Virtual Reality Gameplay Implications for Presence and Dreams

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Abstract

Video game play is becoming more widespread and the associated technology increasingly more immersive, resulting in implications for our sense of self in the world, including in alternative states of consciousness like nighttime dreams. This is a report of three studies conducted over four years, where the impact of video game play in a virtual reality condition was compared to two dimension (2D) computer/game console play. Two elements of reality were considered, the sense of being there or presence, and nighttime dream content. As expected generally more presence was found in the VR than in the 2D consitions. However, more presence was reported in the nighttime dreams than in the waking digitual realities. There were also effects on elements thought to be related to lucidity in dreams. This effect was modulated by the order of presentation of the experimental manipulation. That is experiencing digital realms prior to reporting a previous dream resulted in different estimates of the dreams lucidity than experiencing the digitual realm after the dream report. This points to the fragility of nighttime dream reports retrospectively.

KEYWORDS: virtual reality, Oculus Rift, dreams, lucid dreams, presence, video games

Virtual Reality Gameplay Implications for Presence and Dreams

Our experience of life is subjective and may be a constructed reality (Blackmore, 2012). Within this experience, there exist various other constructed realities or states of consciousness. One such state is experienced by everyone while we sleep: our constructed dreaming reality. While asleep, the cognitive experience of dreaming is separated from most external stimuli. Dreams may simply be our mental experiences of the brain's activity while one is sleeping, and yet the dreamer experiences a biologically constructed reality composed of imagined perceptions that often feel very real. Thus, the dreaming reality is itself a true virtual reality, albeit a biologically created one. Perhaps the brain genetically inherits a virtual reality generator that becomes a predictive model of the world (Hobson, Hong, & Friston, 2014). In this view, the embodied self is a dynamic construct of the brain that is established during sleep and projected outward into waking.

The idea that the nighttime dream is a simulation has been pointed to by various authors (Tart, 1987; Revonsuo, 1995; Revonsuo, Tuominen, & Valli, 2015). In order for the brain to create a truly convincing virtual reality environment during dreaming, it needs to immerse the dreamer and create a sense of presence. Presence is the feeling of being present in an environment, as a dreamer typically feels when inside of a dream. It is a form of immersion that occurs when a dreamer feels that he or she is actually in the biologically created dream, because the simulated dream world looks and feels real. Unless a dreamer is having a lucid dream, and is aware that they are inside of a dream, typically most dreamers are not aware that they are inside of a dream. But even if they do have that dream lucidity, the felt sense of being in the dream remains. In other words, the dream world is so immersive that dreamers believe themselves to be present inside of the dream.

Nilsson, Nordahl, and Serafin (2016) point out that presence and immersion are often used interchangeably but go on to distinguish three types of immersion and connect those to theories of presence. They point out that when examining the relevant literature immersion occurs in response to properties of the hardware in digital technologies, or as a perceptual response or as a response to narratives or a response to challenges. Thus these feelings of immersion occur not just in dreams, but also occur daily in our waking lives and has been examined in a variety of contexts. Advances in technology have increasingly made these experiences able to be re-created. This was initially done in the narrative context and more recently with video games and now with immersive virtual reality technology.

Virtual reality (VR) is a digitally simulated environment that replicates the experience of being present in another location. The developers of VR claim that users will perceive objects found in the virtual world as being equally 'present' to those found in the real world. The extent to which one feels present in another location depends on how well the perceptual systems of the user are submerged in the computer-generated stimuli. The more the system captivates the senses and blocks out stimuli from the real world, the more the system is considered immersive, which in turn allows the user to experience presence. The easiest way to capture these experiences is by wearing a high quality VR head-mounted display. Industry experts have been claiming for the last two decades that in the near future, VR will reach a greater number of consumers and subsequently revolutionize the online world as we know it (Biocca, Kim, & Levy, 1995). In the past, high quality VR head-mounted displays have been too expensive for the average user. This looks to change, however, with the highly anticipated virtual reality head-mounted display systems that are to be released in 2016 (Stein, 2015).

While the current VR technology is still fairly primitive, perhaps in 30 years the technology will be sophisticated enough that we will not be able to tell the difference between our virtual and real world realms (Fredkin, 2011). This sounds very similar to our experience of our dream world realms. Thus, does our new digitally constructed virtual reality affect our biologically constructed dreaming reality? Gackenbach and Hakopdjanian (2016) point out:

> Just as our dreaming reality is constructed, our waking reality may also be constructed. While our waking reality influences our lives the most, other constructed realities also have impact. Yet, never before has such a large part of the population been so widely affected by another constructed reality beyond dreaming; specifically, our technologically constructed digital reality through video game play. One potential consequence of video game play is breaking the illusion or 'frame' of our dreams as reality through various dream experiences. Many of the world's wisdom traditions believe that waking reality is an illusion, and now this idea is supported by modern digital physics. While being aware of the illusory nature of waking reality is difficult, it may be easier to break the framework of perception or 'wake up' to the true nature of reality in alternative realities, such as digital and dreaming (p. 79).

If dreams are continuous with waking life (Hall & Nordby, 1972), then it follows that the activities that we immerse ourselves in during our waking reality will invariably be projected or manifested in some form in our dreaming reality. This is known as the continuity hypothesis, which states that "dreams are continuous with waking life; the world of dreaming and the world of waking are one" (Hall & Nordby, 1972; Schredl & Hofmann, 2003). Thus, we propose that immersion in a digitally constructed virtual reality environment will affect our biologically constructed dreaming reality environment, as both utilize similar experiences of presence and immersion.

There has been a growing body of work that is investigating the effects of immersion and presence in these newly created virtual reality environments (Takahashi et al., 2014; Hoffman et al., 2014; Halley-Prinable, 2013). Immersion in the virtual reality environment affects the misunderstanding of recognition by altering the centre of gravity in healthy adults (Takahashi et al., 2014). Furthermore, the strong illusion of presence has been shown to reduce the perception of pain in "severe burn trauma patients… [by] 35-50 percent… in worst pain intensity on subjective pain rating scales" (Hoffman et al., 2014). In another study that investigated heart rate data (Halley-Prinable, 2013), 51 out of 56 participants found the virtual reality environment to be more immersive, and in this case, also evoked a greater sense of fear, than the digital environment created by an ordinary computer monitor.

Previous research (Gackenbach & Rosie, 2011) has found that video game play affects dream content in the felt sense of being present in each experience. Thus, it follows that if this newly created three-dimensional virtual reality environment is more immersive and evokes a greater sense of presence than our current two-dimensional digital environment, then it should also have a greater effect on our dreaming reality. However, the most compelling question of the introduction of widely available VR systems is: will they add to reality confusion? One type of reality confusion is dream-reality confusion, which has been documented as correlated with dissociative symptoms, fantasy proneness, absorption, and high dream recall, to name a few (Giersberch & Merckelbach, 2006; Levin & Young, 2002).

The intention of this series of three studies is to explore these questions by comparing the effects of video game play on dreaming in the traditional two-dimensional digital environment, to the new three-dimensional virtual reality environment. The major dependent variables will be

various versions of judgements of reality from presence to the nature of dreamt reality, i.e., relative lucidity. We hypothesized that a three-dimensional virtual reality experience will have a measurable degree of impact on dream-reality confusion and relevant dream content. The method and results/discussion for each of the three studies are presented in sequence. Each study highlighted methodological refinements which the following study addressed. These ranged from dream memory affected by digital experiences through to refinements in equipment and game choice.

Study 1 Method

Participants

The participants were pre-screened from a sample of 1173 women from a western Canadian university, with an average age of 20 years old, ranging from 17 to 51 years old. Of this sample, 94 undergraduate females were selected as participants in the current study.

Instruments

Pre-screening Inventory. The parameters in the selection process of participants were: gender (female); frequency of weekly dream recollection (from three to seven days a week); and amount of felt motion sickness (from rarely to never). Other exclusion criteria included current pregnancy or used any drug with motion sickness as a side effect.

Demographics. The participants provided an alias to keep their information anonymous and to match the laboratory questionnaire responses to the follow up dream questionnaire. A previous general demographics questionnaire (Gackenbach & Gahr, 2015) was used to gather information on nine items: gender, marital status, occupation, highest education, race/ethnicity, city and country of residence, first language, and English language proficiency. The questionnaire asked both closed and open-ended questions.

Video Game Play Questionnaire (Gackenbach & Rosie, 2009). Assessed the participants' previous video game play history and most recent video game play experience. Four key items on the questionnaire were closed-ended with continuous responses (i.e., video game play frequency, length of session, number of games played and age at which playing began) and had a Chronbach's alpha of .672. It contained two open-ended questions to have a more in-depth understanding of the participants' history with video game play: "Describe your first video game?" and "What is your favorite game?". The participants were also asked if they had played a video game the day prior to being in the laboratory, and to rank their top five most-played video games.

Social Media Use Questionnaire (Gackenbach & Boyes, 2014). Typically, social media is a more salient online environment for women in university, thus, the researchers were interested in comparing social media use to video game play but this information is not reported herein.

Media Production and Telepresence Survey (Lombard, 2014; Gackenbach & Rosie, 2009; 2011). Three questions drawn from Lombard (2014) about previous media production and telepresence knowledge were initially used to establish if the participants had previous expectations of experiencing telepresence. Since there are several types of telepresence experiences (some of which are very similar), and a single experience may include more than

one type, the participants were asked about ten different types of telepresence from Lombard (2014): spatial; social; transportation; engagement; social realism; perceptual realism; medium as social actor; actor within medium; self-presence; and inverse presence. These questions focused specifically on when the participant most recently experienced each type of presence. The participants chose from "Never" to "More Than a Year Ago" on a seven-point Likert scale. The Chronbach's alpha was .807 for these ten items.

After the experimental conditions were employed, the participants were asked specifically about the telepresence they had just experienced. The ten types of telepresence were reiterated and responded to if they were felt while playing the game ($\alpha = .758$). To determine the amount of presence felt while playing, participants rated how strong the sense of presence was on a seven-point Likert scale: "Not At All" to "Very Strong". An open-ended question on the sense of presence aided in fully capturing the game's effect. Two questions were asked on how long after playing the game did it take for their sense of presence to diminish. Finally, the enjoyment of the video game experience was queried on a seven-point Likert scale: "Not At All" to "Very Strong".

Dream Collection. The participants were asked to provide their most recent dream recalled before the experiment so that it could be compared to a dream reported afterwards. A 1,000 word open-ended form was used to ensure complete description of all objects, places, characters, and events in the dream as they occurred, void of any interpretation, (Gackenabch and Rosie, 2011).The participants were asked about the intensity of the emotions experienced in two dreams recorded on a 5-point scale: before the experiment ($\alpha = .583$) and after the experiment ($\alpha = .724$). The participants were asked to characterize the type of dream, from six dream types; lucid, control, nightmare, bad, bizarre, observer, and electronic, for both the dreams recorded before ($\alpha = .129$) and the dream recorded after ($\alpha = .091$). The very low alphas in this question demonstrate that the six dream types asked about were seen as distinct.

Dream Presence. Ten types of presence were queried in terms of the two dreams reported (Lombard, 2014). The Chronbach's alpha for the dream reported in the laboratory was .821. Additionally, 12 items from Gackenbach and Rosie (2011) were also included in these post-dream queries about dream presence. All presence items regarding feeling like participants were there in the dream were reworded to be consistent with the dream experience; for instance, "to what extent did you experience a sense of 'being there' inside the dream?". Response for the dream presence items were along a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". Chronbach's alpha for these questions for the dream reported in the laboratory was .788. These questions were also asked for the dreams collected after the experiment, the Chronbach's alpha was .801. Permission to quote their dream was obtained.

Observations. The researchers recorded observations of the participants on online software provided by Qualtrics system (http://www.qualtrics.com). The same eight questions were asked in both the first demonstration game and the second racing game. The observations recorded during the demonstration game was based on five minutes of play. The observations recorded during the racing game was based on two-minute intervals, for a total of eight intervals. Verbal behaviors were recorded on a sliding scale from 0-100 for three types of emotions (positive, neutral, and negative), and some examples of vocalizations were also recorded. Non-verbal behaviors (smiles, grimace, muscle tension, body leaning, and breathing rate changes) were recorded as present or absent at each data collection point. The amount of apparent

absorption was also assessed at each data collection point and measured on a scale between 0-100, wherein 100 was deeply absorbed.

Multimedia Devices. The Oculus Rift Developer's Kit 2 (DK2) virtual reality head-mounted display was the primary device used, which was operating on a Dell desktop computer with a Logitech universal gaming controller and headphones. The two video games: "4th Floor Studio" and "Radial-G". Open Broadcaster Software (OBS) Game Capture was utilized for the researchers to watch (not record) the gameplay while the participant wore the DK2.

Procedure

All questionnaires during the laboratory session and after were completed Qualtrics. All the participants read and signed the consent form and were then asked to choose an alias for the purpose of anonymity and for the researcher to match the questionnaires completed during the laboratory session and after the session. Next, the participants completed the first set of questionnaires, which included demographics, media use, and telepresence knowledge. Then, the researcher provided instructions on playing the video games, both the first demonstration game and the second racing game. The objective of the demonstration game was to introduce the participants in the experimental group to the virtual reality environment, as it included walking and looking around a digitally rendered three-dimensional apartment, engaging the participants in the full range of motion. The control group played the same demonstration game on a traditional two-dimensional computer monitor.

After the participants played the first game, they removed the head-mounted display and received instructions for the second game. In this game, the participant is in a futuristic vehicle racing along a track. After completing a lap, the researcher touched the participant on the shoulder, lifted one side of the headphones to tell the participant of their time and instructed them to try to complete the next lap faster. This was done to provide additional motivation to the participant to focus on the game and potentially become more immersed in the experience. The participants in the experimental group wore the head-mounted display the entire time they played the racing game, which was 15 minutes, for a total of 20 minutes for both games. The participants in the control group also played both video games for the same amount of time but their visual experience was on the computer monitor. While the participants were playing both games, the researchers observed and recorded their verbal and non-verbal behaviours.

After the participants played both video games, they completed a second set of questionnaires. These questionnaires included questions on the amount of presence felt when playing these games. Then the participants were asked to record the most recent dream they could recall prior to the laboratory session. The participants self-reported on the felt presence, dream type confidence and dream emotions of the dream they provided. For the final portion of the laboratory session, the participants were given instructions on how to record the first dream they experienced after the laboratory session and how to complete the next set of questionnaires. The researchers informed the participants that the dream recording questionnaires after the laboratory session were the same as the ones completed in the laboratory. The researchers also provided the participants with a one-page summary on how to better recall their dreams and were later sent an email with the website address for recording their first dream after the laboratory session.

Study 1 Results

The prescreened research participants (n = 93) were randomly assigned to either the experimental or control groups.

Media Use History

The participants were asked nine questions about their history with video game play. There were no group differences in the four key video game play questions as a function of condition (i.e., frequency of play, length of play session, number of games played, and ageplaying began). Favourite genre also did not differ as a function of condition but it should be noted that the second most favourite genre was driving games, which were evenly distributed across condition. There was also no difference as a function of condition as to whether respondents had been playing a video game in the 12 hours prior to reporting to the laboratory.

A separate set of questions was asked about previous media production and telepresence knowledge. In a multiple ANOVA on all three questions (i.e., knowledge of media production, knowledge of telepresence, and mean recent type of telepresence experience), there were no significant differences as a function of condition.

Post-Game Analyses

Respondents were asked after they played the video games about various components of presence during the games as well as an overall estimate of their sense of presence in the games, and their sense of enjoyment playing the games. The components of presence were the same ones asked about in terms of their history with presence (i.e., spatial presence, social presence, transportation, engagement, social realism, perceptual realism, medium as social actor, actor within medium, self-presence, and inverse presence). This time however, they were asked simply whether each was present or absent, whereas prior to the manipulation, they were asked the same questions but responded along a seven-point Likert scale. There was a significant condition difference in the overall estimate of presence ($F(1,91) = 4.318$, $p = .04$, $\eta_p^2 = .045$), with those in the experimental condition reporting more overall assessment of presence (mean = 5.77, SD = 1.172, N = 43) than those in the control condition (mean = 5.28, SD = 1.089, N = 50). Despite this overall estimate of presence in the game, when the sum of self-reported types of presence was analyzed, there was no condition difference. Additionally, there was no difference in the degree to which each group enjoyed the game. When we controlled for media production history because there was a condition difference on it, the direction of the results did not change.

Presence was also assessed by the researchers observering the non-verbal behaviors of the participants. The researchers completed an observer's questionnaire at two-minute intervals during the participants playing the racing game, as well as once at the end of the orientation experience in the demonstration game. This routine resulted in nine observation points which were detailed in the "Methods" section. These nine evaluations were summed. Then a condition by type of evaluation ANOVAs were computed. All main effects were significant except the overall rating, which approached significance. One interaction was also significant.
These results are presented in Table 1.

Table 1

Absorption, Verbal and Nonverbal Observer's Ratings of Participants Responses as a Function of Condition

Variable	Levels	F*	Sig	η_p^2	*M*	*SD*	*n*
Overall Absorption	Condition	3.456	.066	.037			
	VR				677.744	126.927	43

	Computer				633.040	104.952	50
Verbal	Condition	5.811	.018	.060			
	VR				25.357	41.791	43
	Computer				11.773	28.387	50
	Valence	19.248	.0001	.175			
	Positive				37.463	69.919	93
	Neutral				11.175	18.111	93
	Negative				7.057	17.238	93
	Interaction	3.91	.051	.041			
	Positive						
	VR				55.186	83.693	43
	Computer				19.740	56.144	50
	Neutral						
	VR				9.791	14.574	43
	Computer				12.560	21.648	50
	Negative						
	VR				11.093	27.106	43
	Computer				3.020	7.369	50
Nonverbal	Condition	4.525	.036	.047			
	VR				2.112	1.979	93
	Computer				1.648	1.669	93
	Valence	24.228	.0001	.210			
	Laugh				2.097	2.3362	93
	Grimace				0.129	0.8499	93
	Muscle				0.699	1.5728	93
	Tense						
	Body Lean				5.516	3.027	93
	Breath Rate				0.871	1.520	93

*F(1,91)

It can be seen that the experimental condition evidenced the most of all three measures of behavioral absorption. Additionally, laughter and body lean were the most prevalent non-verbal indicates across condition, which supports the positive ratings of absorption superiority.

Another way to think of absorption is its effect on performance. Lap times were gathered at the end of each of five or six laps depending on how many the participant finished. T-tests comparing the two groups on their total lap time at the end of five laps was significant ($t(89) = 4.708$, $p < .0001$). The direction of the difference was that those playing on the more familiar interface, the computer monitor, had the faster laps in seconds (mean = 783.39, SD = 47.75, N = 42) than those using the virtual reality head-mounted display (mean = 808.92, SD = 61.99, N = 49). Two participants were deleted due to incomplete data.

Dream Reports

After research participants experienced the manipulation, they were all asked to report a recent dream. It's not surprising that all 93 subjects were able to recall a dream, as they were selected for self-reports of high dream recall ability. 91 percent reported a dream from the

previous week and there was no difference as a function of condition for when this pre-laboratory dream occurred.

Participants were also asked about the emotions they experienced in this dream, as well as their confidence about what type of dream it was. Finally, the participants used the same presence scales (adjusted to wording consistent with presence in dreams) to rate their sense of presence in these recent dreams. The results as a function of condition for the dream reported in the laboratory session will be presented first, as it involved all research participants, and a comparative analysis of the dreams reported after the laboratory session will follow. This analysis will be done in two ways: first in terms of conditions to test the continuity hypothesis; and second to test the sense of presence in two different virtual realities (technological and biological).

Since 15 different emotions were asked about regarding their dream, these were factor analyzed saving the factor scores. The varimax rotated factor matrix is portrayed in Table 2, with factor labels as column headers and marker variables underlined with a .5 cutoff. Percentage of the variance for each factor is also listed in Table 2. Factor scores were saved.

Table 2

Varimax Rotated Factor Matrix of Self-Reported Dreams in Laboratory Reported Dream

	1	2	3	4
	anger	fear	happy	sad
Anger	.792	.182	-.008	.117
Awe	-.156	.048	.696	-.096
Arousal(sex)	.139	-.338	.675	-.069
Anxiety	.144	.736	-.210	.169
Fear	.141	.922	-.119	.100
Guilt	-.007	.021	.034	.712
Frustration	.754	.041	-.159	.060
Sadness	.315	.157	-.237	.603
Hatred	.772	.296	-.045	.079
Happiness	-.297	-.181	.682	.075
Jealousy	.618	-.270	.049	.340
Embarrassment	.295	-.051	.125	.529
Ecstasy	.098	-.010	.825	.079
Downhearted	.027	.118	-.035	.764
Terror	.038	.873	.003	-.050
% of variance	25.35	15.97	11.35	9.17

A Condition x Emotion type ANCOVA with numbers of words in the dream as a covariate was computed. There were no main effects or interactions on self-reported emotions associated with the dream record from prior to their laboratory experience. The same analysis was done for the seven types of dreams, and again there were no main effects or interactions. Before we take up the dream presence ratings we will more fully consider the dreams in terms of the continuity hypothesis.

Dream Reported the Week after the Laboratory: Continuity Hypothesis

Of the 93 research participants, 70 reported a dream after leaving the laboratory. These reports came from one to 38 days after the laboratory session. These dreams will be considered first from a continuity hypothesis perspective, since we are interested in the effects of playing a video game with the virtual reality head-mounted display on subsequent dreams. This hypothesis would argue that only those dreams which occurred in the day or two after the laboratory session, or a week later, due to the dream lag affect, were eligible for a laboratory vs post-laboratory analysis in terms of possible game effects. In other words, when considering impact or incorporation of waking stimuli on subsequent nighttime dreams, the number of dreams allowed to be considered is fewer than if only considering a second dream experience, which follows the first dream experience collected in the laboratory. This latter circumstance will be used to consider difference in presence in games versus presence in dreams.

Thus this first set of analysis is from a continuity hypothesis perspective. Only 32 of the 70 reported post-laboratory dreams fit the continuity hypothesis criteria. These 32 participants' dreams did not differ in number of words, thus that was not pertinent to use as a covariate. However, there was a condition difference for this subgroup of participants in one of the four history of video game play variables, which approached traditional levels of significance ($F(1,30) = 2.849, p = .102, \eta_p^2 = .087$). The control group started slightly younger[i] (mean = 8.77, SD = .612, N = 22) than the experimental group (mean = 8.10, SD = 1.663, N = 10); that is, the control group started between kindergarten and grade three, while the experimental group started on average between grades four and six. Because we were interested in the effects of video game play as a function of level of immersion in playing a video game, history of gaming is a relevant covariate. Thus, these analyses on the 32 dreams, which fit the continuity hypothesis timing criteria, were computed using the age that playing video games began as a covariate.

Separate condition by time of dream ANCOVA's were computed for each type of dream (i.e., lucid, control, nightmare, bad, bizarre, observer, and electronic), with age began gaming as the covariate. There was a near significant interaction for lucid dreams ($F(1, 29) = 3.997, p = .055, \eta_p^2 = .121$). None of the other dream types were found to evidence any affects. The interaction for lucid dreams is displayed in Figure 1.

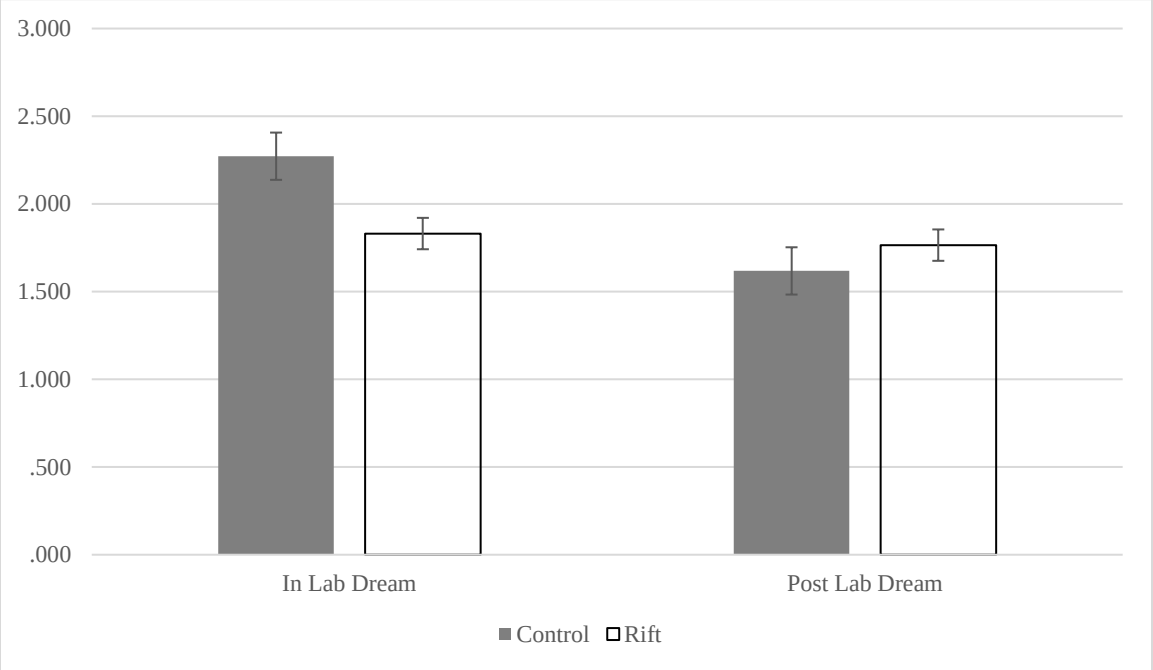

Figure 1. Mean confidence that respondent had a lucid dream as a function of condition and time of dream collection.

While this is a possible statistical artifact, the conceptual interest of this finding makes further consideration valid. The question that arises from this one interaction is: are there truly more lucid dreams from prior to the laboratory experience, but reported in the laboratory after experiencing the virtual reality head-mounted display, than after experiencing the computer monitor display control condition? While this difference did not occur in the entire sample, or rather the same interaction at p=.09 was visually the same, when this subset of participants were selected due to the continuity hypothesis requirement, the difference emerged relative to post-laboratory dream reports.

Several lines of inquiry allow answering this query. One is that lucid dreams are often seen as a form of metacognition deriving from noticing bizarre content or from frightening nightmares (Gackenbach, 1988). Yet in this sequence of analyses, there were no differences in bizarre dream attributions or in bad or nightmare attributions. Nonetheless, in order to determine if some sort of metacognitive mentation was occurring in the dreams, judges coded these 32 respondents dreams for metacognition using Kahan and LaBerge's (1996) Metacognitive, Affective, Cognitive Experience (MACE) questionnaire. It consists of 10 questions most often posed to the dreamer about various types of thinking that went on in their dream. However, it can be used to code dreams by independent judges as well. Two judges trained on this use of the MACE questionnaire reached 80 percent agreement in their coding. ANOVAs on condition by time of dream collection were computed on total MACE scores and on the individual item scores from the MACE. No significant differences were found. Thus the perception on the part of the research participants that their dreams after experiencing the virtual reality head-mounted display were lucid seems to not be a function of bizarreness, fearfulness (as either expressed in labeling a dream a bad dream or a nightmare or in a separate analysis examining the fear, anxiety or terror emotions factor scores reported about their dream), or metacognition (MACE scores).

We also further examined the continuity hypothesis by examining dreams for content that might imply incorporation of the game play stimuli. This was done in three ways. First, participants were asked on the survey right after they reported the post-laboratory dream if they thought that the game was in the dream. There were no group differences in this self-evaluation of game incorporation. Second, a list of words that would indicate incorporations were created[ii] from the original work of Gackenbach and Rosie (2009). Then word counts of all words in the dreams were done using NVivo software. Words were identified from the key words list reported in the dreams of the 32 participants who represent a test of the continuity hypothesis. The results of this analysis are portrayed in Table 3.

Table 3

Number of Words Indicative of Two Games and Extra Game Elements as a Function of Condition in Dreams Collected Post Lab

Subscales	VR (Total incorporations/total words)	CONTROL (Total incorporations/total words)
Total incorporation	26/584 = 4.5%	116/1394 = 8.3%
Radial G subscale sum	7/26 = 27%	12/116 = 10%
Extra game elements	0/26 = 0%	10/116 = 9%
4th floor apt subscale sum	19/26 = 73%	94/116 = 81%

It can be seen that while more incorporation elements were identified in the control condition than in the experimental condition, when broken down to game/extra game elements, the relative incorporations differed somewhat as a function of condition. That is, in both cases there were more references in the dreams to the apartment demonstration game ("4th Floor Studio"). For the rest of the incorporations in the experimental condition, they were entirely in terms of the racing game ("Radial-G"), while in the control condition they were equally distributed between the extra game elements and the racing game. The preponderance of reference to apartment cues may be a gender dream preference for attention to home interiors (Hall & VandeCastle, 1966).

Finally, the continuity hypothesis was tested was using a version of the Hall and Van de Castle (HVDC) scale adopted by Gackenbach and Rosie (2009) for coding for the presence or absence of video game elements (see appendix for coding terms used for this study). No differences were found between the two conditions using the HVDC coding rules controlling for number of words in dreams which could be coded. In summary, there is not a lot of evidence for differences in dream content along the lines specified by the continuity hypothesis. The lucid dreaming difference, however, bears further scrutiny, as it may be more an artifact of perceived presence in the game using the virtual reality head-mounted display than actual dream content. Thus we turned our attention to the concept of presence in dreams and games as a function of condition.

Dreams Reported the Week after the Laboratory: Presence Comparisons

As indicated, we asked about presence in one form or another several times during this study. The two non-dream presence inquiries were reported in the beginning of this results

section. Here presence in the dreams collected in the laboratory and after the laboratory session, compared to gaming presence experiences will be considered.

Histories of presence experiences were treated as a covariate in these analyses in order to more clearly assess differences in presence as a function of condition. This is a foundational analysis as it allows a direct comparison of the sense of being there in two distinct virtual worlds: technologically driven VR; and two incidences of biologically driven nighttime dreams. Thus, all dreams reported in the laboratory and reported after the laboratory are used in these analyses, as the constraints of the continuity hypothesis do not apply.

The first analysis pertained to the question, "How strong was the sense of presence in this gaming/dream experience?". A type of experience (game, laboratory dream, post-laboratory dream) x condition (experimental, control) ANOVA with no covariate, as no such overall question was asked about presence history, was computed. A significant quadratic interaction emerged ($F(1,69) = 5.488$, $p = .022$, $\eta_p^2 = .074$) and is illustrated in Figure 2. We then calculated the total number of types of presence checked for each event and did the same analysis without significant findings.

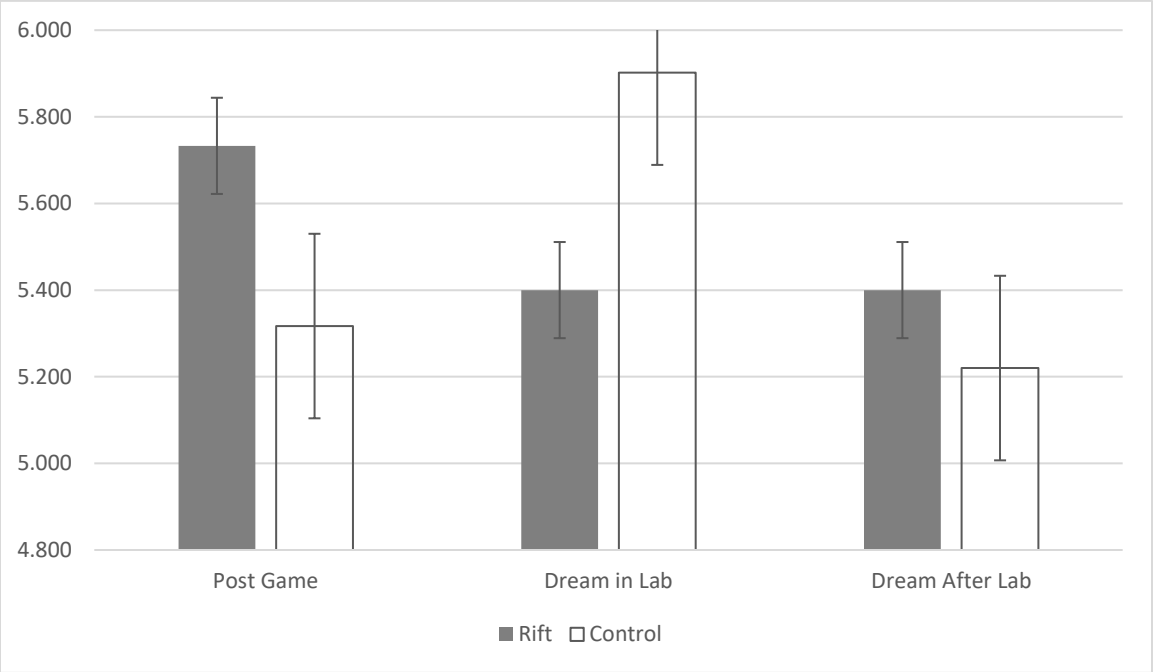

Figure 2. Mean self-report of sense of overall presence under two conditions at three different events.

What is remarkable about the overall presence evaluation finding is that having a waking, highly immersive three-dimensional virtual reality experience results in a different assessment of dreaming presence than one in a two-dimensional virtual reality environment on a traditional computer monitor. Despite the lack of any group differences in the sum of types of presence reported, we decided to further investigate this assessment of presence by examining 10 types of presence which were asked about four times: history of media; after game play in the laboratory; after dream reported in the laboratory; and after dream reported post-laboratory. The first inquiry

was in terms of how long ago did the participant experience each type of presence, while the next three inquiries about presence types were in terms of present or absent in the experience they had just had or reported upon, i.e. game or dream. Consequently, history with each individual type of presence was used as a covariate in order to more closely hone in on relative experiences from the laboratory or sleep. Ten ANCOVAs of condition by type of data collection with history of presence mean for the individual presence types were computed (i.e., spatial presence, social presence, transportation, engagement, social realism, perceptual realism, medium as social actor, actor within medium, self-presence, and inverse presence). Thus for the analysis on spatial presence (assessed three times on three different events), the history of spatial presence was the covariate, and so forth for each variable (i.e., engagement history for engagement presence in task and dreams, etc). These analyses could only be computed for the 70 participants who reported at least some information about a dream after their laboratory session. Two interactions were significant (spatial presence: $F(1,67) = 5.075$, $p = .028$, $\eta_p^2 = .07$; engagement (quadradic): $F(1,66) = 5.675$, $p = .02$, $\eta_p^2 = .079$). Figure 3 shows these interactions.

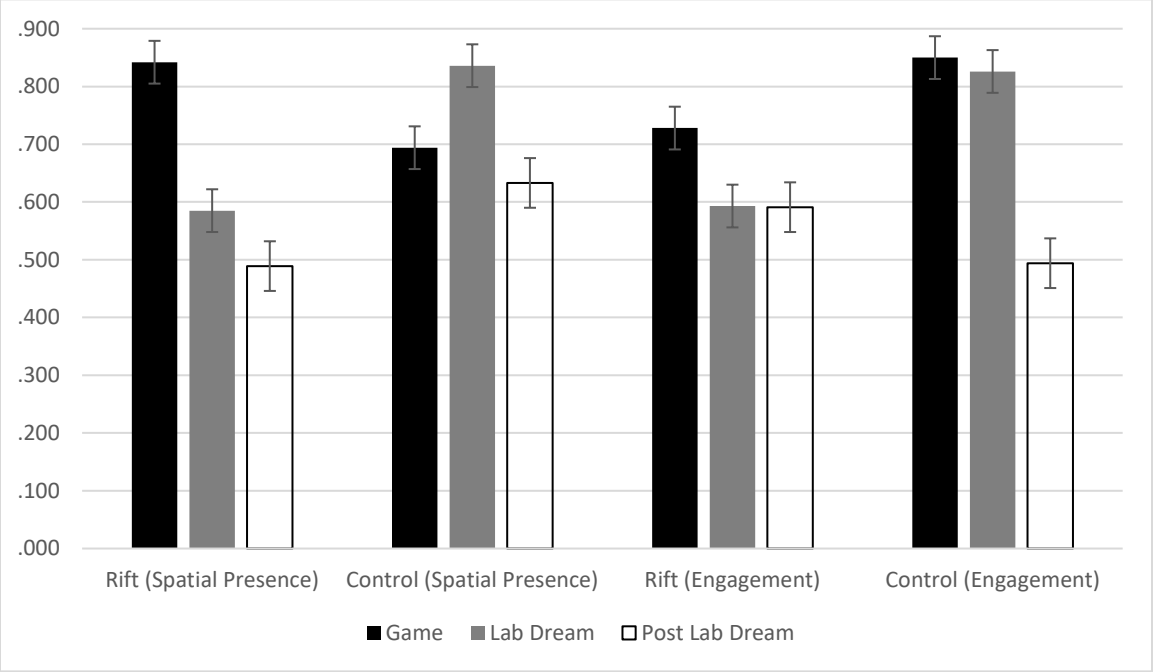

Figure 3. Mean self-report of sense of two types of presence under two conditions for three different events

In the the last two figures, both types of VR are portrayed with two samples of dreams. Here considering incorporation of the stimuli into the dream is not considered. Only participants who provided two dreams at two different times with presence estimates, and one example of presence estimates after immersion in the virtual reality environment are considered. Figure 2 shows that the experimental group had a higher sense of overall presence about the video game than about the dream, with the opposite being the case for the control condition. When assessed by presence type (Figure 3), the observation remains true for spatial presence, but not engagement, whereas the control condition showed no difference in engagement presence in-

game versus their dream collected in the laboratory. When the post-laboratory dream was considered overall, presence dropped for participants in the control condition. It seems that being in the laboratory changed the participants' presence estimates, despite not using the virtual reality head-mounted display. Compared to playing a video game on a traditional computer screen, for the control group, a recent dream was reported as having a higher degree of presence. This group difference disappeared in the follow-up dream estimates of overall presence.

One final presence measure was assessed in this study. This measure was drawn from an earlier inquiry by Gackenbach and Rosie (2011), and pertains to additional questions about presence in dreams, which were derived from Lombard and Ditton (1997), but adapted to dream referents from a technology devise referent. While Gackenbach and Rosie did not find a difference in overall presence scores between gaming and dreams, they found four differences when viewed item by item. In the present study, these questions were only asked of the two dreams collected (in-laboratory and after-laboratory). There was a significant overall presence score difference ($F(1,61) = 4.663$, $p = .035$, $\eta_p^2 = .071$) for the 70 individuals who reported any dream after their laboratory session. Self-reported dream presence was reported higher in the laboratory dreams (mean = 63.92, SD = 10.39, N = 63) than in the post-laboratory dreams (mean = 60.03, SD = 10.13, N = 63). If only the 32 research participants who fit the continuity hypothesis were considered, then there were no differences in this older presence scale as a function of condition or time of dream collection.

Study 1 Discussion

The highly anticipated VR technology is expected to finally deliver a fully immersive video game play experience to the public. Using Oculus Rift Developer's Kit 2, this first of three studies examined the effects of video game play on dream content via the continuity hypothesis and presence. Women with a history of high dream recall were pre-screened and played two video games either with a virtual reality head-mounted display (experimental) or on a traditional computer monitor (control). Questions about presence were asked at various times during the experiment, and dreams were collected both after playing the video game in the laboratory, as well as sometime after the laboratory session.

In a review Gackenbach (2012) has argued that the virtual reality world in video game play does affect the virtual reality world in dreams. Two avenues of investigation of a potential relationship were pursued in this study. One was a direct continuation of video game play on dreams as a result of the continuity hypothesis. The second was a comparison of relative presence in both conditions. According to the continuity hypothesis, daytime experiences can impact nighttime dreams (Shredl & Hoffman, 2003). This hypothesis has been supported in the dream research literature, as well as in the work of Gackenbach and colleagues investigating video game play. Thus, we hypothesized that video game play using a virtual reality head-mounted display will result in an increase in continuity of the gaming experience in subsequent dreams. Furthermore, since a virtual reality head-mounted display has been shown to increase presence (Halley-Prinable, 2013), we also hypothesized that participants in the experimental condition would also report a greater sense of presence while using the virtual reality head-mounted display, but also in subsequent dreams. We found some supporting evidence for these two hypotheses.

The participants were randomly assigned to the experimental and control conditions, as there were numerous group differences. Overall, the participants' general knowledge of media production and presence was less than in Lombard's (1997) preliminary inquiry, which is likely

because these participants are younger, all female and less educated than the participants in Lombard's study. The lack of group difference in types of presence is likely because the sophistication of knowledge about presence needed to identify those types of presence was beyond this pool of participants. This inference is verified by data from Lombard (1997) where such distinctions were made, but from older, more educated participants, with more of a technical background.

Participants in the experimental group reported a higher overall sense of presence than those in the control group, as expected. Additionally, the researcher further verified this higher sense of presence in the experimental group by reporting observations of behavioural indications of absorption. There was no difference in the overall enjoyment of the video game play experience. However, participants in the control group did perform better than those in the experimental group, as shown in the racing lap times. This may be as a result of the participants being more familiar with the traditional computer monitor in the control group, whereas participants in the experimental group were unfamiliar with the virtual reality head-mounted display. The novelty of the technology, as well as the fully immersive three-dimensional background, may have caused a greater degree of distractibility for the participants in the experimental group.

Dream versus Game Presence

Also compared were the virtual dreaming reality to the virtual gaming reality in terms of continuity and presence. Based on the research literature (Shredl & Hoffman, 2003; Blagrove, Henley-Einion, Barnett, Edwards, & Seage, 2011), an event or experience is often dreamt one or two days later, or perhaps up to one week later. Thus, only dreams reported by participants in these time periods were used in this study. This restriction reduced the quantity of post-laboratory dreams from 71 to 32. With these constraints, examinations of incorporation and presence were undertaken. All dreams reported in the laboratory were examined in terms of self-reported emotions and dream type. There were no condition differences of these variables due to random assignment. However, when this sample was reduced to 32 who reported post-laboratory dreams that fall within the continuity hypothesis timeframe, an interaction between condition and time of dream collection emerged for lucid dreams. In other words, those in the experimental group rated their dreams from before their laboratory experience as more lucid than those in the control group. This effect is particularly interesting as lucid dreams are about assessing the 'reality' of the experience.

This finding was further explored in order to determine if participants assigned to the experimental group experienced more lucid dreams than those in the control group. Several lines of inquiry were undertaken, including self-rated dream bizarreness, negative dream types and metacognitive content. These three variables have all been associated with either becoming more lucid (i.e. noticing a bizarre element in a dream and concluding it must be a dream) or the experience of dream lucidity, known as metacognition. In all three cases, there were no group differences for the 32 participants. This suggests that the attribution of the dream as lucid seems to be as a result of the perceptual change elicited by exposure to the virtual reality environment than to the actual content of the dream. Despite this attribution difference, there were no differences for these 32 participants in their self-reports of their felt sense of presence wearing the virtual reality head-mounted display compared to the traditional computer monitor. However, there were group differences in the researcher's observations of their behaviours indicating a greater degree of presence in the experimental group.

Limitations

There are several limitations to this study, including gender, dream recall, number of participants, and data collection time periods. Female participants were used because they generally recall a greater number of dreams, and are more available in an introductory psychology participant pool. An interesting question to consider is if these effects would be similar for males (see Study 3), who generally have more extensive experience with more immersive types of virtual reality and video game play in general. While we received sufficient dream recall in the laboratory dream collection, the post-laboratory dream collection was disappointing, with only 32 dreams eligible to test the continuity hypothesis. In future studies, the post-laboratory dream collection will be required in order to be part of the research participant credit (see Study 3). Finally, collecting the dream during the laboratory sessions after exposure to the video game may be a confounding variable, as ideally dreams would have been collected from half of the participants before and half after the video game play experience (see Study 2).

Study 2

A second study was run to address some of the limitation of the first study. Because of the potential confound of order of dream collection in the first study, a second one was run where a second independent variable was added. This was order of dream collection; before or after the game play. Another differernce in this replication was the use of two female experimenters rather than one.

Study 2 Method

Participants

The participants consisted of 114 women from a Western Canadian University. Participants were awarded up to 4% credit towards their overall course grade: 2% for completing the in-lab session and 2% for reporting a dream with accompanying questionnaire within one week of the lab session.

Instruments

Prescreening. female participants were pre-screened for rarely to never experiencing motion sickness, and for high dream recall (see study 1).

Demographics. (Gackenbach & Gahr, 2015): See study 1.

Video Game Play Questionnaire. (Gackenbach & Rosie, 2009): See study 1.

Social Media Use Questionnaire. (Gackenbach & Boyes, 2014): See study 1.

Media Production and Telepresence Survey. (Lombard, 2014; Gackenbach & Rosie, 2009; 2011): See study 1.

Dream collection. (Gackenback & Rosie, 2011): See study 1.

Dream presenc.e (Lombard, 2014; Gackenbach & Rosie, 2011): See study 1.

Observations. See study 1.

Multimedia device. See study 1.

Procedure

Study 2 was a replication/extension of study 1, thus the method and procedure used were consistent with study 1, with 2 exceptions. First, inconsistent with study 1, participants were not asked to choose an alias, instead university email addresses were used to match in lab and post lab questionnaires with experimenter observation reports. Second, study 2 added an independent variable (order of dream collection). In both the VR and control conditions last dream before the lab experience was collected either before game play or after game play. As such, participants

were randomly assigned into one of four conditions: control condition reporting a dream before gameplay, control condition reporting a dream after game play, VR condition reporting a dream before gameplay, and, VR condition reporting a dream after gameplay.

Upon entering the lab, participants were first asked to read and sign the consent form. They were then instructed to begin the survey. Depending on the condition each participant was randomly assigned to, the survey would stop with an instruction to play a video game, once gameplay was completed, the survey would continue. Depending on condition, dreams were reported either before or after gameplay in both the VR and control condition. Once gameplay began the experimenter would instruct the participant in gameplay (see study 1 for details). Experimenter observation reports are also consistent with study 1.

Study 2 Results and Discussion

Although 114 respondents were run in this study, they were disproportionately distributed and thus it was determined that randomly selecting subjects to achieve close cell sizes was desirable. Thus, cell sizes became 23 from the VR dream reported before game played, 25 from the VR dream reported after game was played, 21 from the control condition dream reported before game played and 22 from the control condition dream reported after game was played. This totaled 91 respondents in all subsequent analyses. This subset of respondents did not differ in their previous experience with the Oculus Rift nor their marital status or English as first language as a function of condition or order of dream collection in the lab. However, there was an interaction on age ($F(1,87)=3.905$, $p=.051$, $\eta_p^2=.043$) such that while all were between 17 (17 to 20 = 1) and 25 (21 to 25 = 2) years of age, those assigned to the VR condition with dreams collected before game play were slightly older (mean=1.48, SE=.147) than those assigned to the VR condition with dreams collected after game play (mean=1.174, SE=.154). The opposite was the case for those assigned to the control condition (mean before game=1.714, SE=.161; mean after game=1.409, SE=.157). Despite this difference age was allowed to randomly vary in subsequent analyses.

Confounds

Possible important confounds were identified and used in subsequent analyse as covariates. These include the sum of social media used, not including video game social media, video game play frequency reported at prescreening, number of words in dream reported in the lab and number of words in post lab dream. While several questions were asked in the lab survey about video game play history, it was thought that due to the demand characteristics of being in an experiment about video game play that the prescreening estimate of video game play was likely more accurate. A condition x order of dream report in the lab ANOVA was computed on prescreening self report of video game play frequency. Despite random assignment there was a condition main effect ($F91,86)=5.084$, $p=.027$, $\eta_p^2=.056$) with those assigned to the VR condition reporting more frequent play (mean=4.101, SE=.251) than those assigned to the control condition (mean=3.280, SE=.263). The frequency of use of social media was asked about in terms of Facebook, Linkedin, Twitter, Tumblr, Instagram, Myspace, Youtube, Google+, Pinterest and Other along a 9-point Likert type scale. These frequencies were summed

and a condition x order MANOVA was computed which also included the age they began using social media and their estimates of social media texts sent. There was a condition x order interaction for the sum of social media frequency (F1,87)=5.208, p=.025, η_p^2=.056). In the VR condition there was more social media use reported in the before dream report manipulation (mean=33.696, SE=1.715) than in the after dream report (mean=31.480, SE=1.645) while in the control condition the opposite was the case (mean before dream report=27.286, SE=1.794; mean after dream report = 32.955, SE=1.753).

The final covariate used when considering dreams was number of words in the two dreams. In a condition x order x time of dream report ANOVA there was a main effect for time (F(1,87)=9.163, p=.003, η_p^2=.095) and a marginal interaction for condition x time (F1,87)=3.341, p=.071, η_p^2=.037). Dreams reported post lab were longer (mean=164.586, SE=11.621) than those reported in the lab (mean=130.572, SE=8.558). For the marginal interaction for the VR condition the post lab dream had more words (mean=171.202, SE=15.982) than the in lab dream reports (mean=116.649, SE=11.769). There was a less pronounced difference for the control condition (mean in lab dreams=144.496, SE=12.427; mean post lab dreams=157.971, SE=16.875). Therefore, words in dreams is used as another covariate in dream analyses.

Another confound for the observer's reports only was the training and ethnic differences between the two experimenters. Condition x time of report x experimenter ANOVA's were computed on total absorption ratings over eight observations, first four observation absorption ratings, last four observation absorption ratings, and positive, neutral, and negative emotional assessment by observers. All six dependent variables evidenced an experimenter effect but no condition or time of reporting effects. These are portrayed in Table 4. Experimenter one was a young adult, dark skinned woman, who grew up in the middle East and India where her first language was Tamil. She learned modern Colonial English in kindergarten as she was educated in a British English based curriculum. She was on a student visa at the university in Canada. Experimenter two was a Caucasian woman, who was born and raised in Canada. She was a returning older student with two children. Her first language was North American English.

Table 4

Observer's reports as a function of experimenter

				Exp. 1		Exp. 2	
Dependent Variable	F*	Sig	η_p^2	*M*	*SE*	*M*	*SE*
Observer rating of absorption sum	5.734	.019	.060	556.119	18.183	615.180	16.665
First four observer rating of absorption sum	9.506	.003	.096	261.000	8.546	296.740	7.832
Second four observer rating of absorption sum	2.688	.105	.029	295.119	10.487	318.440	9.611
Positive vocalizations sum racing only	3.593	.601	.038	13.452	4.540	1.780	4.161

Neutral vocalizations sum racing only	5.473	.022	.057	19.952	4.309	6.280	3.949
Negative vocalizations sum racing only	4.047	.047	.043	3.452	2.458	10.160	2.253

* F(1,90)

Performance and Presence

Despite the experimenter affects in observers' ratings, there were no experimenter effects when recording game performance. This was assessed by lap time at the 2-minute mark summed over seven observations. There was a marginal condition affect (F1,80)=3.293, p=.073, η_p^2=.040) such that those in the VR condition were faster (mean=7.298, SE=.469) than those in the computer screen condition (mean=8.566, SE=.495). Relatedly is respondents assessment of how much they enjoyed playing the video games. A condition x order ANCOVA with social media sum and video game frequency history as covariates was computed and there was an order main effect (F(1,82)=4.383, p=.039, η_p^2=.051) and a condition x order interaction (F(1,82)=10.058, p=.002, η_p^2=.109). Those asked about how much they enjoyed the game in the dream collected before game play condition reported higher scores (mean=5.512, SE=.220) than those asked about their dream after having played the game (mean=4.867, SE=.214). This was almost entirely accounted for by the control condition individuals reporting this information when asked after reporting a dream (VR before mean=5.247, SE=.302; VR after mean=5.599; SE=.305; Control before mean=5.778, SE=.332; Control after mean=4.136, SE=.309).

The sense of being there, presence, was asked about for history of experience, during game play and in dreams. Respondents were introduced to the ten dimensions of presence by asking when or if they had experienced each. They were: Spatial, Social Presence, Transportation, Engagement, Social Realism, Perceptual Realism, Medium as Social Actor, Actor Within Medium, Self-Presence and Inverse Presence. These were rated along a 7-point scale of when experienced, where high numbers were longer ago. These same 10 presence dimensions were also asked about in terms of the gaming experience. In this case it was along a 5-point Likert-type scale assessing strength of presence. Neither of these sums showed any effect in condition x order of reports ANCOVA's. However, respondents were also asked about their overall sense of presence in the game along a 7-point Liker-type scale ranging from not at all to very strong. There was one order of report in lab main effect for overall presence in the game (F(1,69)=5.818, p=.019, η_p^2=.078) but no interactions in the condition x order ANCOVA with gaming frequency and social media use as covariates. When the game was played before the dream collection it was seen as higher in overall presence strength than if it was played after dream collection (mean before=5.64, SE=.227; mean after=4.857, SE=.229).

The sum of dream presence questions was computed for dreams collected in the lab and after the lab. When condition x order x time ANCOVA's were computed with the four covariates, video game frequency, social media use, and number of words in each dream there were no significant effects. However, it can be argued that these covariates are not relevant to a presence analysis. Thus, the same analysis without covariates did result in some significance. Specifically, there was a significant main effect for time of dream collection (F(1,74)=11.875, p=.001, η_p^2=.138) and a near significant interaction between time of dream collection and condition F(1,74)=3.627, p=.061, η_p^2=.047). The interaction means show that the main effect for

sum of self-report presence items was more pronounced for the VR condition (mean VR lab dream=61.572, SE=1.589; mean VR post lab dream=59.346; SE=1.777; mean control lab dream = 64.213; SE=1.589; mean control post lab dream=56.486, SE=1.777).

Finally, one item allowed comparison of self reported sense of overall presence in both the two dreams and after the game play. A condition x state (digital, lab dream, postlab dream) ANCOVA with the same covariates was computed on this question[iii]. There were no differences in the overall sense of presence reported by respondents in dreams versus game.

Dreams

Respondents answered questions about their dreams and judges also coded their dreams. Respondents answered questions about the type of dream, presence in their dreams and emotions in their dreams as was done in Study 1. Judges coded dreams along several dimensions thought to be related to dream lucidity and in terms of game content. A summary of the code book is in Appendix A.

Because of the experimenter differences regarding observations of the respondents in the lab, all judges' evaluations of dreams needed to be examined for an experimenter effect. Judges were trained until they agreed 80% of the time. None-the-less these additional statistics were calculated. Judges rated each dream along 32 dimensions. Thus 64 possible experimenter comparisons were possible for judges' ratings of dreams. T-tests found one significant difference (MACE rating of thinking/happening: t(85)=-2.939 p=.004) in judges dream coding. Given the number of tests this can be attributed to chance and supports that training in this case effectively got rid of experimenter differences. It should also be pointed out that the judges were blind to the origins of each dream they coded.

Dreams were coded to illuminate two major hypotheses, increased lucidity like mentation associated with VR gaming, and more VR gaming than 2D gaming incorporation as per the continuity hypothesis. Thus, results will be presented for both self report and judges assessments in terms of each dimension.

Lucidity Type Dimensions.

There was no difference for condition or when a dream was collected in the lab with or without covariates for self-report of dream lucidity. However, in the condition x order x time ANCOVA, judges assessment of lucidity did evidence a difference. This was the first of four assessments related to lucidity. Judges were blind to when and under what conditions a dream was collected. There were two main effects. One was for the judges assessment that a dream was lucid as a function of when the dream was collected ($F(1,73)=3.744$, $p=.057$, $\eta_p^2=,049$) and the second was a condition main effect ($F(1,73)=4.000$, $p=.049$, $\eta_p^2=.052$). Dreams collected from in the lab were judged to be more lucid (mean=3.932, SE=.041) than dreams collected post-lab (mean=3.860, SE=.049). Also dreams collected in the VR condition were judged to be more lucid (mean=3.964, SE=.045) than those collected in the 2D/computer condition (mean=3.828, SE=.048).

The second lucidity type assessment, as noted in the coding book in the Appendix, were items regarding pre-lucid dream states. However, not enough dreams were coded along these dimensions to allow analysis. The third way lucidity was assessed was using items from the MACE scale. Sum scores for lab and post-lab dreams were computed from these items. The fourth lucidity type assessment was using the Steward/Koulack scale. ANCOVA's with and without covariate's were not significant on either assessment.

Often associated with dream lucidity is dream control which both respondents and judges were asked about. Neither self-reports nor judges' assessments were significant regarding dream control. Another variable thought to be related to lucidity is if the dreamer experiences themselves as an observer to the dream. In the condition x order x time ANCOVA there was a an interaction for order x time of dream collection ($F(1,72)=5.031$, $p=.028$, $\eta_p^2=.065$). It can be seen in Figure 4 that there were no differences in self-reported observer type dreams when respondents were asked to report a dream prior to experiencing the game play. But when asked to report a dream after experiencing the game play then dreams reported in the lab were higher in the observer rating than those dreams reported post lab. This again evidenced the affects of digital reality exposure, 2D or 3D, on memories for dreams. Dream ego stance judges ratings however resulted in no differences.

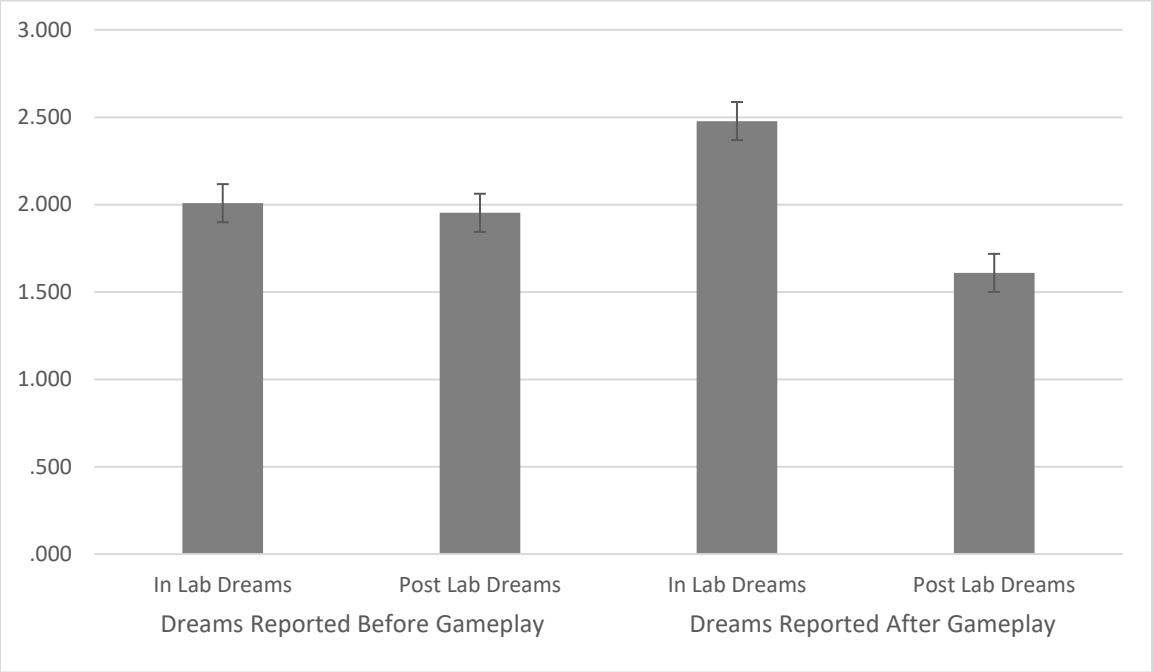

Figure 4. Means for Self-reports of observer dreams as a function of order of response in lab and time when dream was collected.

Other Dream Dimensions.

Respondents were asked if their dreams fell along several other dimensions. These included nightmares, bad dreams, bizarre dreams, and electronic media dreams. Bad, Bizarre and Electronic dreams evidenced no self-reported effects in the condition x order x time ANCOVA's with the same four covariates. Nightmares did show effect. Specifically, there was a condition x time interaction for self-reports of dreams as nightmares ($F(1,72)=3.817$, $p=.055$, $\eta_p^2=.050$). The interaction is primarily accounted for by the lab collected dreams in the control condition (mean=2.071, SE=.219). The other three means were very similar (postlab dreams control condition mean=1.536, SE=.193; lab dreams VR condition=1.485, SE=.206; postlab dreams VR condition=1.699, SE=.182).

Each dream was assessed by respondents in terms of the emotions it elicited. Fifteen emotions were asked about. Due to the large number of emotions data reduction was

accomplished by a varimax rotated factor analysis on the lab dreams and again on the postlab dreams. There were some similarities and some differences in the ways that respondents rated their own dream emotions. These factor structures are portrayed in Tables 5 and 6.

Table 5

Varimax rotated factor analysis of lab dream emotion self-reports

	1 negative emotions	2 fear	3 happy	4 sad
Anger	.730	.207	-.226	.041
Awe	.002	.134	.401	-.668
Arousal (sexual)	.031	.070	.780	.008
Anxiety	.425	.705	-.021	.149
Fear	.231	.855	-.154	.002
Guilt	.723	.196	.133	.092
Frustration	.741	.210	-.265	.245
Sadness	.542	.265	.174	.585
Hatred	.577	.362	-.070	.047
Happiness	-.003	-.337	.655	-.334
Jealousy	.536	-.079	.281	.236
Embarrassment	.773	.041	.130	-.070
Ecstasy	-.010	-.101	.840	.211
Downhearted	.171	.220	.272	.780
Terror	.067	.883	-.002	.068

When considering loading above .5, it can be seen in Table 1 that the lab dreams had four dimensions with general negative emotions and fear the most important. The other two dimensions were happiness and sadness. A somewhat different pattern emerged for the factor analysis of postlab dreams which is portrayed in Table 6.

Table 6

Varimax rotated factor analysis of postlab dream emotion self-report

	1 fear	2 negative emotions	3 jealous	4 mixed emotions	5 sex
Anger	.450	.442	-.109	.569	-.026
Awe	.007	-.021	.011	.857	.104
Arousal (sexual)	.026	-.060	.025	.053	.829
Anxiety	.864	.212	.121	.059	-.067
Fear	.799	.326	.043	.009	-.019
Guilt	.100	.848	.159	.035	.019
Frustration	.620	.115	.399	.375	-.033
Sadness	.110	.672	.497	.078	-.073
Hatred	.277	.704	-.009	.005	-.076
Happiness	-.634	-.078	.051	.527	.291
Jealousy	-.317	.058	.660	.174	-.241

Embarrassment	.310	.027	.800	-.215	.114
Ecstasy	-.191	-.021	-.105	.092	.828
Down-hearted	.146	.486	.526	.034	-.005
Terror	.505	.554	-.236	-.047	-.082

Using the same .5 cutoff for interpretation, in the second factor analysis the primary two factors were the same, if in the opposite order, than the factor analysis on the lab dreams; fear and negative emotions. Following these were factors describing jealousy, mixed emotions and finally sexuality. Despite this interesting difference in factor structure and the nightmare finding, there were no emotion effects in condition x order x time ANCOVA's with the same four covariates.

Gaming into dreams rated by judges.

While respondents were asked if they thought the game factored into their dreams, it was an open-ended question. Thus, judges rated these reasons why they think game incorporated into dream along a dimension called clarity. In the condition x order ANCOVA on these ratings there were no differences with and without covariates. Judges also coded the dreams for game incorporation along three basic dimensions as can be seen in Appendix A. Three scores were computed as sum of ratings of game in dream as well as HVDC and ESRB sums. No differences were found as a function of the major two independent variables.

Study 3

A third study was run in order to address some of the concerns with Study 1 and with Study 2. First male respondents were used in this study as well as male experimenters. Second a more rigorous training method for observing respondents in the lab was adopted. Third, a related individual difference measure was added. Fourth, a more game friendly system was employed. Finally, refined dream coding procedures were employed.

Study 3 Method

Participants

A total of 85 male participants from MacEwan University participated in the study. The ages of the participants ranged from 17-28 with the mean age of 19.54. Participants were awarded up to 4% credit towards their overall course grade: 2% for completing the in-lab session and 2% for reporting a dream with accompanying questionnaire within one week of the lab session.

Instruments

Prescreen. Male participants were pre-screened for lack of motion sickness, comfort with violence in video games, and dream recall frequency.

Demographics. (Gackenbach & Gahr, 2015): See study 1.

Video Game Play Questionnaire. (Gackenbach & Rosie, 2009): See study 1.

Social Media Use Questionnaire. (Gackenbach & Boyes, 2014): See study 1.

Media Production and Telepresence Survey. (Lombard, 2014; Gackenbach & Rosie, 2009; 2011). See study 1.

Dream collection. (Gackenbach & Rosie, 2011): See study 1.

Dream presence. (Lombard, 2014; Gackenbach & Rosie, 2011): See study 1.

Game Transfer Phenomena Scale (GTP). (Ortiz de Gortari, Pontes & Griffiths, 2016): The overall Cronbach's alpha for this 21-items scale was 0.921. This scale assessed

experiences had in video game play that generalize to waking reality using a Likert scale of frequency. The subscales included were altered perceptions modality which is sub-divided into visual, auditory and body sensorial perceptions (i.e., I have visualized or seen video game images with closed eyes, I have heard sounds, music or voices from the game.), automatic mental processes modality (i.e., I have thought about using something from a video game in real-life.), and actions and behavior modality (i.e., I have sung, shouted or said something from a video game in real life without intending to do so.).
Observations. Researcher observations were consistent with study 1 (see study 1), with 3 notable exceptions. First, observations were made every 10 minutes, for a total of 3 set of observations for each participant. Second, the researcher assessed the overall degree to which the player was immersed in the game experience, on a 5-point Likert scale (0 - not at all, 5 - a great amount). Third, the experimenter recorded the number of times they used a health potion and the number of times they died while playing the game.
Multimedia device. The hardware used for the gameplay sessions was the PlayStation 4 (PS4), PlayStation VR headset, a PS4 controller, and a pair of Bose headphones. The VR headset has an exceptionally high-quality resolution (960 x 1080) on a 5.7 inches OLED (organic light-emitting diode) display that covers about 100 degrees of the wearer's field of vision but gives 360 degrees of vision accessible via head movement. The Bose headphones were used to aid in the immersion of the game. The game used was Resident Evil 7: Biohazard which is a first-person survival horror video game. The participants played a section of the game that involved a mix of shooting enemies, exploring the environment, and completing puzzles.

Procedure

Study 3 was a replication/extension of study 1 and 2, procedures were consistent with study 1, while experimental conditions were consistent with study 2 (reporting a dream before or after gameplay, in both the experimental and control conditions). A notable exception to the procedure was the instruction in and length of gameplay, which differed from study 1 and 2, as a different game was used. Participants played Resident Evil 7 – Biohazard for 30 minutes. Before game play, participants were provided with a set of instructions on how to maneuver through the menu options of the game and how to use the controllers. They were also walked through the game play and made aware of the objectives that they should, if they can, cover during the 30-minute period. After gameplay the survey questionnaire resumed, as per study 1 and 2.

Study 3 Results and Discussion

After being pre-screened for gender (male), lack of motion sickness, comfort with violence in video games and dream recall frequency, 88 were selected to be contacted. From these 85 undergraduate males at a western Canadian university participated in this research. They ranged in age from 17 to 33 with an average age of 19. Ninety-four percent were never married. Analysis will begin with examination of potential confounds. Then evaluations of the manipulation will follow. Finally, two types of examinations of reported dreams will be taken up, self reports and judges coding.

Confounds

To be sure that the manipulation was causal for any dream effects, the evaluation of potential confounds was examined. Previous experience with VR was assessed with these

possible responses: Yes, frequently (1) Yes, infrequently (2) Yes, rarely (3) Never used VR headset but have experience with VR (4) Never used a VR headset or experienced any other type (5). Thirty-five percent of the participants said they never had any experience with another 30% indicated they had some experience with VR but never used a VR headset. A chi-square on condition by VR experience response was not significant thus previous experience was not a potential confound.

Several analyses were computed to determine if other elements of history with gaming might have been unevenly distributed across conditions. It can be seen in Table 7 which variables showed such differences despite pre-screening and random assignment to conditions.

Table 7

Game related variables which evidenced condition differences

				VR		Control	
Game Condition Variable	F*	Sig	η_p^2	*M*	*SE*	*M*	*SE*
Video game play frequency	3.844	.053	.045	3.886	.170	4.367	.176
Video game play length	6.324	.014	.072	3.500	.157	4.070	.163
Use of gaming social media	5.348	.023	.062	3.091	.274	4.002	.284
				Before VR		Before Control	
GTP**	7.678	.007	.087	13.091	.690	14.400	.724
				After VR		After Control	
				15.682	.690	13.095	.707

* F(1,81) ** (Game transfer phenomenon) on mental processes (interaction with order of dream report)

The GTP interaction, while not a main effect for condition, was used as a covariate in order to control for a potential personality type effect. This along with the three video game play variables indicated in the table were used as covariates in all analysis involving dreams.

Manipulation Assessment

Before the dream reports are examined, considerations of the assessment of the manipulation of 2D versus 3D gaming are examined. This was done in several ways including, systematic observations by the experimenter, game performance and self reports of felt sense of presence, being there, in the video game.

Game Performance.

A condition MANOVA was computed on these two performance measures:

1. How many times did the participant die during the 30 minute period?
2. How many health potions did the participant use during the 30 minute period?

There were no main effects or interactions with covariates or without covariates. Thus, whatever the interface, game performance was the same across groups.

Observations of Game Performance: Presence

The experimenters made observations while participants played the game. These included verbal emotional expressions, nonverbal gestures and an assessment of the players behavioral indices of absorption, and thus presence, in the game. These were made in three 10-minute intervals over the 30-minute play period. They included expressions of positive, neutral and

negative emotions. Judges coded each set of 10-minute observations with these percent agreements: 81.4%, 74.6% and 81.4%. The average agreement was 79.13%.

Analyses were computed between condition and coding blocks of time for each of the emotions with all four covariates. Covariates were considered justified as the reason for them was to eliminate video game confounds from the manipulation. There were no main effects or interactions.

Observers also coded nonverbal behaviors and there were findings for the condition x block ANCOVA's with the same covariates. There was a main effect for condition ($F(1,68)=28.643$, $p=.0001$; $\eta_p^2=.296$) and a condition x block of time interaction ($F(1,68)=4.130$, $p=.046$; $\eta_p^2=.057$). While overall observers coded more nonverbal behaviors in the VR condition than in the control one (VR mean=3.847, SE=.159; control mean=2.663, SE=.146), the changes of nonverbal gestures over the three 10 minute blocks of play differed by condition (VR block 1 mean=4.598, SE=.196; VR block 2 mean=3.827, SE=.228; VR block 3 mean=3.121, SE=.204; Control block 1 mean=3.142, SE=.179; Control block 2 mean=2.501, SE=.209; Control block 3 mean=2.501, SE=.209). The drop in nonverbal gestures coded was faster for the control condition as it happened by the second block of time while the drop in the VR condition was less abrupt.

Related to these performance measures were the observer's assessments of immersion in the game. The observers gave an overall rating to the degree of immersion based on a five-point likert-type scale where presence was defined for the observers as amount of nonverbals demonstrated. Condition x block ANCOVA's with 4 covariates were computed. An interaction between block of time and condition was significant ($F(1,79)=8.677$, $p=.004$, $\eta_p^2=.099$). Over time the judged immersion decreased in both conditions but more dramatically for the VR condition while for the control condition it seemed to level off (VR block 1 mean=4.470, SE=.131; VR block 2 mean=3.842, SE=.192; VR block 3 mean=3.365, SE=.184; Control block 1 mean=4.056, SE=.136; Control block 2 mean=3.755, SE=.199; Control block 3 mean=3.706, SE=.191). By the third block of observations the immersion was judged to be higher in the VR condition than in the control condition. The drop in immersion from block 1 to 3 could be the participant becoming more use to the VR experience. For example, some participants once entering the game would look around in the environment a great deal (including spinning their chair full circle). For some participants, this is their first time using a VR headset, and as the time progresses, they may become more used to the VR.

Respondents Self Reports of Game Performance/Presence

Immersion or presence was asked about in three contexts, past history with technology, during video game play and in dreams. Presence questions regarding respondent past history with technology and in video game play in the lab were asked about as a function of type of presence (spatial, social, etc.). History questions asked about how long ago the respondent experienced each type of presence; today (1) through don't remember (8). Video game presence was inquired using a 5-point Likert-type scale ranging from not at all (1) to strongly (5). Both observers and game players agreed that they were more immersed in the VR play than in the traditional 2D play. Consistent with the observer's assessments were the respondents self reports of immersion in the game ("How STRONG was the sense of presence in this gaming experience?") as well as self reports of overall history of immersion in media. In both cases respondents were asked to answer the presence questions in terms of different dimensions of presence. The sum of these dimensions was computed and initial analyses were then done. There

were no condition effects for sum of history of media immersion self reports but there was a main effect for sum of game presence scores, condition (F(1,79)-9.341, p=.003, η_p^2=.106). The VR condition respondents reported more presence (mean=35.18, SE=1.269) than the controls (mean=29.466, SE=1.317). The game presence scores were then broken down into types of presence. So when asked for one evaluation of their sense of presence in the game along a 7-point Likert-type scale there was also a main effect for condition (F(1,78)-5.179, p=.026, η_p^2 =.062). Again, those in the VR condition reported more overall sense of presence (mean=5.992, SE=.180) than those in the control condition (mean=5.384, SE=.189).

Finally, they were asked how much they enjoyed the game. There was a marginal condition main effect in the condition x order ANCOVA (F(1, 81)=3.666, p=.059, η_p^2=.043). Those playing in the control condition reported more enjoyment than those playing in the VR condition (control mean=5.781, SE=.225; VR mean=5.182, SE=.217).

Dream Analyses

Two dreams were collected from each participant. The first was their most recent dream prior to reporting to the laboratory. These were collected either before or after the manipulation of game play type. The second dream was collected in the week following the laboratory experience. A bit less than half of the respondents (N=38) reported a dream post lab which occurred in the week after their participation. A Chi-Square analysis of the distribution of these postlab dreams across the two independent variables was not significant thus the condition by order of lab dream collection independent variables was balanced for post lab dream collection. Both dreams were rated by the dreamer and by independent judges along several dimensions. Analyses of the self ratings will be taken up first, followed by the judges coding.

Self Reported Dream Analysis.

Respondents rated each dream in terms of type of dream, emotions in the dream, and felt sense of being there, presence, in the dream. These will taken up in turn.

Dream Type.

Respondents were asked to rate the dream in terms of type of dream experienced, emotions in the dream and felt sense of presence in the dream. Several condition (VR/control) x order (dream collected before/after game play) x dream time (before/after laboratory) ANCOVA's with four covariates, frequency and length of video game play, use of gaming social media and GTP mental process subscale scores, were computed. Nothing was significant for dreamer's ratings of dreams as nightmares, bizarre dreams, observer dreams or electronic dreams. However, significant and near significant findings emerged for ratings of dreams as lucid, control, or bad dreams. The self identification of the dream as somewhat lucid was marginally significant for the dream time x condition interaction (F(1,30)=3.831, p=.060, η_p^2 =.113). It can be seen in Figure 5 that there is no difference in the lab lucidity while post lab the VR condition dreams were higher than the Control condition dreams in this dream attribute. Although this is marginal it is supported by the judge's assessments which will be taken up shortly.

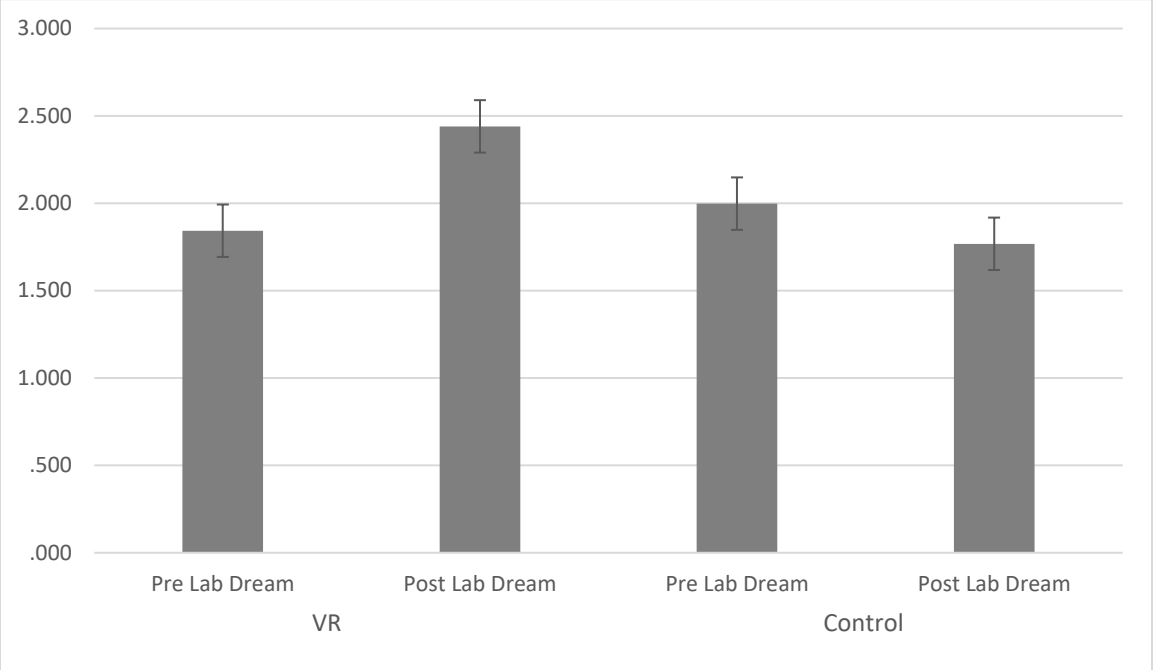

Figure 5. Means of self-evaluations of dream as lucid under two conditions (VR and control) as a function of order of response in lab and time when dream was collected.

The second dream type attribution to show condition effects was dreamer perceived control, control dreams. An order main effect ($F(1,30)=5.786$, $p=.023$, $\eta_p^2=.162$) and a condition x order interaction ($F(1,30)=3.909$, $p=.057$, $\eta_p^2=.115$). All dreams reported after game play were perceived as more controllable (mean=2.332, SE=.206) than those reported before gameplay (mean=1.550, SE=.249). This also interacted with condition such that the VR game play accounted more so for the order effects (before VR game mean=1.371, SE=.369; after VR game mean=2.846, SE=.343; before control game mean=1.728, SE=.350; after control game mean=1.819, SE=.270).

The third dream type effect was for bad dreams in a three-way interaction ($F(1,30)=4.085$, $p=.052$, $\eta_p^2=.120$). It can be seen in Figure 6 that the differences were primarily about when the dream was reported. That is, those reported before the game play showed the most variability in bad dream assesments relative to those reported after the game play in the lab. This is a strong illustration of the importance of situational factors in reporting dreams. In this case playing a video game.

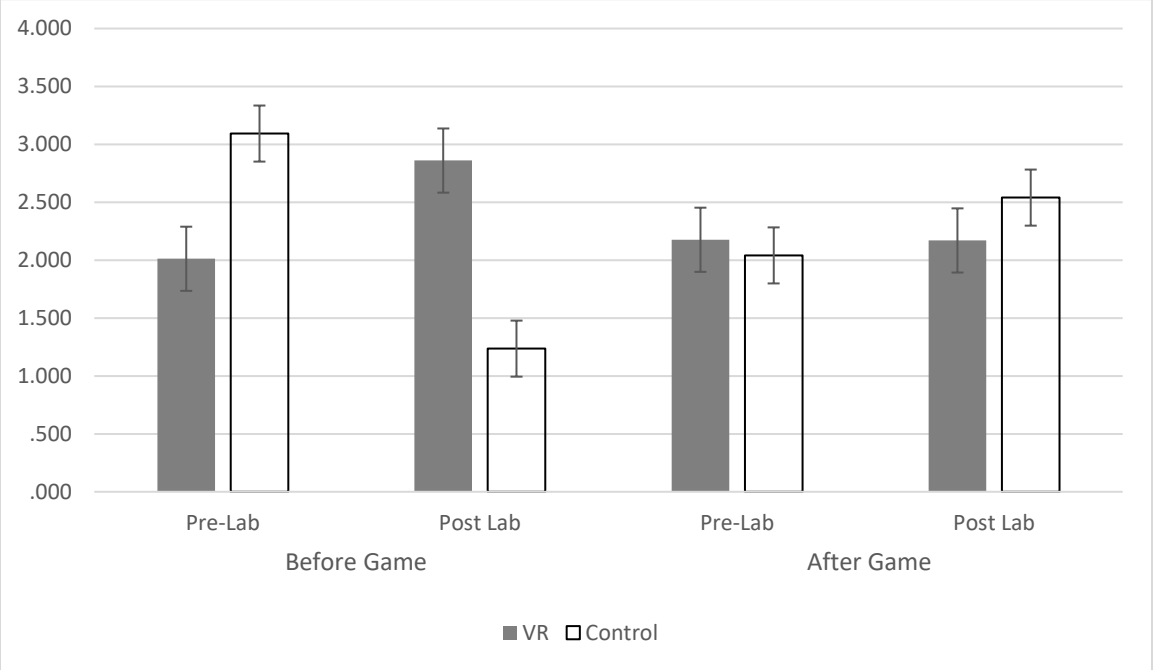

Figure 6. Means of self-evaluations of dream as bad dream under VR and control conditions as a function of order of response in lab and time when dream was collected.

Dream Emotions.

Respondents were also asked to rate their dreams in terms of the emotions they experienced in the dream along 15 dimensions. To reduce the number of emotion variables varimax rotated factor analyses were computed with factor scores saved separately for lab dream and postlab dream. These factor matrices are offered in Tables 8 and 9. Each dream emotion was rated along a five-point Likert-type scale ranging from Not at all intense (1) - Extremely intense (5).

Table 8

Varimax Factor Matrix of Self Reported Dream Emotions for Recent Dream Reported in Lab

	1	2	3	4
Prelab Dream Emotion	Fear	Sad	Anger	Happy
Anger	.210	.108	.880	-.001
Awe	.189	.024	-.345	.640
Arousal (SEXUAL)	-.300	.341	.170	.474
Anxiety	.769	.242	.252	.036
Fear	.884	.145	.158	-.073
Guilt	.193	.661	.152	-.061
Frustration	.064	.170	.797	-.028
Sadness	.293	.622	.189	-.123
Hatred	.282	.108	.631	-.131
Happiness	-.479	.083	-.238	.682
Jealousy	-.178	.665	.001	.157
Embarrassment	.087	.540	.038	.420

Ecstasy	-.070	-.077	.065	.854
Downhearted	.278	.766	.122	.002
Terror	.795	.109	.129	-.100

Table 9

Varimax Factor Matrix of Self Reported Dream Emotions for Recent Dream Reported Postlab

	1	2	3	4	5	6
Postlab Dream Emotion	Anger	Happy	Fear	Sad	Jealous	Embarrassment
Anger	.761	-.022	.278	.024	.090	.116
Awe	-.363	.570	.211	-.234	.221	.331
Arousal (SEXUAL)	.416	.688	.256	.219	-.121	.013
Anxiety	.190	-.245	.554	.311	.371	.392
Fear	.160	-.072	.874	.306	.093	.018
Guilt	.111	-.098	.216	.795	-.034	.119
Frustration	.705	-.226	.049	.189	.054	.316
Sadness	.157	-.273	.090	.505	.601	-.160
Hatred	.914	.077	.159	-.062	-.049	-.011
Happiness	-.147	.748	-.399	-.106	.114	-.031
Jealousy	-.025	.088	-.078	-.190	.856	.003
Embarrassment	.228	-.028	-.071	.104	-.079	.896
Ecstasy	-.052	.866	-.199	.072	-.111	-.137
Downhearted	-.050	.180	.097	.792	-.076	.044
Terror	.256	-.088	.862	.039	-.196	-.128

Interestingly there were different factor structures for the dreams collected at different times relative to the lab experience. Previous research with these emotions has repeatedly found the factor structure like the recent dream prior to the lab experience; Fear, Sad, Anger, and Happy. If not always the same order. However, the factor structure of the postlab dreams added two dimensions to these four; Jealousy and Embarrassment. In any case separate MANOVA's with the same covariates were computed on the factor scores of each dream time collection. For the recent dreams reported in the laboratory there was an interaction between type of emotion and condition ($F(1, 30)=6.999$, $p=.010$, $\eta_p^2=.083$). Three of the four dream emotions attributed to the recent dream showed not much difference between the two game playing conditions (VR: Fear mean=-.131, SE=.150; Sad mean=-.061, SE=.157, Anger mean=.001, SE=.156; Control: Fear mean=.138, SE=.156; Sad mean=.061, SE=.162, Anger mean=-.004, SE=.162). The interaction was accounted for by the Happiness factor scores (VR Happy mean=.267, SE=.151; Control Happy mean=-.286, SE=.157). The control group reported significantly less happiness regarding their previous dream when reported in the laboratory. This might be due to the expectation of many respondents to experience VR and when they found out that they were not to play a VR game they were disappointed. However, half of the respondents reported their recent dream prior to knowing if they would play a VR game or not. Furthermore, there were no significant effects with order provided dream reports. The post lab self reported dream emotions MANOVA with covariates evidenced no significant main effects or interactions.

Dream Presence.

As with game presence, dream presence was asked about along the same dimensions (i.e., spatial, social, etc). Because all three times respondents were asked about presence along the same dimensions it was possible to compare dream presence to game presence sum scores. That is the sum of responses to each of the ten dimensions (spatial, social, transportation, engagement, social realism, perceptual realism, medium as social actor, actor within medium, self presence, and inverse presence) were computed and compared. There was a sizable dropoff at the postlab dream collection time of responses to these items. None-the-less there were two interactions and a main effect. They were an order x presence sum ($F(1, 29)=4.157$, $p=.051$, $\eta_p^2=.125$). For the dreams reported before game play condition the highest presence was for the lab dream (mean=38.453, SE=2.481), followed by the postlab dream (mean=37.592; SE=3.551) and the lowest was gaming (mean=31.841, SE=1.903). While in the same direction for the dreams reported after the game play the two dream presence scores were considerably higher (mean lab dream=51.877, SE=1.964; mean postlab=48.481, SE=2.811; mean game=32.682, SE=1.506).

The second interaction was for condition x presence sums ($F(1, 29)=3.795$, $p=.061$, $\eta_p^2=.116$). The main effect was for order ($F(1, 29)=11.336$, $p=.002$, $\eta_p^2=.281$). Order was the strongest finding with overall presence sums highest after the game condition (mean=44.347, SE=1.543) than in the before game condition (mean=35.962, SE=1.949). The marginal condition x presence sum interaction is of particular interest to the present inquiry. It is portrayed in Figure 7, where it can be seen that the game presence was rated as lower than either dream presence and within that the VR presence was higher. While the dream reported in lab for those who were in the VR condition was also higher. The opposite was the case for the post lab dream presence ratings. Thus VR seemed to have an effect both in game and in a dream reported in the lab while not so much after the dream reported after the lab session.

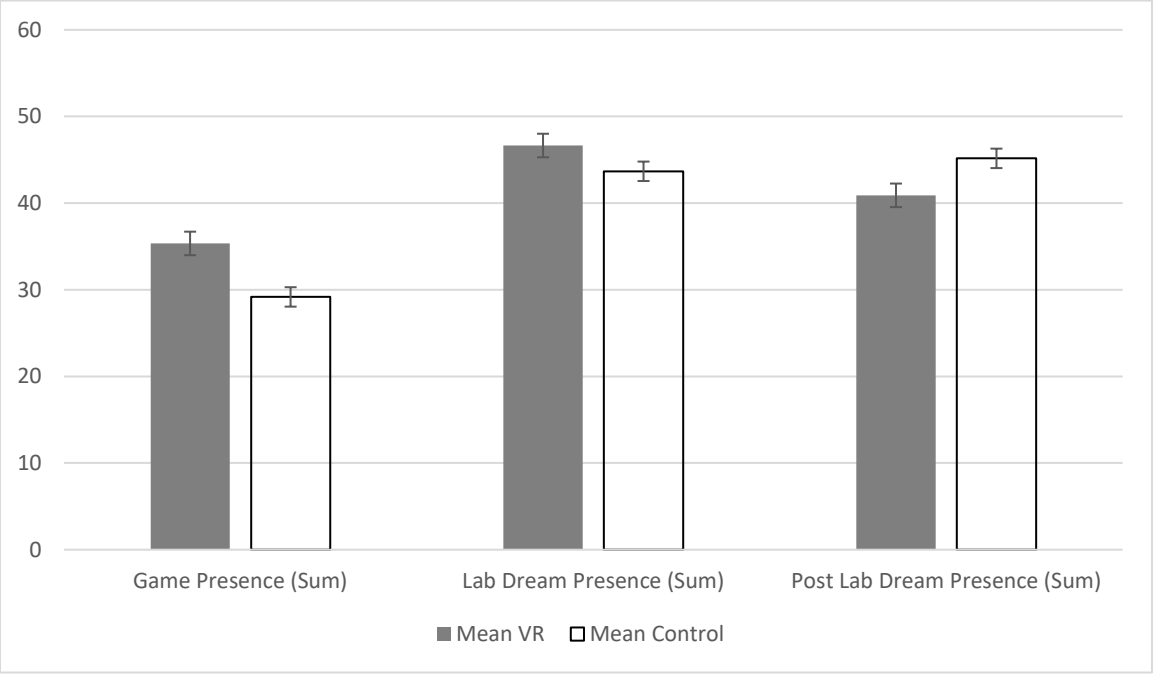

Figure 7. *Means of presence sum scores as a function of condition.*

Sum scores were computed and a condition x order x time of dream collection ANCOVA was computed on these sum scores. There was an order of dream collection in the lab main effect ($F(1, 29)=13.022$, $p=.001$, $\eta_p^2=.310$). Dreams collected both in lab and post lab were viewed as higher in presence when collected after the gaming experience (mean dream collected after gaming=50.179, SE=2.087; mean dream collected before gaming=38.023, SE=2.637). This illustrates the impact that exposure to any type of virtual world can have on estimates of sense of being there in other realms.

Dream presence was also ascertained through a series of questions used in earlier studies (Gackenbach & Rosie, 2011). These 13 items were asked of the dreamer about each of the dreams they reported. As with the dream emotions reports, a Varimax rotated factor analysis on these questions for the lab and post lab dreams were separately computed. These factor matrices are shown in Table 10. Interpretation uses a .5 cutoff.

Table 10

Varimax Factor Matrix of Self Reported Dream Presence for Recent Dream Reported in Lab

Presence in Recent Dream Reported in Lab	1 overall presence	2 reality presence	3 emotional presence	4 sensory presence
DPQ2 How STRONG was the sense of presence experienced in this dream? Not at all strong (1) - Very strong (7)	.835	.148	.076	.098
DPQ5 How involving was the dream?	.721	.215	.103	.418
DPQ6 To what extent did you feel mentally immersed in the dream?	.611	.279	.122	.403
DPQ7 How completely were your senses engaged in the dream?	.383	.231	.185	.626
DPQ8 How much of a sense of physical movement did you feel during the dream?	.074	.118	-.066	.862
DPQ9 The dream caused real feelings and emotions for me: Strongly disagree (1) - Strongly agree (7)	.254	.152	.785	-.073
DPQ10 I was so involved in the dream that I lost track of time.	.129	.156	.710	-.057
DPQ11 After the dream ended and I woke up I had to adjust back to waking reality.	-.171	-.085	.669	.369
DPQ12 Overall, how much did the things and people in the dream you saw/heard…: sounded like they would if you had experienced them in waking reality?	.088	.843	-.034	.100
DPQ13 Overall, how much did the things and people in the dream you saw/heard…: look like they would if you had experienced them in waking reality?	-.022	.830	.094	.092
DPQ14 To what extent did you experience a sense of 'being there' inside the dream?	.438	.532	.249	.121
DPQ15 How much did you feel like the events of the dream were happening to you?	.255	.549	.278	.166

DPQ16 How often did you feel "My body was in bed, but my mind was inside my dream"?	.533	-.338	.048	-.241

Table 11

Varimax Factor Matrix of Self Reported Dream Presence for Recent Dream Reported for Postlab Dream

Presence in Post Lab Dream Report	1 overall presence	2 reality presence	3 sensory presence	4 body in bed
POSTDRDPQ10.11 How STRONG was the sense of presence experienced in this dream? Not at all strong (1) - Very strong (7)	.806	.159	.054	.025
POSTDRDPQ10.14 How involving was the dream?	.700	.222	.120	.263
POSTDRDPQ10.15 To what extent did you feel mentally immersed in the dream?	.862	.219	.238	.145
POSTDRDPQ10.16 How completely were your senses engaged in the dream?	.428	.395	.597	.140
POSTDRDPQ10.17 How much of a sense of physical movement did you feel during the dream?	.203	.110	.868	.112
POSTDRDPQ10.18 The dream caused real feelings and emotions for me: Strongly disagree (1) - Strongly agree (7)	.645	.226	.013	-.384
POSTDRDPQ10.19 I was so involved in the dream that I lost track of time.	.185	.726	.041	.081
POSTDRDPQ10.20 After the dream ended and I woke up I had to adjust back to waking reality.	.504	.243	-.536	.375
POSTDRDPQ10.21 Overall, how much did the things and people in the dream you saw/heard…: sounded like they would if you had experienced them in waking reality?	.113	.914	.133	.025
POSTDRDPQ10.22 Overall, how much did the things and people in the dream you saw/heard…: look like they would if you had experienced them in waking reality?	.349	.818	-.005	-.025
POSTDRDPQ10.23 To what extent did you experience a sense of 'being there' inside the dream?	.782	.316	.117	.104
POSTDRDPQ10.24 How much did you feel like the events of the dream were happening to you?	.528	.635	.173	-.047
POSTDRDPQ10.25 How often did you feel "My body was in bed, but my mind was inside my dream"?	.113	.034	.098	.888

There were some similarities and some differences in the factor structures regarding presence in the two sets of dreams. The first and most important factor in both was an indication of overall presence while the second factor seemed to deal with questions of reality. The third factor for the lab dreams dealt with emotional presence, but for the postlab dream the third factor was relatively the same as the fourth factor in the lab dreams, sensory presence. However, there was

one interesting difference between these factors, in the post lab dream the lack of having to adjust to reality loaded with the sensory elements of presence. The fourth factor in the post lab dreams dealt with feeling like their body was in bed. A MANOVA on the factor scores resulted in one main effect for the postlab dream social/self presence rating ($F(1,78)=4.94$, $p=.029$, $\eta_p^2 =.060$). These factor scores were higher under the VR (mean=.242, SE=.153) than under the control conditions (mean=-.261, SE=.161).

Finally respondents who provided a postlab dream were asked if they thought that their dream contained anything from the video game played in the lab. Of the 38 dreams reported post lab, 21 said it was related to playing the video game and gave specific reasons (55%). These included:

1. I was a hero in the video game and I was trying to be a hero in the dream
2. In the video game you are chased by enemies, and one of the enemies did crawl on all fours very creepily which my unconcious may have interpreted as a bear in my dream

Judges Dream Coding.

Two judges coded the lab dreams and the post lab dreams along several dimensions. They reached at least 80% agreement on test dreams prior to moving on to the dreams collected in this research study. Coding of dreams was always done blind, no information about independent variables or respondents background. The three types of content analyses were threat simulation, lucidity, and game incorporation. Each type of coding will be taken up with results of the coding. For each type of dream coding statistical analysis was for condition x pre/post lab dreams with all four covariates. Furthermore, as noted earlier, the chi-square on postlab dreams reported was not significant so that while there were fewer of them, they were relatively evenly distributed across conditions.

Threat Simulation.

The threat simulation analysis was done as described by the developers of the measure, with only continuous variables used in statistical analyses. These dependent variables were examined in condition x order x pre/post dream ANCOVA's with the four covariates: Threat Simulation Type, Threat present/absent, Nature of threatening event, Target threat sum, Severity of threat, Participation of self, Reaction of self, and Consequences of threatening event. There was only one significant finding which was for the Severity of Threat x order interaction ($F(1, 7)=6.141$, $p=.042$, $\eta_p^2 = .467$). This was accounted for by the large difference in threat judged to be in dreams reported in the lab when comparing those reported before playing the game and those reported after playing the game (mean before=1.266, SE=.833; mean after=3.615, SE=.353). The postlab dreams evidence no such difference in order (mean before=4.307, SE=.336; mean after=3.845, SE=.143). The general lack of findings is not surprising given that all respondents played a combat centric game and that previous game related variables were controlled for with covariates. That said what was found is consistent with the idea that being primed for threat first, playing the game in the lab, and following this by a recent dream report would result in some difference.

Lucidity Content.

The lucidity content was examined using a form of the Voss et al scale. Each item was reframed from a first person to a third person perspective. Thus item 1 "While dreaming, I was aware of the fact that the things I was experiencing in the dream were not real" became "While dreaming, the dreamer was aware of the fact that the things he was experiencing in the dream were not real." Judges answered each question for each dream along a six-point Likert-type

scale, ranging from zero (strongly disagree) to five (strongly agree) with each statement. Then subscale sum scores were calculated for these subscales as indicated by Voss et al. (Insight, Control, Thought, Realism, Memory, Dissociation, Negative Emotions and Positive Emotions).

Seven repeated measure (pre/post lab dream) x condition x order ANCOVA's with the same four covariates were computed on all but the Dissociation subscale score. This scale was dropped because the postlab dreams had no variance in this coding. Of the remaining subscales four resulted in no significant findings (Insight, Control, Thought, and Positive Emotions). Memory, and Negative Emotions had results approaching significance. Realism evidenced a main effect and two interactions. The main effect was for time of dream collection ($F(1, 29)=4.479$, $p=.043$, $\eta_p^2=.134$). Dreams collected in the laboratory, across order and condition, were judged to have higher Voss realism subscale scores (mean = 5.096, SE=.741) than dreams collected after the lab experience (mean=3.719, SE=.793). One two way interaction was significant (time x condition: $F(1, 29)=17.705$, $p<.0001$, $\eta_p^2=.379$). Dreams collected in the lab in the VR condition were rated as higher in realism (mean=6.699, SE=1.128) than those collected in the lab in the control condition (mean=2.317, SE=1.207). While the opposite, if not as big a difference, was the case for the post lab dreams. That is, control condition postlab dreams were rated as higher in reality on the Voss scaled (mean=5.122, SE1.099) than those collected from the VR condition (mean=3.494, SE=1.027). Finally, there was a three way interaction ($F(1, 29)=10.722$, $p=.003$, $\eta_p^2=.270$). Here order of dream collection made a difference. The patterns of reality in dreams collected before game play looked just like the two way interaction (VR beforlab dream mean=8.325, SE=1.662; VR before postlab dream mean=1.417, SE=1.779; Control before lab dream mean=1.681, SE=1.696; Control before postlab dream mean=5.613, SE=1.815). The pattern of judged realism in dreams collected after the game play manipulation was quite different. In the lab dream there was almost no difference in judged realism when collected after the gaming manipulation while both conditions were associated with drops in reality assessement scores from lab to post lab dreams, it was especially m arked for the VR condition (After: VR lab dream mean=5.073, SE=1.545; VR postlab dream mean=3.217, SE=1.654; Control lab dream mean=5.308, SE=1.220; Control postlab dream mean=4.632, SE=1.306).

Game Coding.

Finally, a coding system was developed for content incorporation in dreams. It can be seen in Appendix C. Sum scores were calculated for each of the three major game content areas which were coded as present or absent: Locations, Person/Objects/Things and Actions/Events. The final set of content questions were coded along a 5-point Likert-type scale. The reason for the last set of content categories was that there was enough tangentially game related violence and activities that the need to further characterize the action or event coding seemed justified. Plus, none of the sub-categories of the last set of codes overlaps with actions/events coding, even though overall it may seem like a redundancy. They all cover subtly different details of the dreams. This was confirmed by correlations between action/event sum scores and individual Likert ratings. For the lab dream only one was significant action/events with startles/jumping ($r(83)=.482$, $p=.0001$). For the post lab sum of action/event the only significant correlation was with shooting guns ($r(33)=.431$, $p=.01$). The majority of the correlations were not significant.

The act frequency analyses were then taken up. These are sum scores of the occurrence of a series of things thought to be game related. Three condition x order x time of dream ANCOVA's were computed. There were two interactions for the location sum (Condition x

Time: F(1, 27)=4,290, p=.048, η_p^2=.137; Condition x Order: F(1, 27)=5.449, p=.027, η_p^2=.168).

As with the previous interactions this one was accounted for by the changes in VR condition (VR lab dream mean=.119, SE=.122; VR postlab dream mean=.606, SE=.199). The means and standard errors for these two interactions are shown in Table 12. It can be seen that there was no difference in the presence of location coding in the dreams reported in the lab which is to be expected as those dreams actually occurred prior to the lab. But for the dreams reported after the lab session those from the VR condition had more location references than those in the control condition. For the condition x order interaction difference in location was evident for dreams reported before the gaming condition while the inverse was true for postlab dreams, if of less magnitude. This is harder to explain as the difference is primarily due to the preprimed group (report dream before gaming) and that difference reverses after the gaming prime.

Table 12
Means and Standard Errors for Judges Dream Coding of Game Location Interactions and Order Interactions by Condition

Conditions	locations	Mean	Std. Error
VR	Lab dream locations	.119	.124
	Post lab dream locations	.613	.188
Control	Lab dream locations	.233	.111
	Post lab dream locations	.075	.168

Conditions	Order of in lab dream collection	Mean	Std. Error
VR	Before Game	.571	.159
	After Game	.161	.154
Control	Before Game	-.035	.162
	After Game	.343	.120

For the other act frequency coding variables, person/object/things and actions, there were no significant findings. The means of the five likert descriptions of game activities were computed for both the dreams reported in the lab and those reported post lab. The same condition x order x time ANCOVA was computed on these means with the same four covariates. There were no main effects or interactions.

Summary and Concluding Discussion

Presence is the concept of feeling present in another environment. This feeling is experienced during the biologically created virtual reality of dreams. Technology developers are attempting to re-create this experience using digitally created virtual reality. This feeling of presence often leaves the dreamer or the gamer to ask themselves, ‘where am I?’, which is a question often found in research in video games and the use of the Internet. On a broad conceptual basis, the findings in this research study partially address questions pertaining to technology-mediated presence and subsequent relations to other non-physical realities. It seems

as though a technological virtual reality environment affects the presence that one experiences in a dream, another type of virtual reality. These effects have also been found while awake, as researchers (Guterstam & Ehrsson, 2012) were able to induce an out-of-body illusion for participants, detaching from their physical body when its location was manipulated. The sense of self in the world is increasingly being altered through the use of technology and the Internet, and will only continue to increase as virtual reality technology improves.

In three studies over a four year period the effects of video game play in two modalities, 2D and 3D, were examined in terms of felt sense of presence and dream content. Methodological refinements occurred after each study so that by the third study there were at least more results to consider. After the first study with the finding of lucid dreaming associated with VR gaming the question arose if the effect was associated with when the dream report was elicited in terms of the gaming manipulation. That is, was the dream experienced prior to the lab reported before or after the gaming manipulation. Thus the major methodological adjustment in study two was order of dream report. Several adjustments were made in study three. VR goggles had become more sophisticated and wide spread and associated with gaming consoles, thus the apparatus in the third study was changed to the Playstation gear. Also by 2017 when the third study was run more traditional video games were available. Thus a standard combat game was used. This was because it was thought that combat games are more engaging than racing games as well as the improvement of game play graphics in VR that emerged. In all three studies the same game (racing in studies one and two, combat in study 3) was played under the two viewing conditions.

Due to the many dependent variables over three studies the findings have been summarized in Table 13. This table summary allows consideration of effects across all three studies in one line.

Table 13[1]

Summary of results for each category of dependent variables as a function of study for both condition and order effects

Condition effects

	Study 1	Study 2	Study 3
Media use history	ns	video game frequency: VR>Control Social media: VR: before>after Control: after>before	Video game variables: Control>VR Game Transfer Phenomena: Before: Control>VR After: VR>Control
Game performance	Game Indices: Control>VR	Game Indices: VR>Control (marginal)	Game Indices: ns
Presence	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
1. History of presence	ns	ns	ns
2. game presence	VR>Control	ns (overall and sum)	VR>Control

3. game enjoyment	ns	Before: Control>VR After: VR>Control	Self: Control>VR Judges (emotion ratings): ns
4. observer's rating of presence in games	VR>Control	Ns[2]	Nonverbal: VR>Control Immersion: VR>Control in drop over time
5. dream presence	Lab dream>postlab dream	Lab>postlab (especially for VR)	Self rating: dream social/self presence: VR>Control Judges: see Voss realism coding below
6. game vs dream presence	Post game: VR>Control Lab dream: Control>VR Postlab dream: VR>Control	ns	See order effect below
Dream content	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
1. self evaluations	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
a. lucid related	Lab dream: VR>Control Postlab dream: Control>Vr	ns	Lucid dreams: lab: VR=Control Postlab: VR>Control Control dreams: Order: After>Before Interaction: VR: After>Before Control: Before>After
b. other dream types	ns	Observer dreams: Lab: after>before Postlab: before>after Nightmares: Control: Lab>postlab VR: postlab>lab All other dream types ns	nightmares, bizarre dreams, observer dreams or electronic: ns bad dreams: Before game: Lab: Control>VR Postlab: VR>Control After Game: Lab: VR> or =Control Postlab: Control>VR
c. emotions	ns	ns	Interaction (emotion type x condition): Fear, Sad, Anger ns

			Happy: VR>Control
d. gaming inclusion	ns	ns	55% overall said yes
2. judges evaluations	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
a. lucid related	ns	VR>Control; Lab>postlab MACE ns; Steward/Koulack ns	Ns for most Voss Realism VOSS: Lab>postlab 2-way Interaction: VR: lab>postlab Control: postlab>lab 3-way interaction: Before same as 2-way After drop in realism for both conditions
b. other dreams	NA	NA	Threat simulation ns for most; see order effects
c. gaming inclusion	Control>VR (words) Ns HVDC coding	ns	Location: Lab: VR=Control Postlab: VR>Control ns all other variables

Order effects

	Study 1	Study 2	Study 3
Presence[3]	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
1. game versus dream presence	NA	ns	Before: (lab=postlab)>game After: lab>postlab>game
Dream content	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
1. self evaluations	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
a. lucid related	NA	ns	Control dreams: Order: After>Before Interaction:
b. other dream types	NA	Observer dreams: Lab: after>before Postlab: before>after	nightmares, bizarre dreams, observer dreams or electronic: ns bad dreams: Before game: Lab: Control>VR Postlab: VR>Control After Game:

			Lab: VR> or =Control Postlab: Control>VR
c. emotions	NA	ns	ns
d. gaming inclusion	NA	ns	ns
2. judges evaluations	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx
d. lucid related	NA	ns	ns most Voss scales; Realism: 3-way interaction: Before same as 2-way After drop in realism for both conditions
e. other dreams	NA	NA	Threat Simulation: ns for most Severity of threat: Lab: After>Before Postlab: After=Before
f. gaming inclusion	NA	ns	Location: Pregame: VR>Control Postgame: Control>VR ns all other variables

1. There are two divisions of the table representing each major independent variable: condition and order. There is some replication from part 1 to part 2 if an interaction. Term definitions are: VR=virtual reality condition; control= 2D condition; lab=dream collected in the lab which was most recent; postlab= dream collected after the lab; ns = nonsignificant; NA = not applicable. Sometimes there are further subsets of dependent variables under any one study as is needed – sometimes they are collapsed if all the same
2. There were experimenter effects but no condition or order effects.
3. Order was not as relevant to nondream measure thus only dream ones are reported in the order part of the table.

Several things jump out from this table. The first is that as the method was refined over the three studies more results emerged. The second major observation is that the order of dream collection relative to exposure to digital reality (game condition) made a difference in various ways. Third major result is the complexity of the results. In the condition effects, despite random assignment media use history was differentially distributed across cells in two of the three studies and thus used as covariates in statistical analysis. Game performance differed across all three studies as a function of condition.

The variables of focus were versions of presence and dream content. Presence was measured by self report as well as judges evaluations in both waking and dream reports. All three studies found no group differences in history of presense. Two of the three found higher self report presence in VR gaming than in 2D or control condition gaming. This was expected as that is the essence of VR is the enhanced sense of being there. This was confirmed by the observers ratings in two of the three studies. The second study had to drop these rating due to training

problems. Presence was also assessed in dreams by the respondents. This was higher in dreams reported in the lab and under the VR condition. Thus some overlap of experiences seems evident. This will be picked up shortly in the discussion of the order effects. Finally, game presence was compared to dream presence as rated by the respondent. For Study 1, the overall presence evaluation finding was that having a waking, highly immersive three-dimensional virtual reality experience results in a different assessment of dreaming presence than one in a two-dimensional digital environment on a traditional computer monitor. However, no such finding occurred in Study 2 and in the third study it was a function of order.

Dream content was assessed by the dreamer and by trained independent judges for both the dream reported in the lab and the one reported post lab. The dream content variable of primary interst was lucid dreaming, knowing one is in a dream while the dream is still ongoing. Various assessments of this were made by the dreamer and by the judges. The findings across all three studies were not consistent. In study one condition seemed to make a difference in self assessed lucidity at least for the dream reported in the lab while no such difference was evident in study two. Study 3 found no such difference for the lab dream. Remember the last two studies controlled for order of in lab dream report so here the results are consistent. But also in study 3 there was a post lab difference in condition with the VR condition post lab dreams self assessed as more lucid than the control condition post lab dreams.

Judges did a more diverse assessment of dream lucidity than the dreamers. In studies one and two the same lucidity assessment questions were asked with nothing study one and VR rated as greater in lucidity for the VR condition in study 2. Both studies 2 and 3 found more lucidity in the lab dreams than in the postlab dreams which in study 3 was accounted for by the VR condition. Thus any association between enhanced virtual reality gaming and dream lucidity is tenous at best and requires further examination.

There were also some findings, if not consistent, in other dream types and dream emotions. Bad dreams or nightmares evidenced some complex effects in judges ratings for the second two studies but not the first. Regarding the continutity hypothesis, only study 3 seemed to indicate more game inclusion as assessed by respondents. Also in that study the judges more location of the game references in dreams post the lab gaming session for the VR condition. Thus this offers some support for the continutity hypothesis.

Order of dream report in the lab as a function of pre or post game play was taken up in the second two studies. When comparing dream to game presence ther was an interaction between order of dream collection and time of dream collection such that if collected before playing the game dreams were reported as higher in presence than the game and while in the same direction there was a difference between lab and postlab dreams when collected after playing the game. This was in the third study while no such differences appeared in the second study. There were order effects as well for other dream types in both the second and third studies. No order effects for emotions reported by dreamers or for game inclusion. Judges assessments of dreams resulted in no order effects for study 2 but various for study 3. The point to be taken from these scattered and admittedly uneven results is that when using VR as a manipulation to examine sleep and memory that order of dream reports given relative to the manipulation should be controlled.

Limitations and Conclusions

Gender is one limitation of these studies. While both male and female experimenters were used and both genders were research participants they were not directly compared in anyh one study. It is well known in the gaming literature that especially action/combat games are

played more often by males than females. Indeed the choice of a racing game in studies 1 and 2 aliens with previous research in this laboratory showing that females most favorate game was a racing game. Despite fitting favorite genre to gender of respondents, still the more engaging game play is the combat one used in the third study. Another limitation is the problems with two experimenters in study 2. That was due to either training limitations or perceived cultural differences by respondents possibly affecting results. While in study 3 there were again two experimenters, both male, one was east Indian and one was Caucasian. However, the training regiment was improved and thus the situational impact of cultural differences was not apparent. Another major limitation was the response rate of particpants after the lab in terms of reporting a dream. While the requirements to get course credit were adjusted to allow for this still under the most rigorous circumstance, no credit if no long on to dream report post lab, still only less than half of the respondents reported a dream after the lab experience.

In conclusion several things can be taken away from these multiple studies over several years. First the direction of at least online game play is towards increasing presence through VR goggles. While still a fun novelty in gaming, VR goggles are increasingly being applied to especially medical/health related applications. The central question of these inquiries is does exposure to such alternative realities impact onces sense of reality or being there, presence, while awake and while asleep, lucidity? There is some indication of impact but these questions require more research to further understand how immersion in digital realms might impact reality perception and thus the various processes that are associated with nighttime dreams, lucidity.

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Appendix A: Game Coding Study 1 and 2

Radial G in-game Elements identified were: Buttons/Stick, Shift/Petals, Floating, Advertisement/Facebook, Billboards, Honeycombed, Space/Stars, Tubes, Arch, Flashing, Lights, Colors (Green, Red, Blue, Navy Blue, Orange/Yellow, White), Dashboard, Numbers, Seat, Electrocircuit, Pipes, Circuit board, Beams of Light, Shuttle, Skylight, Finish Line/Checker Pattern;
Radial G: Extra game Elements: Twisting/rolling, Speeding-up/Slowing Down, Passing through, Bumping, Rotating/flipping over, Flashing Lights, Countdown, Music, Electrocuted, Turning, Warping , Glowing, Instructions/Reading;
Extra Game Elements (From Experimental Setting) For Both Games: Goggles , Computer , Small room , Desk , Chair , Keyboard , Mouse , White board , Colors: black, blue, white, Headphones;
4th Floor Apartment: In-game Elements: Bedroom, Mirror, Windows, Sky, Clouds, Sunshine, Books (yoga), Laptop (Macbook), Typewriter, Keyboards, Plants, Clock, Paintings, Photos, Shelves, Drawers, Bed, Pillows, Quilt, Wall, Doors, Colors: White, Yellow, Blue, Black, Green, Grey, Floor, Corner, Art, Kitchen, Clock, Cabinets, Sink, Dishwasher, Fridge, Espresso Machine, Magnets, Stickers, Foods, Plants, , Bathroom, Toilet, Towel, Mirror, Toothbrush/toothpaste, Sink, Dotted-floor, Shampoos, Skylight, Doors, Baskets, , Actions: Walking, Looking, Watching, Looking in Mirror, Falling, Waiting; and
Apartment 4th Floor: Extra game Elements: Walking, Sitting, Dinning, Standing, Enjoy scenery, Sleeping, Cooking, Taking Shower, Reading.

Appendix B: Lucid and Game Play Dream Coding Studies 1 and 2

Lucid/Control/Observer Ratings Used in Military Study:

A. Lucid Dream
    1. Yes, the dreamer clearly states that they knew it was a dream while in the dream
    2. Yes, it's implied that the dreamer knew it was a dream while in the dream
    3. Unsure if the dreamer knew it was a dream while in the dream
    4. There is no indication that the dreamer knew it was a dream while in the dream

B. Prelucid Dream (leave blank if none of these)

    1=dreamer talked about or thought about dreams (theirs or anyone elses) in the dream

    2=dreamer wondered if he/she was in a dream but decided they were not

    3=dreamt woke up to only realize they were still asleep but never really recognized they were in a dream (false awakening)

    4=dreamer had an out-of-body experience (out of body, often from birds eye perspective, clear reference to dream body) in the dream but not recognize it's a dream (i.e., very close to the watcher or 3rd person perspective and indeed might be coded in both)

C. Dream thinking (MACE)

Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	a. Did the dreamer choose between two or more options? (e.g. *I chose to finish my homework instead of going out to the movies*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	b. Did the dreamer comment to him or herself about any person or event? (e.g. *I said to myself "that person looks like my sister"; I said to myself "it looks like it might rain"*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	c. Did something or someone suddenly capture the dreamers attention? (e.g. *I heard a scream behind me and I turned around to see what happened*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	d. Did the dreamer focus for a period of time on accomplishing a particular task? (e.g. *I looked all over for my keys*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	e. Did the dreamer experience any unusual difficulty in accomplishing anything he/she was trying to do? (e.g. *My tennis serve is usually good, but for some reason I couldn't get the ball over the net*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	f. Was the dreamer concerned about the impression he/she made, how the dreamer looked or how the dreamer appeared to others? (e.g. *I was afraid I'd seem foolish if I asked a question*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	g. Did the dreamer feel any emotions during the experiences? (e.g. *I felt angry*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	h. Did the dreamer *think about* their own thoughts or feelings? (e.g. *I thought about the intensity of the jealousy I was feeling*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	i. Did the dreamer *think about* what he/she was doing? (e.g. *I was thinking I need to be careful not to spill the boiling pot*)
Agree strongly = 5 Moderately agree = 3 Disagree strongly = 1	j. Did the dreamer *think about* what was happening around the dreamer? (e.g. *I thought about how people seemed to be running in all directions at once*)

E. Dream Control

1. Control of Dream Self (i.e., dream ego appears to be in command of themselves in the dream. This can include decision making, choices, direction moving in, etc.)

1_____2_____3_____4

None low medium high

2. Control of Dream Characters

1_____2_____3_____4

None low medium high

3. Control of Dream Environment (i.e., any type of control other than self or dream character)

1_____2_____3_____4

None low medium high

F. Dream Ego Stance

1. self in dream ego
2. self flipped back and forth from dream ego and watcher
3. self located in dream ego and watcher at same time
4. self located primarily in watcher

G. Dream Ego as Watcher Emotional Involvement

1. watcher emotionally involved in dream characters
2. watcher neutral or uninvolved in dream characters
3. other (no reference to emotions at all)
4. no mention of watching position

Lucid Dream Rating System from Stewart and Koulack (1989-90)

Directions:This is a system used in the rating of dream reports for lucidity. Below you will find a series of categories, each of which reflects a degree of awareness of the dream as a dream and of the potential to exert control over it. Each dream receives only one score; that being the one corresponding to the highest degree of lucidity reported. Be sure to familiarize yourself with the criteria for all scores before actually assessing any dream reports. To aid in scoring, examples of general statements of the type associated with each of the scoring categories are provided below. The criteria for assigning a given score are as follows: -

No Dream Recalled: **Score 0** is the subject reports that no dream was recalled.

Nonlucid Dream: **Score 1** if the subject reports a dream that does not meet the criteria for inclusion in Categories 2 through 6.

False Awakening: **Score 2** if the subject reports that he or she dreamed of having a dream or that he or she dreamed of awakening but in fact remained asleep.
Examples: “I dreamed that I woke up and. . .“
“I dreamed I was asleep and dreaming about. .

Prelucid Dream: **Score 3** if the subject begins to question the reality of the events he or she is experiencing in the dream. The prelucid state is often initiated by the recognition of some glaring incongruity between what is occurring in the dream and what the subject considers objective reality.
Examples: "I thought, 'This is so weird it must be a dream"
"Then I asked myself, 'Am I dreaming this?'"
"I wondered if I might be dreaming all this"

Lucid Dream: **Score 4** if the subject is aware of dreaming and is convinced that what is being experienced is a dream. The realization may or may not be preceded by prelucid questioning.
Examples: "I knew this couldn't be real"
"I knew then that I must have been dreaming"
"That's when I felt for sure this was a dream"

Lucid Dream with Control Perceived but Not Exercised: **Score 5** if the subject is aware of dreaming and of the potential to control the dream, but control is not exerted. The subject will be lucid as in Category 4, but also realizes that if he or she is dreaming, then he or she can do whatever he or she pleases. However, beyond this realization, there is no actual attempt to alter the dream's content or progress.
Examples: "I knew this was a dream and that I could change it if I wanted, but I let it go on to see what would happen"
"I knew I could wake up if things got too bad"

Lucid Dream with Control both Perceived and Exercised: **Score 6** if the subject is aware of dreaming and of the potential to control the dream, and such control is demonstrated. The subject will be aware of the potential to control the dream as in Category 5, but chooses to actually alter the dream's content or progress.
Examples: "I thought, 'If this is a dream, then I can do whatever I please,' so then I decided to. .
"I knew I could wake up if things got too bad, so that's what I did" "I decided to try an experiment to see if I was really dreaming, so I..."

Game in Dream Ratings:

1. Gaming in dreams types (generally only one subcategory BUT you could have all three in one dream)

    a. In the dream the dream ego is in the game world – the dream is the game (leave blank if none of these)
        1.stated in the dream transcript
        2.implied in the dream transcript
    b. In the dream the playing a video game (leave blank if none of these)
        1.Dream ego playing a video game
        2.Watching others play a video game
        3.Other (i.e., video game playing in the background as a movie etc)

c. In the dream games are mentioned (leave blank if none of these)
   1. Non-video game (i.e., sports watching on TV or watching live or playing 'real' sports; casino gambling)
   2. Video game (i.e., shopping for a video game, dressed as a video game character but clearly NOT playing it, winning a x-box)

2. Game elements in the dream (rate each row):

Characteristic (in ALL cases as related to a video game)	**Present (1=yes; 0=no)**
a. Characters: Self is game character, Other is game character, Self changes into game character, Self controls game character	
b. Activities: Physical, Movement, Location Change, Verbal, Visual, Auditory, Thinking	
c. Emotions: Positive emotions; Negative emotions; Neutral emotions	
d. Settings: Locations	
e. Objects: Architecture, Household, Food, Travel, Streets, Regions, Nature, Body Parts, Clothing, Communication [including technological], Money, Miscellaneous. Look especially for weapons.	

3. The next set of rating scales are from the ESRB **(DO FOR ALL DREAMS NO MATTER IF GAME IMPLIED)**

ESRB Ratings General Category	**Present (1=yes; 0=no)**
a. Violence: Fantasy Violence, Animated Blood, Blood, Blood and Gore, Cartoon Violence, Intense Violence, Sexual Violence, Violence, Violent References	
b. Sex: Nudity, Partial Nudity, Sexual Content, Sexual Themes, Sexual Violence, Strong Sexual Content, Suggestive Themes,	
c. Drugs: Tobacco Reference, Use of Drugs, Use of Alcohol, Use of Tobacco	
d. Language: Language (Mild to moderate use of profanity), Lyrics, Strong Language, Strong Lyrics	
e. Humor: Crude Humor, Comic Mischief, Mature Humor	
f. Gambling: Real Gambling, Simulated Gambling	

Appendix C: Game Coding Study 3

Resident Evil 7: Biohazard – Game Content Coding:

Locations:

	Characteristic	Present (1)/ Absent (0)
L1	Trailers	
L2	Old buildings/Dark environments (Includes houses, rooms, hallways, etc.)	
L3	Basements/Tunnels/Caves/Dungeons/Crawl Spaces/Attics/Between walls	
L4	Forests/swamps	

Person/Object/Things:

	Characteristic	Present (1)/ Absent (0)
POT1	Spiders/Spider lady (Margaret)/Boss from Resident Evil 7	
POT2	Oversized limbs	
POT3	Monsters/zombies	
POT4	Weird goo/black goo	
POT5	Arms, weapons, knives, flamethrowers	
POT6	Holes in the ground	
POT7	Little scary girl	

Actions/Events:

	Characteristic	Present (1)/ Absent (0)
AE1	Window breakings	
AE2	Fires	
AE3	Being chased	
AE4	Shrieks, screams	
AE5	Scavenging, gathering resources	

Code all dreams along the disagree/agree likert scale

Strongly Disagree				Strongly Agree
1	2	3	4	5

1 (LK1) Startle: While dreaming, the dreamer experienced startles or saw enemies jumping
2 (LK2) Shooting: While dreaming, the dreamer was shooting guns
3 (LK3) Stabbing: While dreaming, the dreamer was either stabbing or being stabbed
4 (LK4) Threats: While dreaming, the dreamer experienced verbal threats directed at them
5 (LK5) Bleeding: While dreaming, the dreamer either experienced bleeding on self or on someone in the dream

[i] High numbers indicate younger age.

[ii] Radial G in-game Elements identified were: Buttons/Stick, Shift/Petals, Floating, Advertisement/Facebook, Billboards, Honeycombed, Space/Stars, Tubes, Arch, Flashing, Lights, Colors (Green, Red, Blue, Navy Blue, Orange/Yellow, White), Dashboard, Numbers, Seat, Electrocircuit, Pipes, Circuit board, Beams of Light, Shuttle, Skylight, Finish Line/Checker Pattern;

Radial G: Extra game Elements: Twisting/rolling, Speeding-up/Slowing Down, Passing through, Bumping, Rotating/flipping over, Flashing Lights, Countdown, Music, Electrocuted, Turning, Warping , Glowing, Instructions/Reading;

Extra Game Elements (From Experimental Setting) For Both Games: Goggles , Computer , Small room , Desk , Chair , Keyboard , Mouse , White board , Colors: black, blue, white, Headphones;

4th Floor Apartment: In-game Elements: Bedroom, Mirror, Windows, Sky, Clouds, Sunshine, Books (yoga), Laptop (Macbook), Typewriter, Keyboards, Plants, Clock, Paintings, Photos, Shelves, Drawers, Bed, Pillows, Quilt, Wall, Doors, Colors: White, Yellow, Blue, Black, Green, Grey, Floor, Corner, Art, , , Kitchen, Clock, Cabinets, Sink, Dishwasher, Fridge, Espresso Machine, Magnets, Stickers, Foods, Plants, , Bathroom, Toilet, Towel, Mirror, Toothbrush/toothpaste, Sink, Dotted-floor, Shampoos , Skylight (?), Doors, Baskets, , Actions: Walking, Looking, Watching, Looking in Mirror, Falling, Waiting; and

Apartment 4th Floor: Extra game Elements: Walking, Sitting, Dinning, Standing, Enjoy scenery, Sleeping, Cooking, Taking Shower, Reading.

[iii] Since the state dependent variable includes order and time these were not entered as independent variables separately.