



Competitively Versus Cooperatively? An Analysis of the Effect of Gameplay on Human Emotions and Behaviors

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Abstract. This research aims to explore the impact of cooperative or competitive gaming modes on players' emotion and behaviors. We conducted a within-subject study with 30 participants. Participants were asked to play a fighting game with a male research confederate in two different gameplay modes. We examined (1) self-reported preference, (2) changes in the gamers' emotional states, (3) facial expression data captured by emotion recognition software, and (4) video recordings of the gaming sessions. The statistical results showed no significant differences. However, we were able to identify unique behavioral patterns shown in the competitive gameplay mode.

Keywords: Competitive game · Cooperative game · Gameplay

1 Introduction

1.1 Competitive and Cooperative Gameplay

While video-games can support multiple different types of “playing” and activities as noted by Lundgren and Björk [15], players predominantly play video-games either with their friends, peers and strangers collaboratively towards achieving a set of common goals or compete against other players. While single player games and competitive multi-player video games had been prevailing modes of video game playing, recent years saw an increase in multi-player cooperative/collaborative games [25]. In other words, and arguably, competitive video gaming and co-op (cooperative) video gaming are two major ways of playing video games. Today, multiple players play video games together either cooperatively or competitively on their home gaming consoles, on computers, on handheld devices or over the network. Multi-player games are becoming a de facto norm of game playing as gaming industry increasingly includes social aspects into their games [17].

Video games are becoming an important part of everyday living for many Americans, and gaming industries are flourishing. 2015 data from Entertainment Software Association shows that 51% of U.S. households own a game console and 42% plays a video game on regular basis [4]. CNN recently reported that “PlayStation game sales are fueling a Sony resurgence. Nintendo finally found its Wii successor in the uber-popular

Switch. And Xbox subscriptions are soaring [17].” With the successful resurrection of home video game consoles such PlayStation, Xbox and Nintendo Switch, and ever-growing mobile gaming market [26], more and more users are playing games with other users every day.

As video games are increasingly used in educational settings [8, 14, 16], and more and more schools start to offer game programming courses and degree programs related to game development [27], research on video games also become relevant and crucial. This research aims to explore the impact of cooperative or competitive gaming modes on players’ emotion and behaviors, and reports on both qualitative and quantitative findings from an exploratory user study.

2 Related Works

2.1 Understanding Cooperative and Competitive Games

Competition and collaboration with other players are vital to video games [1]. Cooperative and competitive games offer two different forms of gameplay [1]. In a player versus environment (PvE) setting, players cooperate to defeat non-player controlled (NPC) enemies while players face off against other player-controlled enemies in a player versus player game (PvP) mode. Cooperative games encourage participation and collaboration [22]. The goal in a cooperative environment is to have all players meet a common end goal and win as a team or group [22]. Communication is important in cooperative games to ensure that everyone wins [22]. In competitive games, the competition arises when players compete to achieve personal goals while trying to stop other players from achieving their own goals [1]. Competitive goal structures occur when the fulfillment of interlaced goals is placed on players in a negative setting [1].

2.2 User Studies on Cooperative and Competitive Games

While a number of studies looked at various impacts games have on users [3, 6, 10, 12, 13, 19, 23], a smaller number of studies explored how different game playing modes affect game players. Peng and Hsieh [1] studied the effects of gaming modes on users’ performance, motivation, and efforts. They found out that both cooperative and competitive modes resulted in similar user performance, and that users showed higher motivation and efforts in a cooperative playing mode. Roy and Ferguson [20] looked at the impact of game playing modes on user stress reduction and found out that both competitive and cooperative gameplay was equally successful in reducing stress [20]. Ewoldsen et al. [10] examined participants behavioral patterns when playing a first-person shooter game either cooperatively or competitively. They found no significant differences in the partner measures. Trait aggression and gender were not significant co-variates in any of the analyses.

3 Methodology

The analysis in this paper is based on data from an exploratory user study we conducted last year.

3.1 Participants

Players with varying classifications and majors were recruited from Virginia State University. Participants received no monetary compensation. A total of 30 (10 female, 20 male) college students enrolled in the study. Participants' age ranged from 20 to 29 ($M = 22$, $SD = 2$).

Two participants did not finish the entire session, and their data were excluded from this study. Among remaining, 28 participants (10 female, 18 male), twenty-five (89%) participants identified themselves as African American, two (7%) as Caucasian, and one (4%) as Asian or Pacific Islander. (see Fig. 1. Participant Demographics).

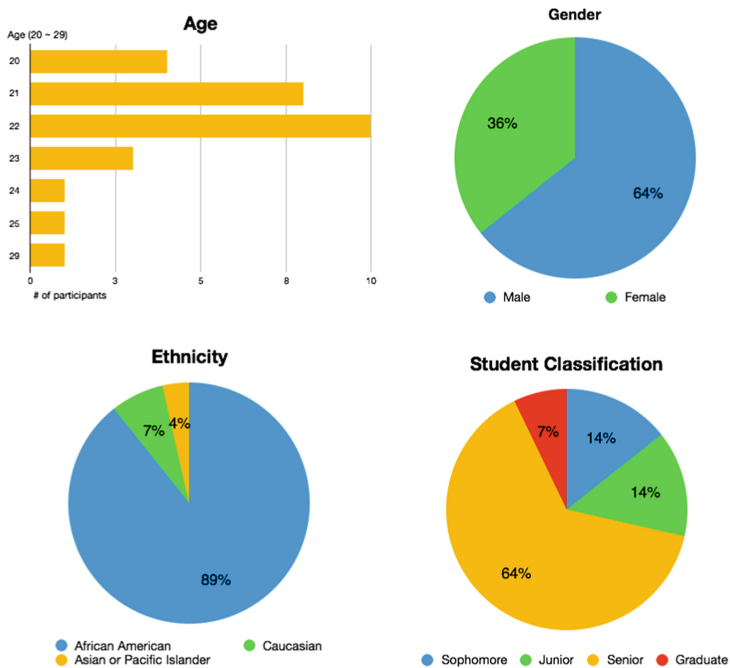


Fig. 1. Participant Demographics (Age, Gender, Ethnicity, and Student Classification Info)

3.2 Game

Brawlhalla (see Fig. 2) is a free-to-play (F2P) fighting game developed by Blue Mammoth Games. F2P refers to an online game business model in which players can try out the game without paying for the service. The game gives players a choice of

playable characters as with most fighting games. The game supports a variety of game-play modes; however, *Local Custom Teams* mode was used in our study in order to control the playing field and minimize possible variability across the study sessions.



Fig. 2. A screenshot of the Brawlhalla game during a competitive multiplayer session. Teams are shown as red versus blue and the orange line shows the participant's eye tracking information. (Color figure online)

The game supported two multiplayer modes, cooperative and competitive. The cooperative mode allowed players to team up and play against a team of two artificial intelligent (AI) agents while the competitive mode put players against each other with each player paired with an AI partner. Each player was able to see the scoreboard live as the game progressed in each mode.

3.3 Tools

In order to measure participants' emotions, researchers employed two sets of tools. First the 20-item Positive and Negative Affect Schedule (PANAS) [24] was used to measure the possible changes in participants' emotions from the start of the game to the end. In addition, we also used *iMotions* and BIOPAC systems to capture participants' physiological signals and facial expressions throughout the game sessions.

The Tobi eye-tracker used pupil dilation and distance metrics of participants over time. This tool received information on emotional responses, behavior, and visual attention. We also used a Logitech HD Pro Webcam C920 together with the *iMotions affectiva* engine to identify points on the face to receive user engagement levels as well as basic emotional states (joy, anger, surprise, fear, contempt, sadness, disgust).

The Galvanic skin response (GSR) sensor measured emotional arousal and stress by measuring changes in the conductivity of the skin. An electrocardiogram (ECG) recorded pathways of electrical impulses through heart muscles (heart rate). Participants' heart rate was recorded while they played the game. The Electromyogram (EMG)

recorded electrical activity as well. It measures activities associated with muscle contraction, responses, and biomechanical movements. Both the Electrocardiogram and Electromyogram were measured with the BIOPAC Systems, Inc MP150 using the Wireless BIONOMADIX electrocardiogram and electromyogram transmitter from BIOPAC.

3.4 Study Protocols and Data Collection Procedures

In order to recruit participants, researchers posted invitations flyers around the campus. Participants were asked to sign-up for a study session on a doodle site.

At the beginning of the study session, researchers briefed participants on the study protocol and the purpose of the study. As a part of informed consent procedure, participants were given ample time to review the consent form and ask questions regarding the consent form, experiment procedures, or the research. Although it was not required for participants to stay and finish the entire session, researchers stated that it would be preferable if the participant could stay until the end. Participants were clearly told that they would not be penalized in any respect even if they decide to leave early. In fact, two participants had to leave their sessions early without completing all the required parts. We had to exclude these two participants' data from the analysis.

The study was designed as a within-subject exploratory experiment. Each participant played the same game twice with a researcher confederate: one game in a collaborative mode and the other in a competitive mode. The order of gameplay modes was counter-balanced. That is, half the participants played cooperative mode first and the other half played competitive mode first. Players were not told that their gaming partner is part of the research team.

No participant had prior experience with the game, and all participants underwent a training session to learn the Brawlhalla gameplay before they play the game with the partner. Training sessions lasted for 10 min. Each player then practiced the game in two 5-min practice sessions with their partner, the researcher confederate, to practice the game in two different play modes. The order of gameplay modes for the practice sessions was also counter-balanced.

Participants were given pre-study and post-game questionnaires. A pre-study questionnaire was given at the beginning of the session to determine demographic information, academic standing, and video gaming habits and preferences. In order to measure players' personality traits, we included the Big Five index personality test [11] in the pre-study questionnaire. A social intelligence test, the Mind in the Eyes test [7, 9], was also included in the pre-study questionnaire to gauge how well a participant's ability to understand or read other people's emotional states. We included this test to see if participants' social intelligence would impact how they perceive different gameplay modes. Our hypothesis was that people with higher social intelligence scores would prefer cooperative gameplay. Post-game questionnaires included self-reported measures of how participants felt about each game mode. All three questionnaires included the Positive and Negative Affect Schedule (PANAS) test [24]. PANAS scores were used to determine possible changes in players' self-reported positive and negative effects throughout the study.

Researchers asked and aided players to put on three sensors (galvanic skin, electrocardiogram, and electromyogram sensors) on them after the training session. Audio and video data were collected using two video cameras as well as *iMotions* in order to capture participants’ facial expression as well as their verbal and non-verbal behaviors during the gameplay. The first camera was placed in front of the participant to capture facial data while the second was placed on the right side of the participant to capture physical behaviors. After each game, players were asked to fill out a post-game questionnaire. Figure 3 depicts the entire study procedure.

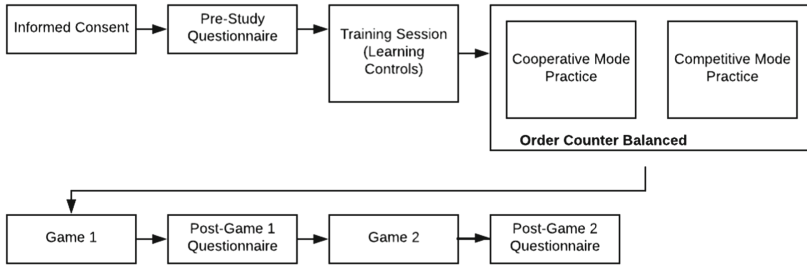


Fig. 3. Study procedure

4 Findings

4.1 Questionnaire Data

The first mood state (PANAS) questionnaire was given before the training session (m1), the second between the first and the second game (m2), the third after the second game (m3). As usual, the sum of scores for the Positive Affect (PA) items and the sum of scores for the Negative Affect (NA) items were calculated for each PANAS test. Difference scores were calculated to monitor the mood changes after playing each game (ΔPA_{m1-m2} , ΔNA_{m1-m2} , ΔPA_{m2-m3} , & ΔNA_{m2-m3}), and from the beginning to the end of the experience (ΔPA_{m1-m3} , ΔNA_{m1-m3}).

No differences were found in across the study both in PA and NA. A paired-samples t-test was conducted to compare the changes in participants’ positive and negative affect scores from the beginning of the study to the end. There was no significant difference in the scores for positive affect measured at m1 (PA_{m1} : $M = 34.75$, $SD = 7.37$) and positive affect measured at m3 (PA_{m3} : $M = 38.25$, $SD = 10.38$); $t(27) = -1.64$, $p = 0.11$. Negative affect scores measured at m1 (NA_{m1} : $M = 13.96$, $SD = 3.69$) and m3 (NA_{m3} : $M = 14.43$, $SD = 5.38$) also showed no significant differences); $t(27) = -0.51$, $p = 0.61$. These results suggest that the gameplay did not have significant impacts on people’s emotional states. Paired-sample t-tests for m1-to-m2 and m2-to-m3 also did not show significant differences in PA and NA scores. In other words, we found no evidence that shows any impact of playing the game, Brawlhalla, on the participants’ emotional states.

In addition, an independent-samples t-test was conducted to compare ΔPA and ΔNA scores from before-game to after-game in cooperative gaming mode (ΔPA : $M = 2.82$, $SD = 5.31$ & ΔNA : $M = -0.11$, $SD = 3.10$) and competitive gaming mode (ΔPA : M

= 0.68, SD = 10.00 & Δ NA: M = 0.57, SD = 4.55) conditions. We found no significant difference in the scores for cooperative and competitive conditions; Δ PA: $t(54) = -1.00$, $p = 0.32$ & Δ NA: $t(54) = 0.65$, $p = 0.52$. In other words, we found no evidence that shows any differences in two different game play modes.

When we asked which game playing mode the players preferred, 17 answered competitive, 9 answered cooperative, one answered both and one did not provide an answer. A chi-square test of goodness-of-fit was performed to determine whether the two-game playing modes were equally preferred. We excluded no answer case and the player who answered “both” from the analysis. Even though over 60% of players preferred competitive mode over cooperative mode, there was no significant statistical evidence that shows a preference for the two-game playing modes was not equally distributed in the population, $X^2(1, N = 26) = 1.88$, $p = 0.17$.

4.2 Biometric Data

In addition to the questionnaires, we collected players’ biometric data using a system called *iMotions*. During the game sessions, we used the system to capture participants’ facial expressions and possibly their emotions. The collected data showed that during game sessions, participants retained neutral facial expressions 65% of the session time. The facial expression capture engine, *Affectiva*, identifies 9 basic emotions: joy, anger, surprise, confusion, fear, contempt, frustration, sadness, and disgust. Even though *iMotions* was not able to capture participants’ facial expressions on some occasions because some players turned their heads away from the camera or the camera itself auto-focused in and out on players, participants’ facial expressions were on average captured in 85% of each gaming session.

Joy

At 17%, “joy” was the highest emotion shown by participants. Smiling, laughing, and smirking were key indicators of joy. During cooperative games, “joy” was more common when players were able to defeat the non-player characters (NPCs). During competitive mode, players were more focused and smiled less often. Some players would only smile due to falling from the playing field or making mistakes during gameplay.

Surprise and confusion

The next most expressed emotions were “surprise” (12%) and “confusion” (12%). Some players were surprised when they realized that not much time was left in a match. Players displayed “surprise” in both modes when they were hit with unexpected attacks. “Confusion” captured moments during which participants forgot the game controls. In some cases, participants verbally expressed that the game controller was not working properly.

Anger, frustration, and sadness

We initially expected to see participants showing “anger” often throughout the game sessions since aggression, anger, and frustration are commonly known to be associated with violent and competitive games [2, 5, 6, 18]. However, in this study, “anger” was the least displayed emotion along with frustration and sadness, each of which shows at

6%. In the cooperative games, players rarely showed any angry expressions. However, in the competitive mode, players showed more anger when losing. “Anger” was closely related to “frustration.” For instance, some players displayed both “anger” and “frustration” when they got hit off the playing field by the opponent.

4.3 Qualitative Finding

The qualitative data analysis was done in multiple iterations. During the initial analysis, we annotated and coded video recordings of all 28 gaming sessions. We open-coded [21] the recordings to categorize various kinds of player behaviors. We focused on how the participant reacted verbally and physically towards the game and the confederate. Our analysis showed that most behaviors were present in both gaming modes while certain behaviors were only observed in one player mode. For instance, while emotional traits exhibited during the game sessions vastly differ from one player to another and *iMotions* data did not show any statistically significant corrections between any of emotions and the gaming modes, some individuals showed more aggressions during competitive play.

Cooperative vs. Competitive Sessions

Some participants displayed quite noticeable behavioral changes when they played the game in two different modes. For example, participant 1 (P1) only smiled briefly during cooperative gameplay; however, he became more aggressive in the competitive session. He stated, “I like competitive better because I like the challenge... so I took that game mode [competitive mode] more serious.” The eye tracking information also showed that he paid more attention to both score and remaining time information shown on screen during the competitive match than he had in the cooperative mode.

Participant 25 (P25) also took the cooperative mode less seriously. During the cooperative play, the participant asks more questions related to the game such as “How do I pick up weapons?” She also smiles more frequently during the cooperative mode. Then during the competitive game session, she became more aggressive. She taunted, and trash talked the confederate with phrases like “Why are you running away?”, “Are you Scared?” and “Yea get some!” She also yelled “Wow, that is crazy!” when she barely lost the match in the final seconds. Taunting and Trash Taking was only observed in the competitive mode. In addition, when players realized how much time they had left to catch up in the competitive mode they often used phrases like “I need to hurry” or “Is that all the time that’s left?”.

5 Conclusion

The aim of our research was to examine the impact that cooperative and competitive games have on human emotions. The current study found that the two game modes were not significantly different in changing or influences human emotions. Yet, we were also able to observe some differences in behavioral patterns. Players seemed to be more relaxed when playing in a cooperative setting and showed slightly more aggression in

the competitive sessions. Our limitations include having a small sample size. In addition, because ran our study at a small HBCU university, it was particularly difficult to recruit participants who can represent broader and more diverse backgrounds and cultures. It is also worth noting that the size of our school and the department made it almost impossible to find participants who did not know one another prior to the study. Future research should use larger size samples and study a more diverse group of participants.

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