THE OCULUS RIFT AS A PORTAL FOR PRESENCE: THE EFFECTS OF TECHNOLOGY ADVANCEMENT AND SEX DIFFERENCES IN THE HORROR VIDEO GAME GENRE

By

Thomas William Murphy Day

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ABSTRACT

THE OCULUS RIFT AS A PORTAL FOR PRESENCE: THE EFFECTS OF TECHNOLOGY ADVANCEMENT AND SEX DIFFERENCES IN THE HORROR VIDEO GAME GENRE

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Virtual reality (VR) and presence research has historically been conducted using large laboratory equipment. With the affordance of new technology, like the Oculus Rift, we can begin to delve into the world of consumer based VR interactions. The majority of consumers purchasing the Oculus Rift are interested in playing video games and one popular genre is horror. In addition, both males and females enjoy video games and VR yet there are still unanswered questions regarding sex differences and presence with these technologies. This study examined the impact of technological advancement (VR headset: Oculus Rift vs. traditional compute monitor), sex differences (males vs. females), and their interaction on spatial presence and fright reaction (self-reported measure as well as observable fear behaviors) while playing the horror game, Alien: Isolation. It was found that males and females did not differ statistically on spatial presence, self-reporting of fear, and observable fear responses. Technological advancement increased feelings of spatial presence. In addition, spatial presence was found to mediate the relationship between technology advancement and fear response (self-reported and observable fear behaviors).

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

We live in an exciting time for Virtual Reality (VR) enthusiasts, researchers, game developers, and now more than ever, the everyday consumer. Budding VR hardware, such as the Oculus Rift, is bringing the once laboratory or large scale arcade experience home. While the barrier of entry is still pretty high, in a few years using head mounted VR displays will be as easy as hooking up a second monitor to a computer. VR is not new; some of the first publications date back more than two decades (Nugent, 1991). Recent VR research has dealt with a multitude of issues including pain management (Hoffman et al., 2014; Mosso-Vazquez, Gao, Wiederhold, & Wiederhold, 2014), exercise (Fox & Bailenson, 2009; Guixeres et al., 2013), social anxiety (Lucacel, Cristea, & David, 2010), self-regulation in high-risk settings (Kniffin et al., 2014), and more. Before the advent of consumer VR devices, there has not been a big push to study the interaction of VR and video game play. While there are studies that focus on playing a game in VR (e.g., McMahan, Bowman, Zielinski, & Brady, 2012), the game being played is specifically designed for the experiment and the VR devices are more advanced than anything the average consumer could purchase. The present research will begin to bridge the gap between laboratory VR experiences and commercially available VR.

Presence has long been a focus of media research, with an abundance of studies focusing on a wide range of topics, including but not limited to television (Bracken, 2005; M. Lombard, Reich, Grabe, Bracken, & Ditton, 2000), virtual environments (Persky & Blascovich, 2008; Tamborini & Skalski, 2006), and the effect of natural controller mapping (McGloin, Farrar, & Krcmar, 2011; Skalski, Tamborini, Shelton, Buncher, & Lindmark, 2011). There is a lack of research on presence with regards to new emerging VR hardware, such as the Oculus Rift. It is important to take into account the promise of consumer oriented VR devices, because these types

of products open the door to a much wider audience than ever before, which in turn, creates new VR applications. How VR hardware affects presence is valuable data to have, even when designing non-game experiences, such as virtual conferences or teaching in a virtual classroom. Moreover, can presence mediate the effect of this new technology on self-reported and behavioral responses? There is also a distinct lack of research in horror, suspense, or fear-inducing video game genres. The same problem arises when looking at males and females with VR video games, even though sex differences have been found to be an important factor for fright reactions to media. Interestingly, past studies have shown inconsistent findings when reporting the interaction of sex differences and presence. Does sex affect the interaction of use with personal VR devices? The objective of the current study is to examine the impact of technological advancement and sex differences on presence and fright reaction in horror video games.

LITERATURE REVIEW

Presence

Defining presence can be complicated because the body of research is interdisciplinary, leading to a multifaceted and sometimes contradicting definition (Biocca, 1997; Heeter, 1992; Lee, 2004). Heeter (1992) worked on developing the first three constructs of presence—personal, social, and environmental, which laid the groundwork for the theories of the future. Lombard and Ditton (1997) worked on an all-encompassing idea of presence defined as, "the perceptual illusion of nonmediation" (Presence Explicated section, para. 1). In this case perceptual means the action is happening in real time and involves human processing systems in relation to objects in their environment. Illusion of nonmediation is explained by a person failing to perceive the existence of a medium in their communication environment and responded as if that medium were not there. The issue with this definition, as pointed out by Lee (2004), is that "[illusion] connote[s] a normative judgment that the feeling of presence is somewhat undesirable" (p. 32). In addition, Lee says discriminating between mediated and nonmediated perception can create unnecessary confusion. Lee (2004) defines presence as "a psychological state in which virtual (para-authentic or artificial) objects are experienced as actual objects in either sensory or nonsensory ways" (p. 37). Lee (2004) goes on to define three categories of presence, those being physical, social, and self-presence. Tamborini and Skalski (2006) recognized a pattern within the research and characterized presence in relation to electronic games as spatial presence, social presence, and self-presence. This conceptualization is generally accepted as the three constructs of presence. However, there is still some debate over the definition of spatial presence because spatial presence can be used interchangeably with physical presence. Jin (2011) explains "One main difference between physical presence and spatial presence is that the former is the sense of

interacting with, touching, or controlling virtual objects as if they have actual, physical properties, while the latter is the sense of being physically located in a virtual environment" (p. 117). Jin (2011) continues by using an example from the online game Second Life (Linden Research, Inc, 2003) where players may feel spatially present because they are moving freely around a virtual environment but they might not feel like they are physically touching real objects. This division of spatial presence has the potential to become nebulous with research relating to presence in virtual environments that utilize a VR device, like the Oculus Rift, because the virtual world becomes the only world one can see and interact with. In addition, there is not a widely accepted measure to accurately differentiate between spatial presence and physical presence. For this current study we are more concerned about the player's overall sense of spatial presence and will not be discriminating between spatial and physical presence.

Technology Advancement. Previous studies have shown that a player's sense of spatial presence is increased with technological advancements such as improved graphics or realistic visuals (Ivory & Kalyanaraman, 2007; Krcmar, Farrar, & McGloin, 2011; McGloin et al., 2011), realistic game controllers (Kim & Sundar, 2013; McGloin et al., 2011; Schmierbach, Limperos, & Woolley, 2012; Skalski et al., 2011), and a larger screen size (Hou, Nam, Peng, & Lee, 2012; Kim & Sundar, 2013). Krcmar et al. (2011) found that participants who played Doom 3 (id Software, 2004) had a significantly higher sense of presence than participants who played Doom (id Software, 1993) because of the graphical enhancements.

Realistic game controllers or natural mapping is the concept of using an input device to control a virtual event in a game that is similar to the device one would use in the real world; for example, racing with a controller versus racing with a steering wheel. One study found that the participants with the steering wheel experienced a higher sense of presence (Schmierbach et al.,

2012). Part of what makes the Oculus Rift such an exciting piece of hardware to study is that it affords the user the ability to naturally look around a virtual environment. Because the Oculus Rift is worn over the head, completely covering the user's eyes, when the user physically turns their head left, the movement is tracked in the game world and the virtual character turns their head left simultaneously. While using this technology the individual does not have to rely on a joystick to look around and can instead explore the virtual space as they would in the real world. To create the sense that the user's physical head movement represents the virtual character, the game being used in this study has a first person view, which means the graphical perspective is rendered from the viewpoint of the player character. Removing the barrier of a joystick and allowing the participant to naturally look around the virtual environment, coupled with cutting edge graphics, should increase their sense of spatial presence.

Hou et al. (2012) found increasing screen size significantly increased feelings of presence. Evaluating screen size with a head-mounted display, such as the Oculus Rift, is complicated because the screens are so close to the user's eyes. However, the concept of field-of-view (FOV) may play a part. FOV is the extent of what is currently visible at a moment in time. One study found that increasing the FOV lead to a higher sense of presence (Lin, Duh, Parker, Abi-Rached, & Furness, 2002). The Oculus Rift blocks out all external stimuli and focuses the user's FOV to one hundred degrees. An argument can be made that removing peripheral distractions associated with traditional monitors will increase feelings of presence because of the FOV and a sense of a large screen size. Based on the above evidence and rationale we propose the following hypothesis:

H1: The technologically advanced medium (Oculus Rift) will increase the feeling of spatial presence compared to a traditional medium (computer monitor).

Sex Difference. Research findings on sex differences and presence are inconsistent. Several studies report that men experience higher levels of presence (Felnhofer et al., 2014; Felnhofer el al., 2012; Lachlan & Krcmar, 2011). Research by Felnhofer et al. (2014) explored collaborative virtual environments and found that men, regardless of age, experienced more spatial presence. Likewise, research by Felnhofers et al. (2012) had participants giving a speech either in front of a virtual audience or an imagined audience and found men reporting a higher sense of presence. Lachlan and Krcmar (2011) had participants playing an old video game, Max Payne (Remedy Entertainment, 2001), and stated that part of the reason men might have felt stronger levels of presence was because of previous experience with the medium. Other studies report that women experience higher levels of presence (Botta & Bracken, 2004; Bracken, 2005; Lombard et al., 2000). Lombard et al. (2000) found that when women reported a higher feeling of presence it was partially attributed to men being more familiar with watching television on a larger screen. These results are contradictory to Lachlan and Krcmar (2011), which may be because playing a video game is more interactive than simply watching a show. Another study focusing on playing various interactive video games for the Nintendo Wii (Nintendo, 2006) reported no difference in presence for males and females (Jin, 2011). The Oculus Rift is new hardware so this study may be the participant's first interaction with the device, possibly ruling out a previous experience bias. The present study revolves around using a VR headset to create an interactive video game experience and will continue to explore the question of sex differences. Thus the following research question is proposed:

RQ1a: Will there be a sex difference in reported spatial presence?

RQ1b: Will there be an interaction effect of sex difference and technology advancement on reported spatial presence?

Fright Reaction

Fright reaction has been extensively studied over the years – all the way back to a study by Blumer (1933). Many of the studies on fright reaction to media revolve around children and the various effects of viewing content (Cantor, 1998; Paavonen, Pennonen, Roine, Valkonen, & Lahikainen, 2006; Singer, Slovak, Frierson, & York, 1998; Wilson, Hoffner, & Cantor, 1987). There are three categories that frequently occur to produce a fear reaction: danger and injuries such as natural disasters, attacks, industrial and nuclear accidents; distortion of natural forms such as mutations, monsters, distortions; and the experience of endangerment and fear by others such as characters' expressions of fear, threat of harm to human or animal protagonists (Cantor, 2002). Cantor (2002) goes on to explain that the categories are not mutually exclusive and more than one category can come together to create a frightening experience. Cantor (2002) also defines three factors that impact a viewers' fear response. The factors are "(a) the degree of similarity of the depicted stimuli to real-life fear-evokers [real looking events are scarier than animated ones], (b) viewers' motivations for media exposure [entertainment, information seeking, etc.], and (c) factors affecting emotionality [such as music and suspense]" (p. 292). Data for fright reaction research is commonly collected by self-reports.

Technology Advancement. As pointed out previously, fright reaction during traditional media consumption is well studied. However, studying fear responses during gameplay of a horror or scary game using a VR headset is an undocumented area of study. The horror genre in video games is popular, especially in the realm of VR because VR has the potential to increase presence, and the more present one becomes in the game world the more likely one may be impacted by the fearful stimuli. Evidence of fright reactions has been documented in previous VR research. One study used VR to measure fear reactions in spider-phobic patients (Peperkorn,

Alpers, & Mühlberger, 2014). Peperkorn et al. (2014) reported participants had large fear responses even for the condition where they knew the spider was artificial and there was no living spider near them. A study by Krijn et al. (2004) postulated two interesting findings. First, virtual reality was found to be as effective as exposure in vivo, and second, more advanced virtual reality equipment lead to a higher sense of presence. Another study found that using moving videos as opposed to still images elicited a much higher fear response (Courtney, Dawson, Schell, Iyer, & Parsons, 2010). Following this logic, playing a horror video game in VR is likely to be more frightening than playing the same game on a computer monitor, because the VR experience is similar to previous in vivo studies, where the virtual stimuli was as effective as the real stimuli. Thus playing a horror game in VR should create a higher fear response because the virtual environment will appear more real with VR than a computer monitor. Currently the Oculus Rift is the most advanced commercially available VR product on the market and because previous research has revealed that VR will stimulate an individual's fear response, the following hypothesis is proposed:

H2: Technology advancement (Oculus Rift) will result in greater fright reaction, measured by a) greater self-reported measure of fear, and b) greater observable fear behaviors than a traditional medium (computer monitor) while playing a horror game.

Based on previous evidence, this study proposes the argument that media technology, in this case VR, leads to increased feelings of spatial presence because VR has demonstrated that even when the participants knew the frightening stimuli was not real, the fear response was real. So the question remains, what exactly is the role of spatial presence in this equation between VR and fear response? The realness of the virtual environment is key in determining presence according to prior research. A study by Kothgassner et al. (2012) found that participants who

gave a presentation in front of a virtual audience, as opposed to imagining an audience, reported an increased sense of realism, as well as, heightened anxiety, stress, and arousal. In addition, an increased sense of presence positively influenced the perceived realness of the environment. Two other research papers had similar results by having participants give a speech in front of an empty room and a room with virtual people (Pertaub, 2001; Slater, 2006). An individual's sense of presence and behavioral reaction's to a virtual environment is linked to how accurately the virtual environment embodies a real world environment. Thus, it is reasonable to assume that a player's level of fear and spatial presence when playing a horror game with VR will be intensified. We argue that the Oculus Rift will increase spatial presence which will in turn result in increased fright reaction when compared to a traditional monitor. In other words, spatial presence will mediate the relationship between technology advancement and fright reaction. The following hypotheses are proposed:

H3: Spatial presence will mediate the relationship between technology advancement and fright reaction; a) self-reported measure of fear, and b) observable fear behaviors

Sex Difference. Research on sex differences and fear response data while playing video games is limited. Thus, this section will be expanded to include research on self-reported fear arousal. Peck (1999) conducted a meta-analysis of media-induced fear conducted from 1987 to 1996 and found a moderate sex difference when participants were self-reporting fear. Two studies by Grossman and Wood (1993) concluded that women self-report feelings of greater intensity and men self-report feelings of lesser intensity. Given the variation between self-reported fright reaction the research questions are proposed:

RQ2a: Will there be a sex difference in self-reported fright reaction?

RQ2b: Will there be an interaction effect of sex difference and technology advancement on self-reported fright reaction?

METHODS

Participants

College students from a large Midwest university in the United States were asked to participant in the study. A total of 71 participants, 44 males and 27 females were recruited from an online subject pool for their participation. The participants' racial breakdown was as follows: three Black or African American, eight Asian, 55 White, one Hispanic, and four with two or more races. The average age of the participants was 21.

Study Design

This study employed a 2 (technology advancement: Oculus Rift versus traditional monitor) x 2 (sex: male versus female) between-subject design. The participants were randomly assigned to either play the game with VR (Oculus Rift) or with a traditional computer monitor. The first dependent variable was presence, which is operationalized as a questionnaire taken after gameplay. The second dependent variable was fright reaction, which is operationalized as self-reported measure of fear, and observable verbal and physical behavioral reactions.

Stimuli

The VR hardware used in this experiment was the commercially available Oculus Rift Development Kit 2. The Oculus Rift was worn over the head and completely covers the user's eyes. The user was afforded a high-definition experience (960 x 1080 resolution per eye) with a 100 degree field of view. Positional tracking maps all of the user's real world head movements into the virtual world. The Oculus Rift also offers a low persistence OLED display to help eliminate motion blur and image judder. All participants played the game using a wireless Xbox 360 controller. The monitor used in the traditional monitor condition is a 1080p, 32in *Vizio*.

Audio was delivered via over-the-ear padded headphones, *TekNmotion, Yapster TM-YB100A*, in both conditions.

Alien: Isolation (The Creative Assembly, 2014) was the video game played in this study. The game is a traditional game, meaning that it is most often played with a keyboard and mouse or a controller and displayed on a monitor or television; because of this the condition without the virtual reality headset will still be an enjoyable and natural experience. Alien: Isolation is universally considered to be a frightening game to play due to its soundtrack, tense atmosphere, and jump scares.

Procedure

Before coming into the lab, the participants completed a screening survey. The survey had questions to make sure participants were comfortable playing a horror game as well as trying out VR with the Oculus Rift. In the survey they were made aware that people sometimes experience mild nausea or dizziness after using the Oculus Rift. Participants that were prone to epileptic seizures were not allowed to participate. They were also informed that if while playing the game they become too scared or uncomfortable to continue they were able to stop at any time.

In order to ensure the standardization of the experiment procedure, a script for the entire process of the experiment was documented. Before coming into the lab participants were randomly placed into one of two conditions – playing Alien: Isolation with the Oculus Rift or playing Alien: Isolation with a traditional monitor. Upon arrival to the lab, participants read and signed a consent form. They were then given a basic outline of what to expect from the study. The researcher then asked if the participant had any questions and answered them if necessary. Once the participant was ready to begin, the researcher explained that the first way they would

play the game was to simply watch the researcher as they played through the beginning of the level. During this time the researcher explained what the buttons on the controller did as well as talked about basic mechanics of gameplay. This first part of gameplay was used as a tutorial so that participants in both conditions were given the same opportunity to ask questions before playing on their own. The controller button layout was quite similar to many other first person games, and was intuitive for the majority of participants, even if they had not played many video games. During gameplay if participants ever lost their finger placement or needed help remembering the action of a button, the researcher was in the room to assist. Regardless of condition, all participants played the downloadable level, Lone Survivor.

Immediately after playing, the researcher assisted the participants in removing the Oculus Rift and headphones. Participants were then asked to fill out an online questionnaire, which included questions about spatial presence and self-reported measures of fright reaction. An open ended question was also included to inquire about the experience of using the Oculus Rift. After the conclusion of the experiment participants that were randomly assigned to the condition without the Oculus Rift were given the opportunity to test out the hardware with no bearings on the statistical findings.

Measures

To measure presence, the spatial presence and negative effects subscale questions of the Independent Television Commission - Sense of Presence Inventory (ITC-SOPI) (Lessiter, Freeman, Keogh, & Davidoff, 2001) was used (see Appendix A). The questionnaire was developed as a cross-media measure of presence. A total of 25 questions were included, such as "I felt I could interact with the displayed environment" and "I felt disorientated." A five point scale was used to assess the measures. An exploratory factor analysis was done and four items

were removed, ("I could almost smell different features of the displayed environment", "I sensed that the temperature changed to match the scenes in the displayed environment", "I felt that all my senses were stimulated at the same time," 'I felt able to change the course of events in the displayed environment"). Cronbach's Alpha of the remaining items in the spatial presence portion was, $\alpha = .949$. Self-reported measures of fear were also recorded with the self-reported measure of emotion from the Peck (1999) study (see Appendix B). The questions ask the participant to indicate how much of a certain feeling they had while playing the game on a five point scale. The eight emotions in question were fright, fear, afraid, nervous, worried, anxious, distressed, and disturbed. This measure had an alpha of, $\alpha = .895$. In addition, three other scales were included as possible covariates to the above scales and were measured before game play. The Brief Sensation Seeking Scale ($\alpha = .779$) was considered as a possible covariate to the self-reported measure of emotion scale (Hoyle et al., 2002) (see Appendix C). Both the Immersive Tendencies Questions (ITQ), (Witmer & Singer, 1998), and the Game Skill and Frequency scale (GSF) (Bracken and Skalaski, 2006), were considered as possible covariates. An exploratory factor analysis was performed on the ITQ with disappointing results because none of the constructs loaded properly. However, the GSF come out strong with all items loaded to one factor with a Cronbach's alpha of .913 (see Appendix D).

In addition to self-reported measures of fear, observable behavioral data was also recorded. A detailed codebook was developed that the researcher would follow during gameplay. There were six behaviors that the researcher catalogued. The first two, spontaneous fear and controlled fear, dealt with verbal cues from the participants. Spontaneous fear was noted every time a participant had an abrupt outburst (e.g., yelling, swearing, etc.), whereas controlled fear was noted whenever the participant made a fearful but coherent comment about the game (e.g.,

describing the environment/ atmosphere, talking about a scary event that happened after the fact, etc.). The other four behaviors came from direct physical movement of the participant. These consisted of abrupt arm movements, a whole body jerk, pulling the head back or away, and kicking the legs upward. The behaviors being recorded are an involuntary reaction to something scary happening in the game. These reactions fall under an area of research called the Startle Effect (Baird, 2000).

DATA ANALYSIS

To examine the effect of sex and technology advancement on spatial presence, a two-way analysis of covariance (ANCOVA) was conducted, controlling for game skill and frequency (GSF). GSF, was significantly related to spatial presence, $F(1,65) = 5.62$, $p < .05$. The main effect of sex was not statistically significant, $F(1, 65) = 3.060$, $p > .05$, indicating that males ($M = 3.67$, $SD = .827$) and females ($M = 3.70$, $SD = .805$) did not differ for spatial presence. The interaction effect was also not significant, $F(1, 65) = .040$, $p > .05$. However, the main effect of technology advancement was significant, $F(1, 65) = 66.47$, $p < .001$, $\eta 2 = .506$. Oculus Rift ($M = 4.24$, $SD = .424$) had greater feelings of spatial presence than a traditional monitor ($M = 3.04$, $SD = .665$). This supports H1 and answers RQ1a, & RQ1b.

The self-reported measure of fear measure from the Peck (1999) study was analyzed next. A two-way between-subjects ANCOVA was calculated. The covariate, sensation seeking, was not significantly related to fear response, $F(1,66) = .080$, $p > .05$. Therefore, the covariate was dropped and a two-way analysis of variance (ANOVA) was used to analyze the data. The main effect of sex was not statistically significant, $F(1, 67) = 2.36$, $p > .05$. Males ($M = 3.18$, $SD = .839$), and females ($M = 3.44$, $SD = .708$) did not differ statistically in self-reported fear response. The interaction effect between condition and sex was not significant, $F(1, 67) = .215$, $p > .05$. The main effect of technology advancement was significant, $F(1, 67) = 8.46$, $p < .01$, $\eta 2 = .112$. Oculus Rift ($M = 3.54$, $SD = .839$) induced greater level of self-reported fear than traditional monitor ($M = 2.99$, $SD = .639$). These results support H2c and answers RQ2a and RQ2b.

The observable behavioral fear data analyzation started with an ANCOVA to examine the effects of technology advancement and sex on behavioral responses based off of the verbal and

physical reactions of the participants, while using the SSQ as a covariate. The covariate, SSQ, was not significantly related to any of the behavioral fear responses, thus ANOVA was used. In addition, the data was not normally distributed, thus a log10 transformation was performed to satisfy the assumption of the statistical analysis. Due to the extremely low instance of the "leg kick" variable the log10 transformation eliminated the usefulness of the statistic and was removed from analysis. The means and standard deviations of the original data are still reported below along with the relevant ANOVA statistics (Table 1).

Table 1:

Observable Behavioral Fear ANOVA

Fear type	Technological Advancement		Sex		Technology Advancement			Sex			Technology Advancement X Sex		
	Oculus Rift	Traditional Monitor	Male	Female	*F*	*p*	η2	*F*	*p*	η2	*F*	*p*	η2
Spontaneous	6.39 (5.50)	2.55 (3.16)	4.14 (4.41)	5.37 (5.68)	16.46	.000	.244	2.38	.129	.045	1.21	.278	.023
Controlled	2.00 (2.30)	.36 (.74)	1.25 (1.93)	1.22 (1.97)	6.63	.016	.191	.098	.756	.004	.568	.457	.020
Arm Jerk	1.53 (1.64)	.67 (1.08)	1.07 (1.57)	1.22 (1.25)	1.42	.243	.042	.226	.638	.007	1.22	.278	.037
Body Jerk	2.24 (1.94)	.970 (1.38)	1.66 (2.03)	1.63 (1.42)	1.28	.264	.030	.009	.927	.000	.363	.550	.009
Head Pull	1.16 (1.53)	.303 (.810)	.841 (1.38)	.630 (1.21)	.997	.329	.043	.156	.697	.007	.446	.511	.020

The main effect of technology advancement for spontaneous fear instances was significant, $F(1, 67) = 16.46$, $p < .01$, $\eta 2 = .244$. Oculus Rift ($M = 6.39$, $SD = 5.50$) resulted in a greater number of spontaneous fear instances than a traditional monitor ($M = 2.55$, $SD = 3.16$). The main effect

of technology advancement for controlled fear instances was significant, $F(1, 67) = 6.63$, $p < .05$, $\eta 2 = .191$. Oculus Rift ($M = 2.00$, $SD = 2.30$) resulted in a greater number of controlled fear instances than a traditional monitor ($M = .36$, $SD = .74$). The other three observable fear behaviors were not significant. These results partially support H2b. Table 2 displays the correlation between self-reported fear and the observable behavioral fear responses.

Table 2:

Correlation between self-reported fear and observable behavioral fear

	M (SD)	Self-Reported Fear	Spontaneous	Controlled	Arm Jerk	Body Jerk	Head Pull
Self-Reported Fear	3.31 (.82)		.43**	.28*	.31**	.31**	.18
Spontaneous	4.61 (4.91)			.32**	.35**	.40**	.42**
Controlled	1.24 (1.93)				.11	.18	.21
Arm Jerk	1.13 (1.46)					.81**	.29*
Body Jerk	1.65 (1.81)						.49**
Head Pull	.76 (1.31)						

** $p < .01$
* $p < .05$

To test the hypothesis that spatial presence mediates the relationship between technology advancement and fright reaction, three regression analyses were conducted. The first regression was to determine a significant relationship between the predictor (technology advancement) and the outcome (self-reported fear response), path c. The second regression was necessary to find a significant relationship between the predictor (technology advancement) and potential mediator (spatial presence), path a. In the third regression equation the outcome variable was regressed on

the predictor (path c') and mediator (path b). Mediation was established because the effect of the predictor on the outcome (c) controlling for the potential mediator (b) is equal to zero. Table 3 shows the results, indicating that spatial presence mediated the relationship between technology advancement and self-reported fear. H3a was supported.

Table 3:

Testing Fright Reaction (Self-Reported Fear) with Spatial Presence as the Mediator

		B	*SEB*	*Beta*
Path c Fear response	Predictor: technology advancement	0.55	0.18	0.35**
Path a Spatial presence	Predictor: technology advancement	1.20	0.13	0.74**
Path b and c' Fear response	Mediator: spatial presence Predictor: technology advancement	0.36 0.12	0.16 0.26	0.37** 0.07

**$p < 0.01$

The same procedure was used to test the hypothesis that spatial presence mediates the relationship between technology advancement and the significant observable behavior fear responses. The mediation analysis was only conducted for two of the five observable behavior fear response, i.e., spontaneous and controlled fear responses because main effects of technology advancement was found for these two. Table 4 shows the results, indicating that spatial presence mediated the relationship between technology advancement and observed spontaneous behavioral fear.

Table 4:

Testing Fright Reaction (Spontaneous Fear) with Spatial Presence as the Mediator

		B	*SEB*	*Beta*
Path c Fear response	Predictor: technology advancement	0.36	0.08	0.53**
Path a Spatial presence	Predictor: technology advancement	1.20	0.13	0.74**
Path b and c' Fear response	Mediator: spatial presence Predictor: technology advancement	0.08 0.28	0.08 0.12	0.16** 0.41

**$p < 0.01$

Table 5 shows the results, indicating that spatial presence mediated the relationship between technology advancement and observed controlled behavioral fear. H3b was supported for controlled and spontaneous observable behavioral fear responses.

Table 5:

Testing Fright Reaction (Controlled Fear) with Spatial Presence as the Mediator

		B	*SEB*	*Beta*
Path c Fear response	Predictor: technology advancement	0.28	0.12	0.43*
Path a Spatial presence	Predictor: technology advancement	1.20	0.13	0.74**
Path b and c' Fear response	Mediator: spatial presence Predictor: technology advancement	0.05 0.22	0.13 0.17	0.11* 0.34

**$p < 0.01$
*$p < 0.05$

DISCUSSION AND CONCLUSION

The present research, which examined consumer VR, with the Oculus Rift, and presence and the effects of technology advancement and sex differences on fear response within the horror video game genre, is the first study to combine these constructs to report empirical data.

Firstly, the technologically advanced personal VR device, Oculus Rift, heightened the user's sense of spatial presence when compared to a traditional computer monitor. Players experienced more spatial presence within the horror game while using the VR headset. This finding falls right in line with other presence research delving into the effects of technological advancements and presence (Hou, Nam, Peng, & Lee, 2012; Ivory & Kalyanaraman, 2007; Kim & Sundar, 2013; Krcmar, Farrar, & McGloin, 2011; McGloin et al., 2011; Schmierbach, Limperos, & Woolley, 2012; Skalski et al., 2011). The results reinforce the idea that technology plays a role in bolstering a player's sense of spatial presence, which is important to keep in mind when designing future studies. If affording a player with a strong sense of spatial presence is a desired outcome then utilizing a device like the Oculus Rift might be beneficial. The everyday consumer purchasing an Oculus Rift can look forward to an engrossing experience.

Secondly, the results also indicated that sex is not a statistically significant predictor of spatial presence and that there is no interaction effect of sex and technology advancement on reported spatial presence. This finding throws a bit of a curve ball at past research which had contradictory findings of either men or women feeling more present (Felnhofer et al., 2014; Felnhofer el al., 2012; Lachlan & Krcmar, 2011; Botta & Bracken, 2004; Bracken, 2005; Lombard et al., 2000). This is important because if both men and women have similar spatial presence responses researchers may not have to design around sex differences, allowing the focus of their studies to hone in on other, unexplored areas. This same logic applies to designing

virtual experiences; developers and user experience experts can focus on sustaining that feeling of presence instead of worrying about sex differences. It should be noted that game skill and frequency of playing games was a statistically significant covariate when used in an ANCOVA with technology advancement and sex on spatial presence. However, this makes sense because perhaps the participant, either male or female, enjoyed playing the video game so they naturally allowed themselves to get wrapped up in the virtual world; or, perhaps they are familiar with first person perspective games so that frees up conscious resources that an unfamiliar participant might have to reserve for remembering button placement, navigation, etc. Researchers need to be aware of possible covariates in the future and plan accordingly.

Thirdly, the more technologically advanced Oculus Rift had a statistically significant impact on self-reported fear and observable behavioral fear compared to a traditional computer monitor. This area of research is still in its infancy and to our knowledge this is the first study to have empirical evidence supporting that consumer VR can elicit a stronger fear response than a traditional monitor. Based on previous literature (Courtney, Dawson, Iyer, & Parsons, 2010; Krijin et al., 2004; Peperkorn et al., 2014) it is logical that VR would elicit a higher fear response but this piece of information is valuable when considering the relationship between fear response, technology advancement, and presence, which the following paragraph will discuss in detail. The data also indicates that there is no sex difference in self-reported fear and observable behavioral fear, which differs from past research that found women tend to report higher feelings of fear and men report lower feelings of fear (Grossman and Wood, 1993; Peck, 1999). Furthermore, there was no interaction effect between sex and technology advancement on fear response. The lack of sex differences may be attributed to the unfamiliarity with the new hardware, Oculus Rift. For all of the participants, exploring a fearful environment in VR was a

brand new experience, thus neither sex had any previous knowledge to draw upon or expectations to fulfill, and possibly because of this no sex difference was found. This may also explain why the original covariate, sensation seeking, was not statistically significant. As VR headsets become more prevalent these findings may vary. For the time being, game designers looking to create a frightening VR game should not have to worry about sex differences and instead focus on improving the players' sense of presence.

Lastly, the most exciting facet of our findings is that spatial presence mediated the effect of technology advancement on fear response for both self-reported and observed behavioral fear responses. Jin (2011) found a similar conclusion with physical presence mediating the influence of challenge on flow. This reinforces that media technology, VR, augments fear only to the extent that it creates spatial presence. The finding provides evidence regarding the underlying mechanism of how technology advancement influences user experience. In our case, the impact of technology advancement on fear response is through how spatially present one feels. The implications of this emphasize the importance of technology advancement on creating a virtual environment that affords the user the opportunity to become spatially present in that virtual world when designing an experience around eliciting emotional player response

The current study has several limitations. First, recruiting female participants was difficult and having a larger participant pool might have implications for the sex differences. Second, the overall sample size for this study was small and only included participants currently enrolled in a major Midwest university which may impact generalizability. Third, the female participants that did participate might not be an accurate representation of all females even within the confines of this population because the participants volunteered, meaning they either have an active interest in VR or were only looking for extra credit; this limitation extends to the

male participants as well. While, this may not be an issue when designing virtual experiences for people who actively play video games in their leisure time, it could impact virtual worlds designed for a one-fits-all setting, such as a virtual social community. Fourth, since the observable behavioral reactions were recorded by one researcher, there is a chance that some movements or verbal cues were missed. Finally, all of the findings are within the umbrella of playing a horror video game. The results could be entirely different for another genre of video game or other VR applications entirely. Future research should examine feelings of spatial presence while playing other genres of video games and using VR for different applications such as the association of spatial presence and attentiveness in a virtual classroom.

APPENDICES

Appendix A:

Spatial Presence Questionnaire

Independent Television Commission - Sense of Presence Inventory (ITC-SOPI) (Lessiter, Freeman, Keogh, & Davidoff, 2001). All questions within the ITC-SOPI are based off of a 5-point scale. All of the questions related to spatial presence and negative effects are reported below.

Please indicate HOW MUCH YOU AGREE OR DISAGRE with each of the following statements below.

(Strongly disagree) 1; (Disagree) 2; (Neither agree nor disagree) 3; (Agree) 4; (Strongly agree) 5

Spatial Presence

1. I felt I could interact with the displayed environment
2. I felt that the characters and/or objects could almost touch me
3. I felt I was visiting the places in the displayed environment
4. I felt I wasn't *just* watching [edit: playing] something
5. I had the sensation that I moved in response to parts of the displayed environment
6. I had a sense of being in the scenes displayed
7. I felt that I could move objects (in the displayed environment)
8. I could almost smell different features of the displayed environment
9. I had the sensation that the characters were aware of me
10. I had a strong sense of sounds coming from different directions within the displayed environment

11. I felt surrounded by the displayed environment
12. I felt I could have reached out and touched things (in the displayed environment)
13. I sensed that the temperature changed to match the scenes in the displayed environment
14. I felt that *all* my senses were stimulated at the same time
15. I felt able to change the course of events in the displayed environment
16. I felt as though I was in the same space as the characters and/or objects
17. I had the sensation that parts of the displayed environment (e.g. characters or objects)were responding to me
18. It felt realistic to move things in the displayed environment
19. I felt as though I was participating in the displayed environment

Negative Effects

1. I felt disorientated
2. I felt tired
3. I felt dizzy
4. I felt I had eyestrain
5. I felt nauseous
6. I felt I had a headache

Appendix B:

Fright Reaction Self-Reported Survey

Peck, E. Y. (1999). *Gender differences in film-induced fear as a function of type of emotion measure and stimulus content: A meta-analysis and a laboratory study*. (Unpublished doctoral dissertation). University of Wisconsin-Madison, Madison. All questions within this survey are based off of a 5-point scale.

How did you feel while playing the video game?

(None of this feeling) 0; 1; 2; 3; (A great deal of this feeling) 4

1. To what extent did you feel FRIGHT while playing the video game?
2. To what extent did you feel FEAR while playing the video game?
3. To what extent did you NERVOUS playing the video game?
4. To what extent did you feel ANXIOUS while playing the video game?
5. To what extent did you feel WORRIED while playing the video game?
6. To what extent did you feel DISTRESSED while playing the video game?
7. To what extent did you feel DISTRUBED while playing the video game?
8. To what extent did you feel AFRAID while playing the video game?

Appendix C:

Brief Sensation Seeking Questionnaire

Hoyle, R. H., Stephenson, M. T., Palmgreen, P., Lorch, E. P., & Donohew, R. L. (2002). Reliability and validity of a brief measure of sensation seeking. *Personality and Individual Differences*, *32*(3), 401-414.

1. I would like to explore strange places
2. I would like to take off on a trip with no pre-planned routes or timetables
3. I get restless when I spend too much time at home
4. I prefer friends who are excitingly unpredictable
5. I like to do frightening things
6. I would like to try bungee jumping
7. I like wild parties
8. I would love to have new exciting experiences, even if they are illegal

Appendix D:

Game Skill and Frequency Scale

Bracken, C. C., & Skalski, P. (2006). *Presence and video games: The impact of image quality and skill level.* Paper presented at the The Ninth Annual International Workshop on Presence, Cleveland, OH. Retreived from http://www.temple.edu/ispr/prev_conferences/proceedings/2006/Bracken%20and%20Skalski.pdf

1. On a monthly basis, how many hours do you spend playing video games (including console games played on Xbox, Playstation or Wii, computer games, and games played on portable devices such as PSP or Nintendo DS, etc)?
    a. Response: Open ended: Hours/ Minutes
2. I can finish video games quickly.
3. I have good game playing skills.
4. I am a good video game player.
5. When I play against other people, most of the time I will win.
6. I rarely quit playing a game before I eventually beat it.
    a. Response for questions 5-6:7 point Likert scale (strongly disagree/ strongly agree)

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