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Spatial Presence and Emotions during Video Game Playing: Does it Matter with Whom You Play?

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Abstract

The authors examined whether the nature of the opponent (computer, friend, or stranger) influences Spatial Presence, emotional responses, and threat and challenge appraisals when playing video games. In a within-subjects design, participants played two different video games against a computer, a friend, and a stranger. In addition to self-report ratings, cardiac interbeat intervals (IBIs) were measured to index physiological arousal. When compared to playing against a computer, playing against another human elicited higher Spatial Presence, engagement, anticipated threat, post-game challenge appraisals, and physiological arousal, as well as more positively valenced emotional responses. In addition, playing against a friend elicited greater Spatial Presence, engagement, and self-reported and physiological arousal compared to playing against a stranger. The nature of the opponent influences Spatial Presence when playing video games, possibly through the mediating influence on arousal and attentional processes.

Keywords--- **Spatial Presence, emotions, social relationships, interbeat interval, video games**.

1. Introduction

1.1. Presence and its determinants

The experience of media users that they are personally and physically present in the displayed environment has been named "Presence," or more specifically, "Spatial Presence" [1, 2]. In 1997, Lombard and Ditton defined presence as "the perceptual illusion of nonmediation" (i.e., an illusion that a mediated experience is not mediated) [1]. Although a complete sense of Presence may be elicited only by emerging technologies, such as virtual reality, more traditional media (e.g., television, video games) offer a lesser degree of Presence as well [1, 3].

Researchers have identified several formal characteristics of media as determinants of Presence: the number of human senses for which a medium provides stimulation (i.e., media sensory outputs), the consistency of sensory outputs, image quality, image size, motion, dimensionality, camera techniques, aural presentation characteristics, interactivity, obtrusiveness of a medium, and the number of people the user can (or must) encounter while using a medium [see 1, 4, 5]. In addition, content features of a medium, such as social realism, use of media conventions, and the nature of task or activity, may exert an influence on Presence [1]. People also differ in their ability to experience Presence [6], and the characteristics of the medium user (e.g., personality, willingness to suspend disbelief) may have a considerable impact on the sense of Presence [e.g., 7].

1.2. Emotions

Emotions can be defined as biologically based action dispositions that have an important role in the determination of behavior [e.g., 8]. According to a dimensional theory of emotion, all emotions can be located in a two-dimensional space, as coordinates of valence and arousal (or bodily activation) [e.g., 8, 9]. The valence dimension reflects the degree to which an affective experience is negative (unpleasant) or positive (pleasant). The arousal dimension indicates the level of activation associated with the emotional experience, and ranges from very excited or energized at one extreme to very calm or sleepy at the other.

It is generally agreed that emotions comprise three components: subjective experience (e.g., feeling joyous), expressive behavior (e.g., smiling), and the physiological component (e.g., sympathetic arousal) [10]. Heart rate (HR; or cardiac interbeat interval, IBI) is a frequently used psychophysiological index of arousal [11]. Emotional arousal is accompanied by increased sympathetic nervous system (SNS) activity that causes the heart to speed up. However, the heart is innervated also by the parasympathetic nervous system. Increased cardiac parasympathetic activity causes the heart to slow down and is associated with information intake and attention [11]. Although the dual innervation of the heart may entail interpretative difficulties associated with HR, HR appears to index primarily emotional arousal during video game playing [12]. Electrodermal activity (EDA; or skin conductance) has also frequently been used as a measure of arousal [11]. When emotional arousal increases, the accompanying activation of the SNS results in increased sweat gland activity and skin conductance.

Facial electromyography (EMG) is, in turn, the primary psychophysiological index of emotional valence

[11]. It is well established that increased activity at the zygomaticus major (cheek) and corrugator supercilii (brow) muscle regions is associated with positive emotions and negative emotions, respectively, during affective imagery and when viewing pictures or other media stimuli [11, 13].

1.3. Presence and emotions

Spatial Presence may exert an influence on both the valence and arousal dimensions of emotions. Media presentations that engender a greater sense of Presence have been suggested as often eliciting greater self-reported and physiological arousal (i.e., a component of emotional arousal) [1, see also 11]. For example, Meehan et al. found that a frightening (i.e., arousing) virtual environment (VE) depicting a pit room with an unguarded hole in the floor leading to a room 20 ft. below elicited greater EDA and HR acceleration (i.e., a decrease in IBIs) compared to a non-frightening virtual room [14]. In addition, EDA and HR changes correlated positively with self-reported Presence during exposure to the frightening virtual height situation. It should be recognized, however, that there is no reason to expect that EDA or HR would increase with increasing Presence when the content of the mediated environment is non-arousing (e.g., a deserted beach of a Caribbean island).

Media presentations, such as video games, engendering a strong sense of Spatial Presence have been suggested as eliciting higher overall enjoyment [5, 15]. Ravaja et al. also recently showed that a high sense of Spatial Presence was related to increased positive, and decreased negative, emotional responses to success in a video game as measured by facial EMG [16]. Thus, Spatial Presence is also related to the valence dimension of emotions. It should be emphasized that, although some authors have used EDA, HR, and facial EMG as measures of Presence, these psychophysiological measures are primarily measures of arousal, emotional valence, or attention rather than direct measures of Presence [see 11].

It is also of note that, although high Presence conditions may elicit increased arousal or more positive or negative emotional responses, it is also possible that emotions affect Presence experiences. For example, it is possible that emotional arousal elicited by arousing media content is accompanied by increased attentional engagement with the mediated environment [e.g., 17], thereby increasing Spatial Presence. That is, as suggested by the two-level-model of Spatial Presence, the focused allocation of attentional resources to the mediated environment contributes to the formation of Spatial Presence [2]. As a result of this increased attentional engagement with arousing media content, there are also less attentional resources left over for the processing of the cues signaling that the mediated environment is artificial.

1.4. The present study

The present study was designed to examine the influence of the nature of an opponent on the experience of Presence and emotional responses when playing video games. That is, we asked does it make a difference whether one plays against a computer, a friend, or a stranger?

Social interactions may be arousing owing to involvement and enthusiasm [e.g., 18]. Johnston, Anastasiades, and Wood also found that a two-person "soccer" video game elicited higher HR reactivity compared to a "squash practice" video game against a machine, suggesting that the social-competitive situation related to the former game results in increased arousal [12]. In contrast, research on the effects of the laboratory analogues of social support has shown that the presence of a supportive other attenuates physiological responses to behavioral challenges [for a review, see 19]. However, it may matter who offers the support. In the study of Christenfeld et al., when subjects gave a speech to a supportive friend or a supportive stranger, the supportive behaviors from a friend resulted in smaller cardiovascular responses than the same supportive behaviors offered by a stranger [20]. In general, a participant performing a task in front of an observer (friend or stranger) may be expected to experience increased sympathetic arousal compared with a participant performing the same task in the absence of an observer [19]. This is because the presence of another person who "observes" inevitably creates a situation laden with task performance evaluation potential [19]. It is of note, however, that the nature of the opponent (a friend vs. a stranger) might make a difference when playing a competitive video game.

Given the aforementioned considerations, we hypothesized that playing against another person would elicit greater anticipated threat prior to the game (Hypothesis 1), perceived challenge (Hypothesis 2), self-reported arousal (Hypothesis 3a), and physiological arousal as indexed by decreased cardiac IBIs (Hypothesis 4a) compared to playing against a computer. Given that (a) playing video games against another person involves high evaluation potential and (b) as opposed to a stranger, a friend may serve as a continuing reminder of task performance [19], we also expected that playing against a friend would elicit greater self-reported arousal (Hypothesis 3b) and physiological arousal (Hypothesis 4b) compared to playing against a stranger. Heightened arousal when playing against another person, and particularly against a friend, is likely to be accompanied by an increased desire to perform well and attentional engagement with the game. As suggested above, the allocation of attentional resources to the mediated environment may contribute to Spatial Presence experiences [see 2]. That being so, we hypothesized that playing against another person (friend or stranger) would elicit greater Spatial Presence (Hypothesis 5a) and Engagement (Hypothesis 6a) compared to playing against a computer. In addition, playing against a friend was hypothesized to elicit higher Spatial Presence (Hypothesis 5b) and Engagement (Hypothesis 6b) compared to playing against a stranger.

Given that humans are social beings who have an appetitive motivation for social interaction (social relationships are intrinsically rewarding) [21], we expected that playing against another human being would elicit more positively valenced emotional responses compared to playing against a computer (Hypothesis 7a). Likewise, playing against a friend might elicit more positive responses compared to playing against a stranger (Hypothesis 7b). The suggestion that Presence may result in greater enjoyment [5, 15] is also relevant to these predictions.

2. Methods

2.1. Participants

Participants were 99 (51 male and 48 female) Finnish undergraduates with varying majors, who ranged from 19 to 34 years of age (mean = 23.8 years). Of them, 61% played video games at least once a month. Participants participated in the experiment in groups of three same-sex persons. In each of the 33 groups, two of the participants were friends who knew each other before and one was a person unknown to the others (i.e., a stranger). Each participant received three movie tickets for participation. In the present study, we used only the self-report and physiological data collected from the 33 so-called main participants (see below).

2.2. Design

A 2 (Game) × 3 (Opponent) within-subjects design was employed.

2.3. Video games

In the present study, we used two video games: Super Monkey Ball Jr. (Sega Corporation, Tokyo, Japan) and Duke Nukem Advance (Take 2 Interactive, Berkshire, UK). The games were played with the Nintendo Game Boy Advance console (Nintendo Co., Ltd., Kyoto, Japan). In the two-player condition, two Game Boy Advance consoles were connected with a Game Boy Advance Game Link Cable (Nintendo Co., Ltd., Kyoto, Japan).

Super Monkey Ball Jr. takes place in a surrealistic world with bright colors and includes a game board hanging in the air and a cute little monkey trapped in a transparent ball. The game view is from behind the monkey. In the single-player mode, the player's task is to tilt the board to roll the ball towards a particular goal without falling off the edge of the board into the depths. The player needs to avoid obstacles and pick bananas as the monkey rolls around the stages. The aim was to clear each stage with as high a score as possible. The player had 30 to 60 s to clear each stage and earned extra points for clearing the stage in half this time. The player earned extra points also by picking bananas. The practice session and the actual play sessions were played with the Normal Mode, Beginner difficulty level, and AiAi character. In the two-player mode (Monkey Duel), both players steered their own monkey characters and raced through the stage trying to reach the goal first. There were no bananas to collect and the player had to start from the beginning of the stage if he or she fell or was pushed off the edge. Also in the two-player mode, the player had 30 to 60 s to clear each stage. In general, Super Monkey Ball Jr. is a relatively nonviolent game with happy background music and atmosphere. It requires fast reflexes and some strategy.

Duke Nukem Advance is a version of the classic first-person shooting game. In the single-player mode, the player controls Duke Nukem character and tries to stop the alien scientists from taking over the world. The Game starts in a military base and the player has to clear each stage by finding a specific item or completing some task. To complete the tasks, the player has to kill alien monsters who roam over the base. The player has to solve some easy puzzles to proceed in the game and he or she can pick up more powerful weapons, armor, and first aid kits from around the base. In the single-player mode, the game was played at the Let's Rock difficulty level. The two-player mode was a death match game located in a similar military base environment. Each player controlled one Duke character and tried to hunt down and kill the other character. There were no other opponents, and after death the player could start again from a random place in the game environment. In general, the game is rather violent.

2.4. Procedure

When arriving to the laboratory, the three participants returned a number of questionnaires that had been sent to them beforehand. From the two participants who were friends, one was randomly chosen as the main participant. After a brief description of the experiment, the participant filled out an informed consent form. Electrodes were then attached to the main participant and he or she was seated in a comfortable armchair. Next all three participants practiced both games for 5 min in the single-player mode. This was followed by a rest period of 7 min, during which baseline physiological measurements were performed on the main participant. The main participant played each of the two games for 8 min against a computer (single-player mode of the game), a friend, and a stranger. The order of these six game sessions was randomized for each (main) participant. The main participant and opponent sat next to each other during game playing. After playing all games, the electrodes were removed, and the participants were debriefed and thanked for their participation.

2.5. Self-report measures

All self-report scales were presented on a computer screen.

2.5.1. Presence. The sense of presence of the participants was measured after each game with the ITC-Sense of Presence Inventory (ITC-SOPI), a 44-item self-report instrument [22]. Previous work with the ITC-SOPI has identified four separate factors: (a) Spatial Presence (19 items; e.g., "I had a sense of being in the game scenes," "I felt I was visiting the game world"), (b) Engagement (13 items; e.g., "I felt involved [in the game environment]," "My experience was intense"), (c) Ecological Validity/Naturalness (5 items; e.g., "The content of the game seemed believable to me," "The game environment seemed natural"), and (d) Negative Effects (6 items; e.g., "I felt dizzy," "I felt nauseous"). In the present study, we used only the 37 items addressing the first three factors. The wording of some of the items was slightly altered to adapt the instrument specifically for use with video games. Each of the items was rated on a 5-point scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The psychometric properties of the instrument have been shown to be acceptable.

2.5.2. Valence and arousal. Participants rated their emotional reactions in terms of valence and arousal to each of the games using 9-point pictorial scales. The valence scale consists of 9 graphic depictions of human faces in expressions ranging from a severe frown (most negative) to a broad smile (most positive). Similarly, for arousal ratings, there are 9 graphical characters varying from a state of low visceral agitation to that of high visceral agitation. The ratings are made by selecting a radio button below an appropriate picture. These scales resemble P. J. Lang's Self-Assessment Manikin [23].

2.5.3. Threat and challenge appraisals. Before each game, the degree of perceived threat that the game provided (i.e., anticipated threat) was assessed by asking participants, "How threatening do you expect the upcoming game to be?" [cf. 24]. After each game, subjective experience of challenge was assessed by asking, "How challenging was the game you just played?" Both items were rated on a 7-point scale, ranging from 1 (*not at all*) to 7 (*extremely*).

2.6. Physiological data collection

Electrocardiogram (ECG) was recorded from the main participant using the Psylab Model BIO2 isolated AC amplifier (Contact Precision Instruments, London, UK), together with three EKG leads in a modified Lead 2 placement. IBIs (ms) were measured with the Psylab Interval Timer.

The digital data collection was controlled by Psylab7 software, and the signal was sampled at a rate of 500 Hz.

2.7. Data reduction and analysis

Mean values for IBI were derived for each of the sixteen 30-s epochs during the games.

All data were analyzed by the General Linear Model (GLM) Repeated Measures procedure in SPSS. Analyses of the ratings measures data included two within-subjects factors, i.e., game (2 levels: Super Monkey Ball Jr. and Duke Nukem) and opponent (three levels: computer, friend, stranger). When analyzing IBI data, a third within-subjects factor was included, i.e., time (16 levels: the sixteen 30-s epochs). Two orthogonal contrasts were used to compare the appropriate levels of the opponent within-subjects factor: (a) computer vs. friend and stranger (Contrast 1) and (b) friend vs. stranger (Contrast 2).

3. Results

3.1. Threat and challenge appraisals

As hypothesized (Hypothesis 1), Contrast 1 indicated that playing against a friend or a stranger elicited higher anticipated threat compared to playing against a computer, $F(1, 32) = 7.55$, $p = .010$, $\eta^2 = .19$ (Figure 1, top panel).

In testing Hypothesis 2, post-game challenge ratings tended to be higher for the friend and stranger conditions compared to the computer condition, although Contrast 1 narrowly failed to reach statistical significance, $F(1, 32) = 3.54$, $p = .069$, $\eta^2 = .10$ (Figure 1, bottom panel).

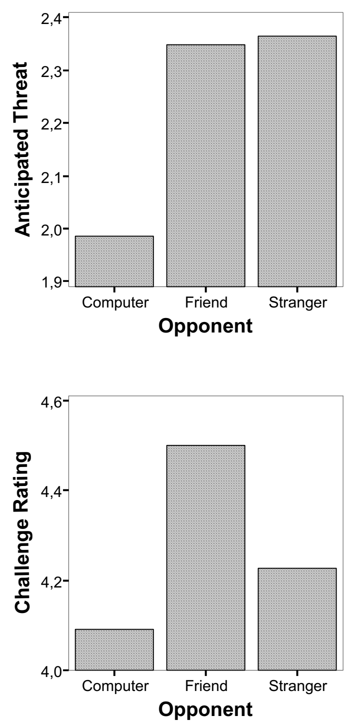


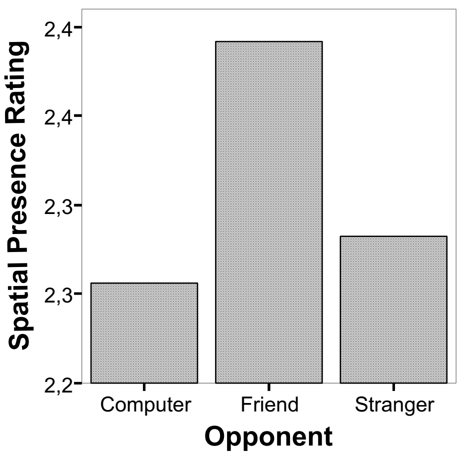
Figure 1 Anticipated threat (top panel) and challenge ratings (bottom panel) as a function of the opponent

3.2. Presence ratings

In agreement with Hypothesis 5a, Contrast 1 indicated that Spatial Presence was higher when playing with another human being (i.e., a stranger or a friend) compared to playing against the computer, $F(1, 32) = 5.22$, $p = .029$, $\eta^2 = .14$ (Figure 2, top panel). In addition, in testing Hypothesis 5b, Contrast 2 showed that playing with a friend elicited higher Spatial Presence compared to playing with a stranger, $F(1, 32) = 5.97$, $p = .020$, $\eta^2 = .16$.

In addressing Hypothesis 6a, Contrast 1 showed that playing with a human elicited higher Engagement than playing with a computer, $F(1, 32) = 17.83$, $p < .001$, $\eta^2 = .36$ (Figure 2, bottom panel). In addition, playing with a friend elicited higher Engagement than playing with a stranger (Hypothesis 6b), $F(1, 32) = 12.34$, $p = .001$, $\eta^2 = .28$.

We also tested the differences in Ecological Validity/Naturalness ratings between the two games. Ecological Validity/Naturalness was higher for Duke Nukem compared to Super Monkey Ball Jr., $F(1, 32) = 5.53$, $p = .025$, $\eta^2 = .15$.



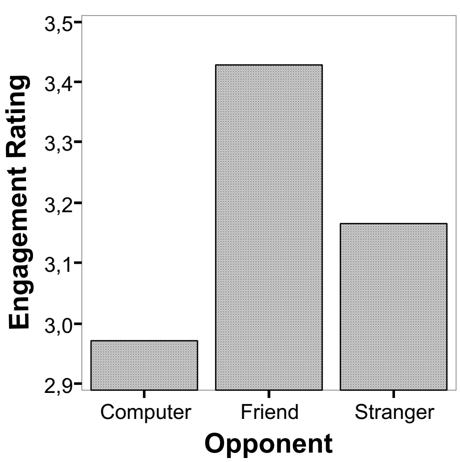


Figure 2 Spatial Presence (top panel) and Engagement (bottom panel) as a function of the opponent

3.3. Valence and arousal ratings

As suggested by Hypothesis 7a, playing against a human elicited a more positive emotional response compared to playing against a computer, for Contrast 1, $F(1, 32) = 24.19$, $p < .001$, $\eta^2 = .43$ (Figure 3, left panel). In testing Hypothesis 7b, although playing with a friend tended to elicit a more positive emotional response compared to playing with a stranger, Contrast 2 narrowly failed to reach statistical significance, $F(1, 32) = 3.53$, $p = .076$, $\eta^2 = .10$.

The Hypothesis 3a suggestion that self-reported arousal would be higher when playing against a human compared to playing against a computer was not supported by Contrast 1, $p = .191$; this was apparently due to low arousal ratings elicited by playing with a stranger. However, in agreement with Hypothesis 3b, Contrast 2 was significant indicating that playing with a friend elicited higher self-reported arousal than playing with a stranger, $F(1, 32) = 9.26$, $p = .005$, $\eta^2 = .22$ (Figure 3, middle panel).

3.4. Cardiac interbeat intervals

In agreement with Hypothesis 4a, Contrast 1 showed that cardiac IBIs were shorter (i.e., higher HR) when playing with a human compared to playing with a computer, $F(1, 31) = 27.20$, $p < .001$, $\eta^2 = .47$ (Figure 3, right panel). As hypothesized (Hypothesis 4b), Contrast 2 showed that playing with a friend elicited shorter IBIs (i.e., higher HR) compared to playing with a stranger, $F(1, 31) = 10.75$, $p = .003$, $\eta^2 = .26$.

4. Conclusions

In the present investigation, we investigated how the nature of the opponent (i.e., computer, friend, or stranger) influences Spatial Presence, emotional responses, and threat and challenge appraisals when playing video games. As hypothesized, the results showed that arousal ratings and physiological arousal as indexed by cardiac IBIs were higher when playing against another person (friend or stranger) than when playing against a computer (self-reported arousal was low when playing against a stranger, however). Apparently, the social-competitive situation related to playing against another person evokes increased arousal [cf. 12]. The presence of another person who “observes” inevitably creates a situation that involves high task performance evaluation potential, thereby increasing arousal [19]. This suggestion is also supported by the findings that playing against another person elicited higher anticipated threat prior to the game and higher post-game challenge ratings compared to playing against a computer. Threat appraisals have previously been associated with increased sympathetic arousal [25].

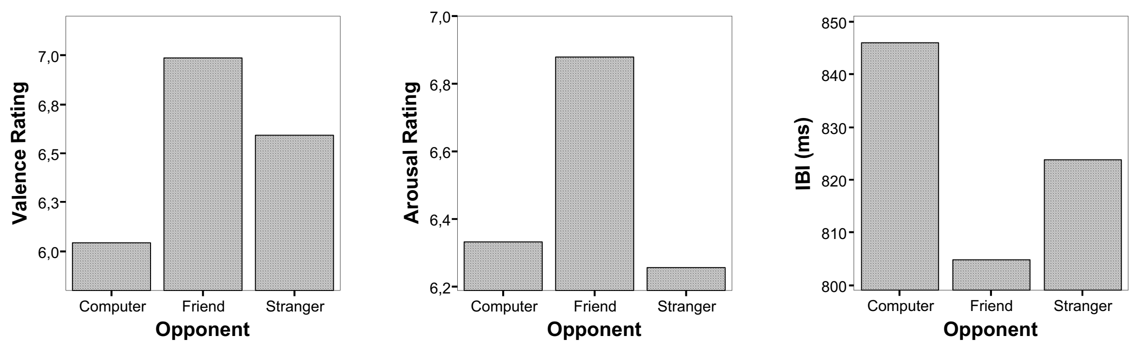


Figure 3 Valence ratings (left panel), arousal ratings (middle panel), and cardiac interbeat intervals (IBIs; right panel) as a function of the opponent

We also found that playing against a friend elicited greater self-reported arousal and shorter cardiac IBIs (i.e., higher physiological arousal) compared to playing against a stranger. This is likely because, as opposed to a stranger, a friend may serve as a continuing reminder of task performance [19]. Thus, it may be more important for a player to perform well when playing against a friend, which may result in increased arousal.

An important finding was that playing against another human being elicited higher Spatial Presence and Engagement as measured by the ITC-SOPI compared to playing against a computer. In addition, we found that playing against a friend elicited higher Spatial Presence and Engagement compared to playing against a stranger. Given that these differences in Presence were paralleled by arousal differences (see above), arousal may be a mediating factor. The two-level-model of Spatial Presence suggests that the focused allocation of attentional resources to the mediated environment contributes to Spatial Presence experiences [2]. Thus, given that arousal increases attention [17], increased arousal when playing against another person, and particularly when playing against a friend, may have contributed to increased Spatial Presence. It is also of note that, as a result of an increased attentional engagement with the game in the stranger and friend conditions, there may be less attentional resources left over for the processing of the signs that the game environment is artificial. Relevant to this, we have previously found that games played with a higher difficulty level elicit higher Spatial Presence (and arousal) compared to easier games (an exceedingly high difficulty level may, however, decrease Presence) [26]. A higher difficulty level is also likely to tax the cognitive resources, thereby diminishing attention paid to cues signaling that the game environment is not real.

We also found that playing against another human being elicited more positively valenced emotional responses compared to playing against a computer. This was expected, given the appetitive motivation of humans for social interaction [21]. This finding is also in line with the suggestion that high Presence conditions result in greater enjoyment [5, 15].

An apparent limitation of the present study was that the participants had to fulfill the relatively long questionnaire six times, which may have influenced the results (although we counterbalanced the six conditions). In the present study, both players were in the same room. However, video games are increasingly played over Internet or LAN, so that the players do not see each other. Thus, future studies should examine whether the present results replicate when the players are in different rooms, but have the knowledge with whom they are playing. Future studies might also examine the potential moderating effect of personality (e.g., sociability) on the associations found in the present study.

In sum, the present study showed that playing against another human elicited higher Spatial Presence, engagement, anticipated threat, post-game challenge appraisals, and physiological arousal compared to playing against a computer. In addition, playing against a friend elicited greater Spatial Presence, engagement, and arousal compared to playing against a stranger. The nature of the opponent influences Spatial Presence when playing video games, potentially through the mediating influence on arousal and attentional processes.

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