Effects of screen size, viewing angle, and players' immersion tendencies on game experience

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ABSTRACT

This study investigated the effects of viewing angle manipulated through screen size and the moderating role of players’ immersion tendencies on presence experience in the context of computer game playing. Thirty participants played a third-person computer game, Tomb Raider 2, in two screen size conditions: a 12.7-in. and an 81-in. display. ANCOVA analyses showed that playing in front of a large screen led to a more favorable impression on the game character, a more positive mood change, and significantly higher feelings of both physical and self-presence, confirming previous research. Our findings also revealed that individuals’ intrinsic immersion tendencies have a positive moderating effect on the sensation of physical and self-presence, above and beyond the influence of screen size. The results suggest that feeling of presence as well as overall game experience is determined by the interaction between technological factors and human influence.

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1. Introduction

Over the last decade, a substantive body of video game studies has emerged as a research field. Perhaps drawing from more established research on television (Bandura, 1994), early and primal studies on video games have been focused on the effects of media contents, predominantly on violent or educational topics (Bushman & Anderson, 2002; Lee & Peng, 2006; Sherry, 2001). A number of recent studies have demonstrated that media forms, such as display sizes, viewing angles, fidelity, resolutions, cuts, synchrony, and movements, also produce significant psychological effects (Skalski & Whitbread, 2010). Technological improvements of life-like display size, high fidelity video and audio, and seamless interactivity in newer generations of games have received growing attention, especially as the increasing realism of video games has been presented to lead to such consequences as aggression, empathy, memory functions, pro-social behaviors, etc. (Anderson & Dill, 2000; Anderson et al., 2010; Ballard & Wiest, 1996; Barlett, Rodeheffer, Baldassaro, Hinkin, & Harris, 2008; Boot, Kramer, Simons, Fabiani, & Gratton, 2008; Calvert & Tan, 1994; Dill & Dill, 1999; Lee, Peng, & Park, 2009; Provenzo, 1991; Swing, Gentile, Anderson, & Walsh, 2010).

In addition to media factors, such as arousing contents and advanced forms, certain characteristics of media users can also impact what individuals are actually experiencing while playing games (Alfarro, 2010; de Kort, Ijsselsteijn, & Gajadhar, 2008; Shiratuddin & Zaibon, 2010). Perhaps one of the most valuable approaches to understand the role of individual characteristics in gaming experiences is by the concept of presence (Barlett et al., 2008; Lang, Potter, Bolls, Bryant, & Oliver, 2009; Lee et al., 2009; Richardson, Powers, & Bousquet, 2010). Presence refers to a sense of “being there” in the mediated environment. Heeter (1992) contended that a user’s personality may predetermine whether that person is “receptive to alternative types of virtual experiences” (p. 270). For example, individuals with a higher capability of constructing spatial images tend to feel stronger spatial presence than those with a low spacial visual imagery (Wirth et al., 2007). Player’s age (van Schaik & Burkart, 2010), gender and experiences with the media forms (Lachlan & Krcmar, 2008) were also found to affect the level of presence in computer games.

Lombard and Ditton (1997) proposed three major inducers to the feeling of presence across media: characteristics of media form, characteristics of media content, and characteristics of the media users. Numerous studies have documented support for this view by relating presence to possible contributing factors (e.g., Bracken & Botta, 2010; Bracken & Skalski, 2009; Petey, Bracken, Rubenking, Buncher, & Gress, 2010; Skalski & Whitbread, 2010; Tamborini & Skalski, 2006). An abundance of presence literature has examined different aspects of media content, forms, and users, providing substantial theoretical and empirical evidence in favor of
one factor or another. There are, nevertheless, few studies that directly compare one factor to another. Thus, it remains a lack of understanding of how technological components and personal characteristics interplay to contribute to presence experience. It is still unclear to what extent individual traits precondition the relationship between media factors and the formation of presence. This study contributes to this line of research by taking both media factor and user factor into account. In particular, we want to investigate game players’ immersion tendencies as a precondition of presence experience and screen size as a media form variable in a third-person point of view video game. Immersion tendency is defined as an individual’s disposition to become involved in mediated environments (Witmer & Singer, 1998). Screen size has been one of the most systematically studied media form factors (e.g., Lin, Hu, Imamiya, & Omata, 2006; Reeves, Detenber, & Steuer, 1993). It is well accepted that both foster sensations of presence and media experience in general, and our study attempts to disentangle the intertwined influences.

2. Literature review
2.1. Screen size, viewing angle and media experience

Screen size is one of the most rigorously investigated among many formal features of media. The empirical evidence supports that screen size influences audience’s viewing experience, such as their arousal, evaluation of the media character, and enjoyment of the media, and leads to positive media experience overall (Grabe, Lombard, Reich, Bracken, & Ditton, 1999; Lombard & Ditton, 1997). In a study on viewers’ evaluations and behavioral responses to the television broadcast in three screen size conditions (10 in., 26 in., and 42 in.), subjects had a significantly more favorable evaluation of both the people on the screen and the viewing environment in the large screen condition (Lombard & Ditton, 1997). Larger screen display also led to higher emotional arousal (Lombard, Reich, Gracken, & Ditton, 2000) and memory (Detenber & Reeves, 1996). Viewers’ emotional responses and memory for a six-second exposure to pictures were significantly different in two screen size conditions (90 and 22 in.).

The viewing distance was fixed or was not specified in previous research investigating the effects of screen size. Researchers acknowledge that the proportion of participants’ visual field (viewing angle) occupied by the image is varied and creates a different confound when the viewing distance is fixed (Lombard et al., 2000). Additionally, people naturally adjust their viewing distance according to different screen sizes. With a big screen, people take a long viewing distance, and with a small screen size people adopt a short distance. The manipulation of the media form factor screen size is interconnected with the variables of viewing distance and viewing angle. However, since the research tradition has established screen size as the dominant variable, the current study still adopt the term screen size to situate our study in this line of research. After all, viewing angle is determined by viewing distance and screen size, and viewing distance is selected by users based on the screen size.

Little evidence has accumulated that such psychological effects of large screen size translate into different types of media, especially in the context of video game playing. Bellman, Schweda, and Varan (2009) compared advertising effectiveness across three screen sizes: TV (35 in.), personal computer (10 in.), and iPod (2 in.). However, their results show no evidence for significant effects of screen type on ad recall, attitudes toward the ad and the brand, and purchase intentions. The study failed to empirically prove the effectiveness of commercials translated over from analogue to a digital medium. Another study suggested that large displays in 3D game context are superior in improving spatial knowledge of a virtual environment (Bakdash, Augustyn, & Proffitt, 2006) and inducing physiological responses and higher subjective ratings of excitement (Hu, Lin, Sakai, Imamiya, & Omata, 2005).

Games are usually played on different devices with a wide ranging screen sizes such as 5 in. display for Game Boy, PlayStation Portable, mobile phones and 50 in. 3D display TV monitors. It is imperative to extend the current research on the effects of screen size in non-interactive media such as television into the domain of interactive, digital media. We propose to bridge the gap in the current research and examine game character evaluations, psychological arousal, and overall enjoyment of the interactive game play on different display conditions.

H1. Game players with a large screen will evaluate game characters more positively than players with a small screen.

H2. Game players with a large screen will feel a greater mood change than players with a small screen.

H3. Game players with a large screen will enjoy the game more than players with a small screen.

2.2. Relations between screen size and presence

Presence is a multidimensional construct. It is argued to be an immediate outcome of exposure to advanced game technologies (Steuer, 1992; Tamborini & Skalski, 2006). In Lee (2004)’s distinction of physical, social, and self-presence, physical presence is defined as “a psychological state in which the virtual physical objects in the game interface are experienced as actual physical objects” (p. 32). The whole game environments, e.g., the gun used by the avatar, the car driven by the avatar, are all seemed to be real physical objects to the player, who controls the avatar in the game environment. Players can be so immersed that they have the illusion that the gaming environment is real world. Physical presence is one of the key elements of the gaming experience because it enhances the realism of playing experience for the player, which ultimately will influence their evaluation of the game experience.

Self-presence is a psychological state in which the players feel that avatars, the role that they play in the game, are actually themselves. During game playing, players control their avatars as if the action of the game character is their own action. To some extent, the game players are so identified with the game characters that they feel that they are actually the game characters. Scholars have proposed that the analysis of the problems associated with interactive violence in video games should deal with game features that increase the player’s identification with an aggressive character (Anderson et al., 2010). Studies on passive viewing suggested that identification can be increased through such aspects as narrative, similarity between viewers and media characters, exposure length, and social realism (Cohen, 2001). In an interactive video game context, players may be required to take actions from the perspective of the game characters, through avatar controlling, for example. Research on serious games suggested that interactive games can be more effective in influencing people’s willingness to help (Peng, Lee, & Heeter, 2010) and health diet (Peng, 2009) than non -interactive viewing due to players’ increasing identification with game characters.

Screen size is one of the determinant media form variables that influences presence (Lombard & Ditton, 1997). Early research has shown that screen size influences variables that proximate physical presence, such as “involvement” and “participation” in the television viewing setting (Reeves et al., 1993). Participants who watched action film clips on a 70 in. screen reported significantly greater
agreement with the statement “I felt like I was a part of the action” than subjects who watched on a 35 in. screen. Participants who viewed film scenes on a 52 in. screen color television with surround sound audio reported a greater sense of “participation” and “involvement” in the scene compared to their counterparts who viewed it with a 5 in. black and white television with monophonic audio (Lombard & Ditton, 1997).

Recent studies directly investigated the relationship between presence and display size. In an experiment with 65 undergraduate students who were shown brief examples of rapid point-of-view movement on a television, participants who watched the large screen (46 in.) reported a greater sense of presence than those who watched with the small screen (12 in.) (Lombard et al., 2000). In addition, participants in the large screen condition thought that the movement in the scenes was faster, experienced a greater sense of physical movement and enjoyed the movement to a greater extent. A group in the large screen condition also found the viewing experience more exciting and was more physiologically aroused compared to a group in the small screen condition. Grabe et al. (1999) contended that “There is substantial evidence for the idea that larger screens promote perceived realism of media content and perceptions of presence” (p. 5). In the game playing context, besides player engagement and interaction, the visual stimuli are similar to the television viewing experience. It is thus reasonable to believe that the larger the screen size, the greater the sense of presence the player will feel.

H4. Game players with a large screen will feel a greater sense of physical presence than players with a small screen.

H5. Game players with a large screen will feel a greater sense of self presence than players with a small screen.

2.3. Immersion tendencies, presence, and game experience

A plethora of studies have covered a wide ranging topic of presence and its impact on participant’s experience. However, only a few researchers have attempted to empirically investigate how individual factors such as immersion tendencies affect game experience. Video games players often experience a sense of engagement or an experience of losing themselves in the game world. Such experience of a complete focus on the game environment and an appealing engrossment free from distraction is often referred to as immersion. Witmer and Singer (1998) defined immersion as a “psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences” (p. 227). The concept of immersion has been discussed from three different research traditions mostly in virtual environment.

Firstly, scholars used immersion as an objective description of technology that operates in virtual environments (Slater, Linak, Usoh, & Kooper, 1996). Secondly, immersion is viewed as part of game experience that is critical in understanding the relationship between players and the game experience. It was viewed as an outcome of game enjoyment (Brown & Cairns, 2004; Jennett et al., 2008) or as a primary factor underlying the process of presence (Witmer & Singer, 1998). Witmer and Singer developed a measurement to evaluate different degrees of involvement and concluded that higher level of immersive experience predicted more presence (1998). Jennett et al. (2008) attempted to quantify immersion subjectively through questionnaires but also be objectively by tracking eye movement or comparing task completion time.

Thirdly, immersion is also viewed as an intrinsic human characteristic. Some players become easily involved with the game whereas others do not experience the same level of engagement despite the similar level of game structure and environmental factors. Murray, Fox, and Pettifer (2007) used individuals’ immersive tendencies as one of psychological characteristics in pretest in their study of presence. Baños and colleagues (2004) also reported that subjects with lower degree of immersion tendency showed higher scores in presence. In this study, we used the term, immersion tendency, as an individual attribute that is intrinsic to participants, not as an outcome or a byproduct of a gaming experience. Among intrinsic individual traits, immersion tendencies were associated with the evaluation of the media experience (Murray et al., 2007; Witmer & Singer, 1998). Weibel, Wissmath, and Mast (2010) reported in the study of the Big Five personality traits that high openness to experience, neuroticism, and extraversion are associated with the tendencies to be immersed and tend to affect the media process.

Research has demonstrated the importance of individual characteristics in presence studies. Presence literature suggests that focus of attention and high level of involvement are essential for experiencing presence in video games. Immersion tendencies, mental alertness or ability to concentrate or block other distractions were significantly associated with presence (Murray et al., 2007; Ross, Joshi, & Currie, 1990; Witmer & Singer, 1998). Fully immersed players perceive themselves as part of the game world and cut off from other stimulus flow from outside of the game world. Therefore, the tendency to easily identify with the game characters and a sense of interacting with the game environment directly, not through game controls, will produce a higher sense of presence.

Experimental studies have confirmed that immersion tendency is the mediator for people’s experience of presence (Murray et al., 2007; Witmer & Singer, 1998). However, the relationship among display size, immersion tendency, presence, and experience-related variables is still not clear. Researchers have postulated that immersion tendency, as a dispositional attribute of individuals, predetermines how easily someone experiences presence (Weibel et al., 2010; Witmer & Singer, 1998). That is, participants with a high level of susceptibility to the virtual environment and immersion tendency will experience more presence in a video game above and beyond the influences of technological manipulations. Participant’s psychological abilities and personality traits may also interact with levels of enjoyment and produce different awareness and performance in virtual environments (Wirth et al., 2007). In this pre-post design, we tested how personality related factors such as immersion tendency contribute to moderate the experience of presence and evaluation of other gaming experience related variables. Participants with higher immersive tendency will exhibit more awareness and sensitivity toward the same game construction or viewing environments and, in turn, report higher level of presence and greater impact on gaming experience. We hypothesize that immersion tendency, as an individual dispositional characteristic, is a moderator for people’s feeling of presence and evaluation of general gaming experiences.

H6. Immersion tendency will be a significant covariate for game players’ feelings of physical and self-presence.

H7. Immersion tendency will be a significant covariate for players’ evaluation of gaming experience (i.e., evaluation of game characters, arousal, and enjoyment of game).

3. Method

3.1. Experimental design

Thirty undergraduate students were recruited from a large introductory communication class in exchange for course credits. A pre-screening was conducted to ensure that all participants were reasonably familiar with video games in general. A two group
between-subject comparison design was used. Subjects were randomly assigned to two screen size conditions with gender being approximately balanced within groups, i.e., of the 15 subjects of each condition, 8 were male and 7 were female. Subjects’ ages ranged from 19 to 43, with a mean age of 24.5.

After being greeted to an experimental laboratory on campus, each subject watched a six-minute instructional video, briefing the experimental process. A pre-test paper-and-pencil questionnaire was administered. Each subject was then assigned to play a segment of video game, Tomb Raider 2, either on a 12.7-in. rear-projection screen (i.e., the small screen-size group) or on an 81-in. screen (i.e., the large screen-size group). Since it is very unlikely that people watch an 81 in. screen and a 12.7 screen with the same viewing distance, we varied viewing distance across conditions in order to create a more realistic viewing environment for each condition. More specifically, participants in the 12.7 in. screen condition played the game with the viewing distance of 36.5 in., and participants in the 81 in. screen condition played the same game with the viewing distance of 51.5 in. As a result, the big screen condition provided an approximate 76 degrees of viewing angles, and the small screen condition provided approximately 18 degrees of viewing angles (there were slight differences of viewing angles for subjects due to their sitting postures, sitting height, etc.). The actual viewing angles provided by the display in the participant’s visual field and actual viewing distances are illustrated in Fig. 1.

The game used in this study was, Tomb Raider 2, an action-adventure game presented in a third person perspective. The player controls the female character—Lara Croft, an archeologist—through a series of tombs and other locations in search of treasures. On the way, Lara—and the player—needs to solve puzzles and kill enemies in order to complete each level. Subjects were given 15 min to practice the game so that they understood the game environment sufficiently enough to proceed. Then subjects played the actual game for 30 min. After the game play, they completed a post-test paper-and-pencil questionnaire and were debriefed.

3.2. Measures

3.2.1. Physical presence

Physical presence was measured using four items adapted from Kim and Biocca’s (1997) physical presence scale. Construct validity of the scale has been indicated by significant correlations with other measures of physical presence. The four 7-point scale (1 = strongly disagree and 7 = strongly agree) items were: (1) “During the game, I sometimes felt that the cave was all around me,” (2) “How much did you feel as if you were inside the cave observing the events,” (3) “How much did you feel as if you were inside the cave exploring the environment,” and (4) “To what extent were there times when you felt that the virtual world became the reality for you, and you almost forgot about the real world outside.” Internal consistency measures of reliability (Cronbach’s alpha) for physical presence yielded reliability of 0.82. A follow-up item analysis suggested that dropping items did not contribute to the reliability of the scale. Thus, the four items were averaged to create the scale scores. Higher scores on this scale denoted higher level of physical presence experience during the game play ($M = 4.39, SD = 1.29$).

3.2.2. Self-presence

Self-presence implies the degree to which players feel as if their game avatar were their real self. The items of this scale were based on earlier instruments measuring self-presence (e.g., Jin, 2011; Jin & Park, 2009; Park, Lee, Jin, & Kang, 2010). Convergent validity of this scale was indicated by strong correlations with measures of presence, physical presence, and social presence across different virtual reality contexts. The five 7-point scale (1 = strongly disagree and 7 = strongly agree) items were: (1) “During the game, how often did you imagine yourself as the character,” (2) “During the game, I felt as if the character and me thought alike,” (3) “How much did you feel as if you and the character were one,” (4) “How much did you feel good when the character succeeded in doing something,” and (5) “I just forgot it was computer character in there and just felt as if it was me inside the cave.” The items were averaged to create the scale scores. Cronbach’s alpha for this scale was 0.85, indicating a highly reliable measure ($M = 4.02, SD = 1.46$).

3.2.3. Evaluation of game characters

Evaluation of game characters were drawn from modified versions of McCroskey, Hamilton, and Weiner’s (1974) Credibility–Homophily measure on players’ impression of the game character. Convergent validity of this scale was indicated by strong correlations with other subsets of McCroskey, Hamilton, and Weiner’s (1974) Credibility–Homophily scales, such as perceived attraction and credibility of a character (Nowak & Rauh, 2005). Participants were asked whether they perceive Lara Croft (the game character of Tomb Raider 2) as honest, sympathetic, and good on 7-point bipolar scales. The items were summed to create the scale scores. Cronbach’s alpha for this scale was 0.73, indicating a reliable measure. Higher scores on this scale denoted more positive attitudes toward the game character ($M = 14.50, SD = 2.47$).

3.2.4. Mood change

Mood scale was adopted from Zuckerman & Lubin’s multiple affect adjective check list-revised (MAACL-R). Adequate reliability

![Fig. 1. Two conditions with screen size, viewing distance, and viewing angle parameters.](image-url)
(internal consistency and test–retest reliability) and validity (convergent, discriminant, predictive, and diagnostic) have been demonstrated for the instrument (Lubin & Zuckerman, 1999). Since this study aims to look at the mood change scale, composite scale of five mood items, anxiety, depression, hostility, positive affect, and sensation seeking were measured in both the pre- and the post-test. The final mood change score was obtained by calculating the difference between the averaged mood scores on the two tests ($M = 3.93$, $SD = 3.22$).

3.2.5. Evaluation of the game

Evaluation of the game scale was created by combining four 7-point items reflecting general evaluation and attitude toward the video game. Four evaluation items measured excitement of the game, coolness of the game, graphic quality of the game, and intention to recommend the game to others. Validity of this scale was indicated by strong correlations with other evaluative items, such as willingness to pay the game again, and intention to purchase the game in the future. Internal consistency measures (Cronbach’s alpha) for this measure yielded reliability of 0.78, indicating a reliable measure. The four items were averaged to create the scale scores. A higher score on this scale indicated a more positive attitude towards the video game ($M = 4.81$, $SD = 1.40$).

3.2.6. Immersion tendencies

Immersion tendency was measured in the pre-test to capture individuals’ internal disposition to become involved in a virtual environment. The items of this scale were based on Murray, Fox and Pettifer’s (2007) immersive tendencies questionnaire (ITQ). Convergent validity of this scale was indicated by significant correlations with absorption scale and dissociation scale (Murray et al., 2007). Example items were: “How often have you cried watching a good, sad movie,” and “How often as a child did you play pretend or make-believe.” Responses categories ranged from 1 (very rarely) to 7 (very often). The items were summed to create the scale scores. Cronbach’s alpha for this scale was 0.73, indicating a reliable measure ($M = 9.83$, $SD = 4.44$).

3.3. Data analysis

Kolmogorov–Smirnov tests of normality were first conducted on the dependent variables to decide between parametric (e.g., ANCOVA) and nonparametric (e.g., Mann–Whitney) statistical tests for our study. The results supported the normality assumption. Secondly, since this study aims to investigate the influences of both individual traits (i.e., immersion tendency) and media factors (i.e., screen size) on the formation of presence and gaming experience, ANCOVA was the fitted statistical test for our study. Specifically in our study, one-way ANCOVA model allows to compare dependent variables (i.e., presence and gaming experience) in two groups (i.e., screen size: large vs. small) while taking into account influences of a continuous variable, called covariate (i.e., immersion tendency). Furthermore, since covariate is commonly used to capture the extraneous pretreatment differences, immersion tendency is considered as an appropriate covariate reflecting the dispositional characteristic of individuals. Finally, Levene’s test for equality of variance was performed, and the homogeneous assumption was supported. Thus, data analyses for this study were based on a series of full-factorial One-way ANCOVA using immersion tendency as a covariate.

4. Results

Descriptive statistics for the indices above are presented in Table 1. The results of the ANCOVA analysis are shown in Table 2.

H1 expected that game players with a large screen would evaluate game characters more positively than players with a small screen. H1 was supported. The ANCOVA analysis with character as the dependent measure indicate a main effect for screen size, $F(1,29) = 5.18$, $p = .031$, $\eta^2 = .16$. Specifically, the big screen size group ($M = 15.40$, $SD = 2.38$) reported a more favorable impression on the game character – Lara Croft – than the small size group ($M = 13.60$, $SD = 2.29$).

Consistent with H2, a significant main effect of screen size on mood was found, $F(1,29) = 4.36$, $p = .046$, $\eta^2 = .14$, suggesting that game players with a large screen ($M = 2.80$, $SD = 2.14$) would experience greater arousal and mood change than players with a small screen ($M = 5.07$, $SD = 3.75$) after playing the game. H2 was supported.

H3 suggested that game players with a large screen would enjoy the game more than players with a small screen. It was not supported.

H4 suggested that game players with a large screen would feel a greater sense of physical presence than players with a small screen. As shown in Table 2, H4 was supported. The ANCOVA analysis with physical presence as the dependent measure indicated a main effect for screen size, $F(1,29) = 6.45$, $p = .017$, $\eta^2 = .19$. Specifically, participants who played game with a big screen ($M = 4.81$, $SD = .88$) felt more physical presence toward the game than those with a small screen ($M = 3.97$, $SD = 1.51$) do.

H5 predicted that players in the large screen condition would feel a greater sense of self-presence than players in the small screen condition. The results of ANCOVA revealed a significant main effect for screen size on self-presence, $F(1,29) = 5.02$, $p = .033$, $\eta^2 = .16$, indicating that participants who played game with a big screen ($M = 4.47$, $SD = 1.33$) felt more self-presence toward the game than those with a small screen ($M = 3.59$, $SD = 1.49$) do. Thus, H5 was supported.

We also hypothesized that immersion tendency, measured as an individual intrinsic characteristic in a pre-test, would moderate the effects of screen size on people's feeling of presence and gaming experience in general. H6 expected that immersion tendency would be a significant covariate for game players’ feeling of physical and self-presence. H6 was supported. Immersion tendency had a significant effect as a covariate for physical presence, $F(1,29) = 6.16$, $p = .020$, $\eta^2 = .18$, and for self-presence, $F(1,29) = 4.61$, $p = .041$, $\eta^2 = .15$. Participants who had a higher level of immersion tendency showed stronger sense of physical and self-presence than those who have a lower level of immersion tendency.

H7 expected that immersion tendency would be a significant covariate for players' gaming experience (i.e., evaluation of game characters, arousal, and enjoyment of game). It was not supported. There was no significant covariate effect for immersion tendency on players' evaluation of game characters, arousal, or enjoyment of game.

5. Discussion

The purpose of this study was to investigate the effects of viewing angle manipulated through screen size on feelings of presence and psychological responses such as mood, enjoyment and social responses in the context of computer games. We also investigated the moderating role of individual immersion tendency on the level of presence and gaming experience.

Firstly, ANCOVA analyses showed that screen size is influential in affecting physical presence, self-presence, impression on game characters and players' mood. Participants experienced a greater sense of physical and self-presence in front of a large screen. Display size directly influenced the player’s feeling of involvement and
greater enjoyment. The media characters, feeling greater mood change and reporting experience among viewers including assessing characteristics of interactive media genre such as computer game. Media form that and behavioral responses in traditional media can be extended in the empirical evidence that the effect of a large screen size on emotional ton & Wohl, 1956; Lombard & Ditton, 1997). This finding adds* ANCOVA analysis on screen size and immersion tendencies.

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Small screen</th>
<th>Large screen</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>η²</th>
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<td><strong>Game character evaluation</strong></td>
<td>Screen size</td>
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<td>1</td>
<td>28.36</td>
<td>5.18*</td>
<td>.16</td>
</tr>
<tr>
<td></td>
<td>Immersion tendency</td>
<td>5.48</td>
<td>1</td>
<td>5.48</td>
<td>1.00</td>
<td>.04</td>
</tr>
<tr>
<td><strong>Player mood change</strong></td>
<td>Screen size</td>
<td>41.70</td>
<td>1</td>
<td>41.70</td>
<td>4.36*</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>Immersion tendency</td>
<td>3.33</td>
<td>1</td>
<td>3.33</td>
<td>35</td>
<td>.01</td>
</tr>
<tr>
<td><strong>Game evaluation</strong></td>
<td>Screen size</td>
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<td>1</td>
<td>1.46</td>
<td>71</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>Immersion tendency</td>
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<td>1</td>
<td>5.23</td>
<td>2.54</td>
<td>.09</td>
</tr>
<tr>
<td><strong>Physical presence</strong></td>
<td>Screen size</td>
<td>8.28</td>
<td>1</td>
<td>8.28</td>
<td>6.45*</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Immersion tendency</td>
<td>7.91</td>
<td>1</td>
<td>7.91</td>
<td>6.16*</td>
<td>.18</td>
</tr>
<tr>
<td><strong>Self-presence</strong></td>
<td>Screen size</td>
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<td>1</td>
<td>8.90</td>
<td>5.02*</td>
<td>.16</td>
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<td></td>
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<td>1</td>
<td>8.17</td>
<td>4.61*</td>
<td>.15</td>
</tr>
</tbody>
</table>

Lastly, our hypotheses expecting the moderating role of immersion tendency on players’ level of presence and other psychological responses received mixed support. In our study, immersive tendency significantly affected players’ feeling of physical and self-presence while playing the game. Consistent with previous studies that people with higher degree of immersive tendency experienced a stronger sense of presence (Baños et al., 2004; Witmer & Singer, 1998), our results identified such moderating effects of immersion tendency in the context of interactive digital contents. As predicted, participants with high level of involvement with media in general were more likely to feel that they were being in the virtual world and they were being the game character themselves. People who tend to be easily engaged and become caught up in the media experience are more able to identify with the computer mediated gaming world and scored higher in the physical and self-presence items. Our findings suggest that a capability of being receptive to media experiences and involved in various media contents needs to be empirically linked to the sense of physical and self-presence in the context of games.

However, the interaction between people’s willingness to be immersed in the mediated world and other psychological or social responses is still unclear. In fact, our results did not show the moderating effects of immersion tendency on gaming experience in general including level of enjoyment, evaluation of game avatars and arousal. Previous literature demonstrates that individual differences mediate participant’s feeling of presence during the game play (Ljoselestein, Ridder, Freeman, Avons, & Bouwhuis, 2001; Lombard & Ditton, 1997). Similarly, people’s sense of enjoyment and assessment of the interactive media experience may vary as other personal factors and willingness to suspend disbelief in the mediated world are interrelated.

To summarize, this study proved the importance of immersion tendency in understanding the experience of presence in the interactive media context. However, there is limitation in empirical understanding of the relation between large individual or environmental variation and other factors that affect the level of other psychological and cognitive variables related to gaming experience. Individual difference within users’ cognitive, emotional and behavioral characteristics is related to the media experience and need to be corroboratively assessed when testing presence or other aspects of media consumption. Other characteristics such as domain-specific knowledge, introversion or extroversion, psychological factors and demographic differences are also shown to affect the experience of virtual environments and task performance in VE and need a renewed attention from game scholars.

Table 1

Descriptive statistics for character evaluation, mood change, enjoyment, physical presence, self-presence, and immersion tendency by condition.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Small screen</th>
<th>Large screen</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>η²</th>
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</thead>
<tbody>
<tr>
<td><strong>Game character evaluation</strong></td>
<td>Screen size</td>
<td>28.36</td>
<td>1</td>
<td>28.36</td>
<td>5.18*</td>
<td>.16</td>
</tr>
<tr>
<td></td>
<td>Immersion tendency</td>
<td>5.48</td>
<td>1</td>
<td>5.48</td>
<td>1.00</td>
<td>.04</td>
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<td><strong>Player mood change</strong></td>
<td>Screen size</td>
<td>41.70</td>
<td>1</td>
<td>41.70</td>
<td>4.36*</td>
<td>.14</td>
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<tr>
<td></td>
<td>Immersion tendency</td>
<td>3.33</td>
<td>1</td>
<td>3.33</td>
<td>35</td>
<td>.01</td>
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<tr>
<td><strong>Game evaluation</strong></td>
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<td>1.46</td>
<td>1</td>
<td>1.46</td>
<td>71</td>
<td>.03</td>
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<tr>
<td></td>
<td>Immersion tendency</td>
<td>5.23</td>
<td>1</td>
<td>5.23</td>
<td>2.54</td>
<td>.09</td>
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<td><strong>Physical presence</strong></td>
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<td>8.28</td>
<td>6.45*</td>
<td>.19</td>
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<td></td>
<td>Immersion tendency</td>
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<td>1</td>
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<td>6.16*</td>
<td>.18</td>
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<td><strong>Self-presence</strong></td>
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<td>Immersion tendency</td>
<td>8.17</td>
<td>1</td>
<td>8.17</td>
<td>4.61*</td>
<td>.15</td>
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</tbody>
</table>

*p < .05.