and social presence are apparent. The difference between competence ratings co-occurs with a sequence effect, which indicates that for each of the game modes competence is higher when the mode is the second to be played (being a sign of training effect). But, irrespective of sequence, competence is always higher in the competitive mode, contradictory to H3. Moreover, the difference between the two game modes regarding competence is particularly high when the collaborative game mode is played first. This pattern suggests that acquainting oneself with the game and playing it is easier in the competitive mode than in the collaborative mode. A possible explanation is that while competing against each other, players can focus on their own performance, whereas in the collaborative mode they also have to coordinate their actions with their partner.

Furthermore, participants reported more positive affect when playing against each other as opposed to playing collaboratively. This confirms hypothesis H1-a and the findings of previous studies, indicating that competitive play provides a more intense experience in terms of higher arousal of positive feelings. At the same time all subscales of state aggression turned out to score significantly higher in the competitive mode, as well. Higher aggression in the competitive mode is in line with previous findings and the hypothesis H1-c. Nevertheless, at first glance it seems to be contradictory that the game mode that aroused more anger and hostility is also supposed to provide more positive feelings than the other mode. In consideration of the facts that all aggression scores do not indicate high-level aggression and that negative affect was not higher in the competitive mode, it can be suggested that a certain degree of aggression contributes to the challenge and conflict proposed by the game. This may result in higher arousal and thus make the game more fun. On the other hand, aggression could also be the result of higher arousal in the sense that it works like an outlet for high arousal and tension. In further research studies, this effect of aggression should be investigated precisely in order to see whether the positive

relation between aggression and positive affect would still persist or even revert if the level of aggression becomes very high.

Another aspect that in previous studies was found to have great influence on positive affect is social presence. Though the feeling of social presence is high in both game modes, as was expected due to the co-located playing setting, empathy and behavioral engagement are significantly higher when playing collaboratively (confirming hypothesis H1-d), while involvement in negative feelings is significantly lower. In this context, it has to be noted that the effect on behavioral engagement is also influenced by the game mode sequence, thus the varying intensity of behavioral engagement might not (exclusively) be traced back to the difference between collaboration and competition. However, the differences found can neither be explained by the physical presence of players at the same location nor by a difference in communication opportunities, as both aspects were kept constant for both game versions. In fact, it seems that forced collaboration (a player is hardly able to win the game without coordinating his actions with the other) and common fate (players both loose or both win) support empathy and behavioral engagement and restrict negative feelings like jealousy. Overall, both self-report measures of social presence and observed cooperative performance metrics indicate that the linkage between players is closer and the social interaction richer when playing collaboratively as opposed to playing competitively.

But, while it has been shown before that the degree of social presence is a strong indicator for player enjoyment [9, 10], that does not apply to the study at hand: Though empathy and behavioral engagement are significantly higher in the collaborative mode, players experienced significantly less positive affect compared to the competitive mode. Regarding this inconsistent finding, it can be suggested that a difference in social presence has only small impact on positive affect if social presence values of both game modes show a size above-average. That is to say, when social presence is high in both conditions, a significant difference is less likely to influence player experience compared to a situation in which one condition shows rather low values of social presence (e.g. due to a mediated setting). It can be assumed, then, that in case of the two game modes of the study at hand, other factors might be more influential and account for the difference in positive affect.

Now, comparing the game modes and considering that the competitive setting arouses higher positive affect – that is to say enjoyment – the competitive mode is supposed to be preferred by the majority of participants. However, results of the survey show quite the contrary: Significantly more players (29 compared to 15) reported that they would choose the collaborative mode if they had to play the game again and were allowed to choose under which condition they would rather like to do so (14 people did not have any preference). It becomes apparent that reducing player experience to one dimension such as positive affect does not account for the complexity of game evaluation processes. Hence, scores on the positive affect scale are not sufficient to predict whether a player likes a game, favors it over another or is going to play it again.

Competitive attitude significantly correlates with a couple of player experience dimensions, particularly with tension and all subscales of state aggression. This indicates that the more competition-oriented a player is, the more he engages with the game and tries to defeat the other player. Furthermore, in the collaborative mode competitive attitude is negatively correlated with positive affect. Though a correlation does not provide information about causal relations and their direction, this correlation suggests that a person who is highly competition-oriented experiences less positive affect in the collaborative game mode. The needs of competition-oriented persons might not be satisfied by collaborative gameplay, as there is no direct opponent or opportunity to match with someone. Overall, results regarding the competitive attitude of players indicate that it might be an influential trait factor when it comes to evaluating a multiplayer game.

In opposition to hypothesis H2 about gender effects, gender did not account for any of the differences resulting from the variation of the interaction mode. While this is in line with the findings of one study of Kivikangas et al. [14], it conflicts with the results of other studies. Hence, a clear statement about whether gender is an influential factor for the evaluation of competition and collaboration cannot be made. However, one possible reason for the conflicting results is that it is not gender but a closely correlated factor like, for instance, competitive attitude that influences the experience in collaborative and competitive games. Competitive attitude correlates with many dimensions of player experience and is at the same time supposed to differ significantly between males and females in population (cf. [1]). The lack of gender effect in the study at hand may be due to the fact that female and male participants did not significantly differ regarding their competitive attitude (which does not represent the pattern that is expected in the whole population). However, as researchers in previous studies did not account for (or at least did not report about) competitive attitudes of participants, this assumption cannot be controlled but needs further investigation in future studies. Further research is required to get to the bottom of potential differences between males and females.

There are also some limitations of the study at hand which have to be acknowledged. While findings are supposed to be generalizable to similar games (mainly other casual dexterity games), possibly other game genres feature different player interaction patterns and thus provide other opportunities for the design of collaboration and competition. As interaction patterns and their concrete implementations are supposed to differ regarding their effect on player experience, further studies with other games should be conducted in order to see whether results are replicable with other game genres and game mode configurations. Furthermore, limitations related to the group of participants have to be considered. A larger sample size would help to determine whether the effects found in this study do also occur in a larger population. Besides, as nearly all participants were students with an age between 18 and 32, it has to be admitted that the generalization of results to other age-groups and social classes is limited.

7. CONCLUSION

Despite limitations of generalizability due to the number of participants and game characteristics, differences found between the collaborative and the competitive game mode provide evidence for the influence of the social setting on player experience. We argue that through the unique game design we are able to pin down this influence far more precisely than other, more general studies on player experience. Results reveal higher positive affect and a higher level of aggression in the competitive version as well as higher empathy and behavioral engagement in

case of collaboration, which is in line with previous player experience studies [8, 9, 14]. At the same time, social presence did not prove to be a sufficient predictor of positive affect in contrast to [11]. This highlights the complexity of the underlying psychological processes of gameplay which lead to fun and desirable experiences. Furthermore, gender effects reported in [14] were not confirmed, as in our case both male and female players experienced the game similarly. Instead, competitive attitude is suggested as an influential trait factor shaping the experience induced by collaboration and competition.

Altogether, the results of this study are supposed to contribute to a refined understanding of how social aspects of games influence the overall and specific aspects of player experience. We intend to extend the developed test bed game design by integrating additional game modes and playing variations, e.g. increasing the number of players. This will enable the investigation of the impact of further game design elements and eventually foster the understanding of cause and effect in digital games.

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