DIFFERENCE IN GAMERS’ EXPERIENCES IN 2DTV AND 3DTV

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ABSTRACT
This study provides some insight into the influence of gender on user experience relative to whether or not they are using 3D technology. Participants played a video game on either a 2DTV or a 3DTV, after which various psychological attributes were assessed. Males experienced more challenge and flow in the 3DTV condition, while females seemed to prefer the 2DTV condition. In addition, the role of gender in the perception of various display characteristics was analyzed, indicating that males were better able to distinguish various objects in the game.

Keyword: 2DTV, 3DTV, Challenge, Flow, Game, Skill

1 This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2011-32A-B00297)
DIFFERENCE IN GAMERS’ EXPERIENCES IN 2DTV AND 3DTV

Video games have been an object of research for decades, partly due to their popularity (and therefore their economic relevance) and the unique mental and physiological experience that users undergo while engaging in these games. Researchers have looked at a variety of mental states experienced while engaged in playing video games, such as presence, interactivity, arousal, aggression, and empathy, as well as physiological responses, such as heart rate, skin conductance, and skin temperature. In addition, ever since the blockbuster movie “Avatar” was released in a three-dimensional (3D) format in 2009, 3D technology has increased in interest to the general public. In turn, 3DTV’s have gained in popularity because of this consumer interest, along with their decreasing price and the introduction of 3D standards for 3DTV’s (Jose, 2012, July 17). As a result of this increased attention, 3D video games have become more popular as well, but unfortunately less research has focused on 3D video game effects.

3DTV’s provides true stereoscopic 3D, allowing users to experience such three-dimensional stimulation with unprecedented quality. In response to this, video game companies have been adapting their games to be able to be played on 3DTV’s, as well as making games specifically utilizing such 3D functionality. Studies have been done comparing the viewing experience of 2DTV versus 3DTV (Park, Oh, Subramaniyam, & Lim, 2012). Kulshreshth, Schild and LaViola (2012) found that playing a video game in a 3D stereoscopic condition can help participants perform better than those playing with a two-dimensional (2D) display. The current study further explores the difference between 2DTV and 3DTV as it applies to various psychological factors while playing video games. The goal of this study is to examine the impact of perception and gender on a variety of psychological states experienced by the user while playing video games. Some of these states can be considered positive, such that they encourage the user to spend more time in the activity and increase the entertainment value of the experience. This can in turn lead to better conceptions of what attributes should be instantiated in the game design process.

Gender

An issue in video game usage that is often addressed is gender. Most video game studies demonstrate that males play more often and for longer periods of time than females (Sherry, Greenberg, Lucas, & Lachlan, 2006; Terlecki, et al., 2010). In fact, Jansz and Tanis (2007) found that almost all (99%) online players of First Person Shooter (FPS) games were male. Males also tend to be more confident in their video game playing abilities (Terlecki, et al., 2010).
There may be multiple causes for this disparity. Ritterfeld and Weber (2006) feel that technological skills, or the lack thereof, may be a contributing factor for gender differences. Williams (2006) claims that “women have been systematically socialized away from technology” (p. 206). Girls may be less familiar with computers and video games and “thus establish lower average self-efficacy beliefs with respect to computer games than boys...Players who never enter the cyclic process of mastery, increase of efficacy beliefs, performance gain, and new mastery experiences will not display a strong general disposition that favors engagement in the given activity” (Klimmt & Hartman, 2006, p. 142).

Based upon a sampling of video game players to discover their preferences, Wood, Griffiths, Chappell and Davies, (2004) discovered many significant gender differences. In the survey, more males than females considered realistic settings important. Significantly more males thought that games based on factual events were important for enjoyment compared to females. Significantly more females than males reported that humor was important. Significantly more males than females rated sophisticated artificial intelligence (AI) as important. Significantly more males than females liked surviving against the odds. Significantly more females than males were in favor of point accumulation. Females also considered features such as solving puzzles, finding things, and collecting things to be important, whereas males did not.

Bradley and Lang (2000) found that arousal was correlated with positive affect in men and negative affect in women, so heightened arousal may be perceived as positive in males and negative in females, explaining reactions to extremely arousing games. This difference may diminish experiences of presence and decrease overall entertainment. Also, Ku et al. (2005) found that human emotion could be affected by the facial expression of a virtual avatar according to the avatar’s gender.

A variety of studies have explored the relationship between presence and gender. Lombard, Reich, Grabe, Bracken and Ditton (2000) found that when screen sizes were varied, women experienced a greater number of presence-related responses. Skalski and Tamborini (2007) discovered no differences between genders for presence-related variables. Lachlan and Krcmar (2011) found that men experienced more overall presence and sensory immersion than women. Felnhofer, Kothgassner, Beutl, Hlavacs and Kryspin-Exner (2012) discovered a significant gender difference across all three presence subscales used (spatial presence, realness, and sense of being there).

As there is abundant evidence of gender differences on a variety of psychological factors, it is hypothesized that similar differences, as noted above, will emerge when gender is compared to the aforementioned variable of dimensionality.
Display Perception (proximity, clarity, materiality, transmission,)

Display perception refers to the perceived characteristics of the display. Chung and Yang (2012) measured display perception in order to understand specifically what 3D characteristics were perceived. The four relevant factors involved in the perception of the display, especially when viewing a 3DTV, include proximity, clarity, materiality, transmission. Proximity is related to depth perception, as well as the perception of speed. Clarity is related to resolution, vividness, and the perception of color. Materiality is related to the ability to distinguish one object from another by perceiving the edges of those objects. Transmission is related to the ability to understand the messages, theme, and goals of the game.

RQ1. What effect will dimensionality (2D vs. 3D) and gender (male vs. female) have on the game users’ experience of display perception?

Challenge, Skill, and Flow

One of the primary reasons that users play video games is for the challenge of the game (Sherry, et al., 2006). They can increase their skill or achieve the next level, as well as gain a sense of competency after becoming adept at a particular aspect of the game.

Skill and challenge are both relevant for flow, a concept formulated in the 70’s by Mihaly Csikszentmihalyi in an attempt to understand the state of mind achieved when someone engaged in an activity becomes fully immersed in the moment (Csikszentmihalyi, 1990). Flow is a state of enjoyment that involves facing challenges, receiving feedback about the progress one is making, and adjusting behavior based on that feedback. Flow consists of a number of characteristics, including “intense and focused concentration, merging of action and awareness, loss of reflective self-consciousness, a sense that one can control one’s actions, distortion of temporal experience, and experience of the activity as intrinsically rewarding” (Nakamura & Csikszentmihalyi, 2002, p. 90). It is achieved when a balance exists between the skill of the participant and the difficulty of the task. If the participant’s skill is too high in relation to the challenge, he or she will feel boredom. In contrast, if the challenge is too great compared to the participant’s skill, he or she will experience anxiety.

Skill can be a predictor of presence (Skalski, Lange, Tamborini, & Shelton, 2007; Bracken, & Skalski, 2006). Also, the interplay of skill and challenge that leads to flow may be significant to presence (Hartmann, Klimmt, & Vorderer, 2009; Jin, 2011). In fact, Weibel, Wissmath, Habegger, Steiner, and Groner, (2008) suggested that flow is a mediating variable between presence and enjoyment. In an alternative model,
presence (along with cognitive skill) may predict flow (Bowman & Boyan, 2008).

The notion of a “gamer” elicits an image of someone who is familiar with video games and who plays video games regularly. Yet, with the rise in popularity of smartphones, an increasing number of people, both men and women, are becoming “casual gamers”, people who play video games occasionally, but who don’t invest a large amount of time in them. In 2005, casual gaming was a $300 million industry, but today analysts estimate that it has risen to a $3 billion industry (Benedetti, 2010, July 21). Though casual gamers are a far cry from the “hard-core gamer” who plays tens of hours per week, it will be interesting to look at this new, broader spectrum of gamers to discover the influence of prior game use on such concepts as flow.

RQ2. What effect will dimensionality (2D vs. 3D) and gender (male vs. female) have on the game users’ experience of challenge?
RQ3. What effect will dimensionality (2D vs. 3D) and gender (male vs. female) have on the game users’ experience of skill?
RQ4. What effect will dimensionality (2D vs. 3D) and gender (male vs. female) have on the game users’ experience of flow?

Method

Sampling
This study included 10 male and 10 female university students in Seoul. Their mean age is 22.55 years (SD= 3.03) and the average video game playing time per week was 171.32 minutes (SD=187.39). None of the participants had played a 3D game during the previous six months. All subjects were randomly assigned to one of four experimental groups following a 2 X 2 factorial design, with two independent variables: display dimensionality (2D vs. 3D) and gender (male vs. female).

Instruments
The video game used in this experiment was Sonic Generations, a game in which the user controls a cartoonish hedgehog named Sonic in his attempt to defeat the villain, Dr. Eggman, by advancing through a variety of levels as quickly as possible. Sonic has relatively simplistic controls and depicts Sonic moving at great speeds, making the game enjoyable for both beginners and advanced gamers. Sonic Generations can be categorized as an action-adventure game, in that the protagonist moves “through a series of obstacles or challenges to reach some specified goal” (Smith, 2006, p. 52). This genre of game elicits the highest sense of presence (Gackenbach & Brown, 2011). Each level of Sonic Generations can be played in either a 2D or a 3D condition.
The 3DTV used in the experiment was a Samsung UN46C7000, which has an active shutter 3D system with shutter glasses also made by Samsung. The screen size is 46 inches (height: 57.5 cm, width: 102 cm). The distance between the subject and the display was 2.3 m. This conforms with the practical recommendation for 3D image safety performed in Korea (3D Viewing safety association, 2011). The illumination of the room for the experiment was between 280 and 300 lux.

Among next-generation gaming systems, the Playstation 3 (PS3) was chosen for this research. It was released at the end of 2006 and has struggled to catch up to the commercial success of the Xbox 360. Yet its graphical capabilities and processing speed make it ideal for gaming research. The graphics processing of the PS3 is handled by the NVIDIA RSX, which enables HD quality graphics (Thorsen, 2005, May 16). It has a Cell processor that runs at a speed of 3.2 GHz. The PS3 can also play Blu-ray DVDs. In 2009, an update was available for PS3’s to allow for 3D video games and films.

**Procedure**

Each participant completed a pre-test survey to determine game usage and self-efficacy about playing video games, and then he or she entered the experiment room, which had been set up for the participant to play the Sonic Generations game. The researcher briefly explained to the participant how to control the video game character and gave some warnings and advice while the participant was playing the game. Because Sonic Generations doesn't have a tutorial mode, the subject was allowed to adapt to the game on the second stage for 2 minutes. After 2 minutes, the researcher renewed the game from the beginning of the second stage. The participant played the second stage for 8 minutes and then the subject was directed to play the first stage for 5 minutes. After playing the game, the participants were administered a questionnaire about display perception, challenge, skill, and flow.

Before verifying the hypotheses in this study, reliability tests were run for each factor examined. The Cronbach's alphas of all of the factors were above .66. Therefore, all of the factors had suitable reliability. For game self-efficacy and game experience, there is a significant difference between the male and female groups [game self-efficacy: \( F(1,18)=5.81, p<.05 \), game experience: \( F(1,18)=6.87, p<.05 \). 2×2 between-subject factor design analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were conducted, with display dimensionality (2D vs. 3D) and gender (male vs. female) as the independent variables, and display perception, skill, challenge, and flow as the dependent variables. Since over time individuals with experience using one particular interactive environment will develop scripts that are suitable for processing the content and interacting functionally with the environment,
Game self-efficacy and previous game experience can affect challenge, skill and flow (Vorderer, Hartmann, & Klimmt, 2003; Kim & Park, 2010). Thus, game self-efficacy and game experience were used as control variables for skill, challenge, and flow.

<table>
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<th>Variable name</th>
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<td>Game experience</td>
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<td>7</td>
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<tr>
<td>Flow</td>
<td>.82</td>
<td>10</td>
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Results

There was neither interaction effect nor main effect of dimensionality and gender on display perception, so RQ1 was not supported. A significant main effect appeared in challenge with dimensionality [$F(1,14)= 5.23, p<.05, \eta^2= .27$]. So RQ2 was supported. There were not any significant effects for skill. So RQ3 was rejected. An interaction effect appeared marginally significant for flow [$F(1,14)= 4.35, p=.06, \eta^2=.24$], supporting somewhat RQ4.

When controlled for self-efficacy and game experience, males experienced a greater degree of challenge and flow in the 3DTV condition than in the 2DTV condition. Females experienced a greater degree of Challenge in the 3DTV condition than in 2DTV. Conversely, females experienced more flow in the 2DTV condition than in the 3DTV condition.

For challenge, the highest estimated mean score came from the group consisting of males playing on a 3DTV ($M=3.21$, $SE=.21$). However the lowest estimated mean score came from the group of females playing on 2DTV for challenge ($M=2.65$, $SE=.27$). For flow, the highest estimated mean score came from the group consisting of males playing on a 3DTV ($M=3.91$, $SE=.22$). Also the lowest estimated mean score came from female group playing on a 3DTV ($M=3.20$, $SE=.21$).

For overall display perception, there was no significant effect. But since display perception consists of four factors, each of the factors was specifically scrutinized. Two out of four had a significant main effect with gender. They were display perception materiality and transmission. However transmission reliability was lower than standard that it won’t be reported. Gender had a significant main effect on display perception materiality [$F(1,16)= 5.40, p<.05, \eta^2= .25$]. Males (materiality:
M=3.49, SD=.94) experienced a greater degree of materiality than females (materiality: M=2.96, SD=.54).

Discussions

It was surprising that there was no difference in display perception between the 2DTV and 3DTV conditions. Sonic Generations takes place within a 3-dimensional virtual environment in which depth is a major part of the viewing experience. Therefore it makes sense that such an environment would benefit from being able to better perceive the 3-dimensional stereoscopic perspective and thus would better be able to perceive the various display characteristics. It was expected that all four sub-factors would be relevant to dimensionality, while in fact none of them were. Meanwhile, there was a gender difference for display perception materiality. Part of the gameplay involves being able to distinguish the various objects in the game. As such, males were able to perceive a significantly higher degree of materiality than females, meaning that they could distinguish the various objects in the game. Since males play more often and have greater self-efficacy than females (Terlecki, et al., 2010), it makes sense that they would be more familiar with a virtual environment and the objects therein, and able to distinguish details that females may miss.

There was a dimensionality difference for challenge. 3DTV games are somewhat new and unique, and none of participants had played a 3D game during the previous six months. Thus, Playing a 3D game would be more of a new experience and challenge than playing a 2D game for the participants, regardless of gender.

The most interesting thing in this research is the interaction effect between dimensionality and gender with flow. Why do males prefer to play in 3D more than in 2D and why are the results reversed for females? In general, men outperform women on visual-spatial tasks (Weiss, Kemmler, Deisenhammer, Fleischhacker, & Delazer, 2003). Previous research shows that men tend to use overall structure or context information while they are dealing with spatial information, while on the other hand, women tend to rely on sequential processes or depend on landmarks, which is somewhat impoverished information (Lawton, Charleston, & Zieles, 1996; Galea, & Kimura, 1993). Thus, men could have an advantage over women with spatial exploration tasks, which are similar to the type of play found in Sonic Generations. In fact, some research reports that watching something in 3D does not involve a significant difference in presence or involvement between genders (Lee, 2011; Obrist, et al., 2011). There doesn’t seem to be a gender difference in 3D. But actively playing a game requires a greater use of spatial ability than passive watching behavior. In a game, the user has to interact with their game controller, their character, and other aspects of the game. This interaction behavior as an active action might require the
direct exploitation of their spatial ability more than behavior in which they are passively watching. Since 3D adds depth information that is not included in 2D, a 3D game player would be required to use more skillful spatial ability. Thus females who played on a 3DTV would feel more unfamiliarity, difficulty, and would perceive it as more unenjoyable than males who played on a 3DTV, or even females on a 2DTV. Also, prior experience with the game genre used and the higher affinity of males for 3D animations and spatially complex environments could influence the difference between males and females (Schild, LaViola, & Masuch, 2012).

In general, people feel more presence with a 3D stereoscopic effect than with regular 2D (Chung & Yang, 2012; IJsselsteijn, de Ridder, Hamberg, Bouwhuis, & Freeman, 1998; de Boer, Verleur, Heuvelman, & Heynderickx, 2010), so males who play video games on a 3DTV might have an even better game experience, considering their superior spatial ability. This result is consistent with previous research about 3D games (Schild, LaViola, & Masuch, 2012).

Based on the results of this experiment, there is clearly a significant gap between male and female gamers. Males tend to begin gaming at a younger age and play more often than their female counterparts (Terlecki, et al., 2010; Bryant & Davies, 2006). This may be a factor in the fact that video gaming self-efficacy of men is often superior to that of women (Hartmann & Klimmt, 2006). There is also a preponderance of male gamers, though female gamers are increasing and are a significant part of the gaming community. A 2012 study by the Entertainment Software Association indicated that the gaming population consists of 47% females, up from 40% in 2010 (ESA, 2012). In time, the differences between male and female gaming experiences and performance may continue to diminish and even disappear as female gamers catch up to their male counterparts.
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