Presence in video game play and nighttime dreams: An empirical inquiry

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Summary. A felt sense of presence in games versus dreams was measured by a self-report inventory applied immediately after playing an immersive video game for 20-25 min (a single session) and immediately after waking up (from a dream, at home, for 14 days after the game session). After prescreening, 40 subjects were randomly assigned to one of four groups to play a video game. These groups differed in terms of the fidelity (VR type goggles versus TV monitor) and interactivity (playing versus watching). 117 usable dream reports were collected. The results of ANCOVA over the whole data did not give significant effects, but in item-by-item testing, four of 12 items showed significant dream/game presence differences. Three were in the direction of dreams eliciting a stronger sense of presence than games and one in the opposite direction. In a further content analysis, the dream presence was found to be related to dream aggression.

Keywords: presence; video games; virtual reality; VR; dreams; dream aggression; fidelity; interactivity

1. Introduction

While presence has been a focus of inquiry in the field of virtual reality (VR) research, and indeed has a long history in communication studies, only recently have theoretical parallels to nighttime dreaming been seriously considered. Such experiences of the night have been called "inner presence" by Revonsuo (2006). Moller and Barbera (2006) argue that there are several reasons why dreaming is important for the study of presence. They point out that dreaming may be considered a natural experiment in presence and indeed could be considered the 'gold standard' by which other inquiries should be compared. They also note that dreaming offers a "unique window into the processes that determine how the brain organizes information (external and internal)" (p. 104).

Perhaps the best example of why dreams can be considered the gold standard of presence is that in the face of the bizarre content in dreams the dreamer does not lose their sense of the 'reality' of the dream. Dream bizarreness, Revonsuo (2006) argues, is also useful for understanding the binding problem in consciousness. He defines consciousness-related binding as "the problem of understanding the relationship between the phenomenal unity of consciousness and the immediately underlying mechanisms that could explain phenomenal unity" (p. 205). In tying this to dreams, Revonsuo goes on to point out that "a dream object does not transform randomly into another object, but into an object that shares many semantic or associative features with the first. In the waking state such associations do not intrude into our consciousness, for they are unable to override the externally supplied sensory information" (p. 247). In the face of these meaningful dream transformations, the sense of "being there" is not disturbed. Even if noticed as odd and triggering state awareness, dream lucidity (Gackenbach & LaBerge, 1988), presence is sustained. Dreams are not experienced as thought but as perception (Foulkes, 1985).

Moller and Barbera (2006) point out that there are characteristics of dreams which enhance their felt sense of being there. For instance, the narrative structure is coherent and from the first person perspective. The narrowing of thought process, "single-mindedness", would, according to Moller and Barbera, "account for the overall sense of coherence and narrative structure present in a dream despite the presence of otherwise bizarre elements. It would also account for the uncritical or 'delusional acceptance' of the dream experience as real" (p. 102).

Given the increasing call for the study of dreams as a form of VR with attendant presence, and indeed characterizations of dreams as the "gold standard" of presence, it is surprising that no one has measured presence in dreams no less its relationship to presence in VR. That is the purpose of the present study.

1.1. Presence in Waking

Presence is apparent in just about all mediated communications to some degree (Riva, Anguera, Wiederhold, & Mantovani, 2006). While sought after in the traditional push media, Riva et al. (2006) note that "the user is no more a passive receiver but fully experiences the media content: he is present in it" (p. 511). The most widespread experience of the technologically mediated experience of 'being there' is video game play.

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While the impact of such play is of concern due to the potential negative effects, as on subsequent aggression (Dill & Dill, 1998; Griffiths, 1998; Anderson, Berkowitz, Donnerstein, Huesmann, Johnson, Linz, Malamuth, & Wartella, 2003) and addiction (Griffiths & Davies, 2005; Salguero & Moran, 2002), the benefits of such play are also becoming increasingly apparent. For instance, in a recent study examining perceptual and cognitive skill differences between expert gamers and non-playing individuals Boot, Kramer, Simons, Fabiani and Gratton (2008) examined a range of cognitive abilities, including attention, memory, and executive control. This group found that "experts could track objects moving at greater speeds, better detected changes to objects stored in visual short-term memory, switched more quickly from one task to another, and mentally rotated objects more efficiently" (p. 387). There are also psychosocial benefits (Durkin & Barber, 2002) as well as physiological ones (Russoniello, O'Brien & Parks, 2009).

The increased game quality, graphics, and engagement should also improve presence. This is apparent in the practical applications. Immersive environments such as virtual and/or artificial reality including gaming treatments for phobias and other psychological issues, are proving effective. For instance, video game play has been a useful distraction tool for painful cancer treatments in children (Gershon, Zimand, Pickering, Rothbaum & Hodges, 2004). All of these effects, negative and positive, point to the power of this media and imply presence.

1.2. Presence and Gaming

Indeed presence has been studied directly in the game studies literature (Persky & Blascovich, 2008; Nowak, Krinar, & Farrar, 2006). One of the challenges that the gaming industry faces is trying to improve their product not only cosmetically (graphics and visual effects) and through enhanced interfaces, but to keep their games interesting, challenging, fun and engaging. To do this, developers need to merge cutting edge technologies with interesting themes, ideas and concepts, while somehow managing to keep their product relatively straight-forward to use as well as affordable. Some of the best games available have a common feature: a player can 'lose' him or herself in the game, and maintain a level of enjoyment throughout their gaming session. Developers are aware of this, and are creating games that generate a sense of being "in" the game, and a desire to play not only that particular game again, but to seek out the game developer's newer releases.

According to Lombard and Ditton (1997), presence can be understood in terms of six conceptualizations: social richness, realism, transportation (i.e., a sense of 'being there'), perceptual and psychological immersion, social actor within medium (response to social cues within medium; i.e. television), and medium as social actor (response to social cues by medium; i.e. an avatar). As Lombard and Ditton (1997) discussed, there are many different understandings and definitions of presence, but they all share common ground: they all involve a lack of awareness of, or acknowledgement of, a medium being used for some form of communication. In essence, the individual uses some form of technology to interact with an environment, and is not fully aware of using this technology to communicate with the environment at some point during the process. In relating presence to more recent audio/video technology, Lombard and Ditton (1997) identified greater image clarity and screen size as factors that can enhance the odds of experiencing presence. Anderson and Casey (1997) note that the more human senses that are involved in the virtual reality experience, the higher the sense of presence. Following the success of the Wii and the Kinect for Xbox 360, haptic type controllers are rapidly claiming the video game market. But creating presence in gaming is not just a hardware issue.

Presence is responsive to content. Both Persky and Blascovich (2008) and Nowak, Krinar, and Farrar (2006) found that gamers reported more presence when playing aggressive games. Petkova and Ehrsson (2008) point out the how crutial the 1st person perspective is when trying to encourage fully immersive in-body experiences, as found in dreams and waking. Bradley (2004) reports higher presence in games where there is a story than in ones where there is not. Finally, high end video game players have been found to report more presence while gaming than those who play less often (Persky & Blacovich, 2008; Nowak, Krinar & Farrar, 2006; Bown & Gackenbach, 2010).

1.3. Dreams and Gaming

The relationship between video game play and dreams has been investigated by Gackenbach and colleagues. Thus far they have found that gamers report more lucid and control dreams under some conditions, thus potentially allowing for conflict resolution in the dream work of regulating bad emotions (Gackenbach, 2006; 2009a), as well as possibly fulfilling the threat simulation role of REM sleep (Gackenbach & Kuruvilla, 2008a). In fact, in a recent study (Gackenbach, Ellerman, & Hill, in press) on military gamers, this group found that when affect load and distress were controlled, more frequent gamers reported less of some threat or military type dream content in their military dreams than soldiers who rarely gamed. This lab also report increased bizarreness in gamers' dreams when media exposure was controlled. Dream bizarreness was associated with creativity (Gackenbach, Kuruvilla, & Dopko, 2009; Dopko & Gackenbach, 2009).

Games have also been used as stimuli to study the learning function of dreams beginning with a study on the incorporation of Tetris by Stickgold, Hobson, Fosse and Fosse (2001). In a later study from this same laboratory (Wamsley, Perry, Djonlagic, Babkes Reaven, & Stickgold, 2010), they used an arcade type video game in which the individual is downhill skiing, and examined its impact on sleep mentation. So too Ribeiro and Pantoja used the video game Doom as a stimulus (as reported in Callaway, 2009). After playing Doom for an hour before sleeping in a sleep laboratory almost all subjects dreamt about the game. Long time players' dreams had frontal areas activated while more novice players had motor areas activated. Play performance the next morning improved.

1.4. Present Study

In the previous experimental studies on gaming incorporation (Stickgold, et al, 2001; Wamsley et al, 2010; Ribeiro & Pantoja as reported in Callaway, 2009) there was no manipulation of the pre-sleep stimuli. However, Nielsen, Saucier, Stenstrom, Lara-Carrasco and Solomonova (2007) found differences in participant self-reports of stimuli incorporation into dreams following exposure to varying levels of sensory immersion and interactivity in a game-like VR maze.

In the present inquiry we aimed to increase the difficulty

of the gaming environment, as compared to the maze task used in the study by Nielsen et al. (2007) experiment, while still keeping the game tasks achievable, and the interface controls simple enough to accommodate some variation in the levels of subject gaming ability. We predicted that the Nielsen et al. (2007) results would be replicated in that high fidelity conditions would have more stimuli incorporation into dreams, and secondly that those in the interactive gaming condition would have higher stimuli incorporation into dreams than those in the non-interactive gaming condition. The incorporation part of this study is reported elsewhere (Gackenbach, Rosie, Bown, & Sample, 2011). Our hypotheses were partially supported. The independent variable of fidelity (i.e., goggles versus TV monitor) was paramount for self reports during waking and in the subsequent dream incorporation. Interactivity, i.e., watching versus playing a video game, became the dominant variable when dreams were viewed from the judges' perspectives.

Here we are focusing on the presence measures which were administered after the game play session and after each reported dream for two weeks post game play. We expect dream presence reports to be higher than game presence reports for dreams where the subject reports dream incorporation of the game. Non-incorporation dreams were only partially examined because the point of this inquiry is to examine similar experiences in waking and sleep in terms of felt sense of presence or being there.

2. Method

2.1. Participants

A total of 1169 prescreens were collected. Male participants numbered 405 (34.6%), female participants numbered 762 (65.1%), and 2 (< 1%) participants declined to give gender information. The ages of those taking the prescreening were as follows: 19 years old or younger (N = 552), 20 to 25 years old (N = 469), 25 to 30 years old (N = 76), 30 to 39 years old (N = 47), 40 years old or older (N = 19) and those that declined to answer (N = 6). They were determined to be ineligible for the study if they reported infrequent video game playing (less than several times a week), low dream recall (those that reported remembering dreams less than several times a week), susceptibility to motion sickness in high immersive environments, a history of epilepsy or other conditions associated with increased sensitivity to stimulation, fear of heights, or susceptibility to very high levels of frustration when engaged in learning new video games.

Of all the prescreen participants, 167 fulfilled our requirements and were contacted to initiate participation in the study, 53 of which booked an initial laboratory appointment, and 45 of which showed up for an appointment. Out of the 45 participants that were run through the laboratory experiment, we were only able to use data from 40 participants (10 per condition) , 15% were female (N = 6), 85% male (N = 34), with an average age between 18 and 25 .

2.2. Materials

1) *Pre-screening Inventory*: This inventory consisted of a set of questions concerning dream recall and video game history that Gackenbach and associates (Gackenbach, 2006; Gackenbach & Kuruvilla, 2008b; Dopko & Gackenbach, 2009) have used in past studies. In this instance, questions also included susceptibility to motion sickness and epilepsy. Questions were also added about levels of frustration when learning new video games and about fear of heights in order to address the relatively short amount of time given the participants to learn the video game's commands, and the frequent exposure to virtual heights, and falls from virtual heights in the video game chosen as pre-sleep stimulus, 'Mirror's Edge'. Questions regarding video gaming history were also asked, as in previous studies, covering their current typical video gaming habits, the breadth of video game types they have played, how long they've been playing video games and what style of video game they typically play. Finally, dream recall history was inquired about as used in Dopko and Gackenbach (2009).

2) *Multimedia Devices*: The gaming console used was a Sony Playstation 3. The game was Mirror's Edge, which is a first person action-adventure game selected because of its maze or obstacle course style, similar in some ways to the maze task used in the Nielsen et al. (2007) study. Additionally, research on perspectives (i.e. 1st person versus 3rd person or overhead) with gaming and virtual reality has demonstrated the cruciality of the 1st person perspective when trying to achieve an immersive in-body experience (Petkova & Ehrsson, 2008). It has been rated T for Teen by the Entertainment Software Rating Board (ESRB).

Specific courses and training maps were selected from this game for use because of their lack of violent content, and their lack of excessive ease or difficulty. The in-game training course was used in order to familiarize participants with the button configurations necessary for them to succeed in the time trials which followed. Participants followed the training course until either the buttons for physical combat were introduced, or play duration reached 12 minutes, at which point the training session was discontinued. We did not use any of the maps or chapters which include the game's violent content, so it was not necessary for participants to learn combat button configurations. Participants then played 2 training minutes of a time trial that takes place on the identical course that the training session was conducted upon (course name Playground 1) . This allowed for the participant to be introduced to the concept of quickly maneuvering through an obstacle course in order to reach specific checkpoints sequentially, while in a familiar setting. Once the two minutes were up, the participant was then run through up to three different time trial course maps that all have different in-game physical surroundings. In cases where the participant reached 12 minutes in the training course, the participant was started on the actual time trials immediately so as to keep exposure times between conditions as close as possible.

The courses, whose names are Edge, Flight and Heat, were selected for the time trials because they are a good match across courses of challenge and difficulty. The courses all offer challenging puzzles, which could result in the participant being 'stumped', but do not require exceedingly complex controller commands in order to successfully navigate the course. Also, time trial courses involving balance beams were not included, due to ambiguous instructions for navigating these obstacles (there is more than one way to use the controller in order to cross the balance beams). A familiarity with the PlayStation 3 motion detecting controller might have provided an unfair advantage concerning completion times if maps with balance were selected for the time trials.

Several people of varying console gaming skill and playing habits were all asked to run through all of the available courses several times, in order to determine which courses were found to be very difficult or frustrating, and which people found too easy. Those that were thought to be of moderate challenge and difficulty were selected because, while we were selecting individuals that frequently play video games to fulfill out high-end gamer criteria, frequent playing history does not guarantee that all individuals would be playing games of similar complexity and/or challenge concerning button configuration.

The researcher video-recorded an associate going through the training map, the Playground 1 practice time trial, and 3 times through the time trial courses Edge, Flight and Heat. The associate was instructed to play as if it was his first time playing the game, and the recorded gaming session was used in the low interactivity conditions (for those participants watching a pre-recorded gaming session). The duration of the entire video is 26 minutes and 33 seconds, 20:06:56 of which was actual play time, and the rest menuing system or loading screen time .

Zetronix ZX920W 80" video goggles with surround sound speaker headphones were used for the high fidelity condition while a 20 inch tube television with built in stereo speakers was used for the low fidelity condition. Additionally, piggyback audio/video cables that enable the researcher to see what the subject is seeing while wearing the video glasses was used in the high fidelity condition. In both fidelity conditions under high interactivity the data was projected behind the subject so that clear pictures could be taken of game performance information. Also this allowed the experimenter to follow along with the subjects training in case there is a question or problem during the training, and to insure that instructions were being properly followed.

3) *Post-Game Play Questionnaire*: Except for a few items the same presence inventory from Lombard and Ditton (1997) was used to inquire about the sense of being there in the game. Sample items included, "How involving was the media experience?" and "How much of a sense of physical movement did you feel during the media experience?". All responses were on a 5-point likert type scale ranging from not at all to very much (or appropriate adjectives depending on the item). This inventory also included a question about video game session enjoyment.

4) *Dream Collection*: Online dream collection occurred via a website (surverymethods.com) that participants were taught how to use. It allowed for them to log on at any time and record their dreams. A Dream Recall Tips handout was given to each participant. It included various tips on remembering dreams, and also advice on how to diary dreams (Dopko & Gackenbach, 2009) . Items from the post game play questionnaire on presence in the game were re-worded for the post-dream questionnaire to be appropriate for a dream rather than for a media experience. For instance, the item on the game presence scale "How involving was the media experience?" became "How involving was the dream?" on the dream presence scale. Table 1 in the results section lists all of the media and dream presence items.

5) *Media Use Questionnaire*: During each dream collection session, subjects were asked to fill out a questionnaire regarding what elements of the dream, if any, were related to the game play experience they had in our lab setting. After every dream entry during the 14 days of dream collection, participants were asked to fill out a questionnaire concerning their media use during the day preceding the dream. They were also asked for their opinion regarding if other media was incorporated into the dream. If subjects preferred to not share a dream or did not recall one they still had to log onto the collection website in order to receive course credit for research participation.

2.3. Procedure

Participants were pre-screened, and those fulfilling medium to high dream recall requirements, that were moderate to high-end video gamers with no susceptibility to motion sickness, epilepsy, fear of heights or high levels of frustration when learning a new video game were selected for the study. It should be noted that Mirror's Edge is not a well known video game. Nonetheless anyone who claimed they had played it for more than an hour were not included in the subjects invited to participate. We ran into significant problems finding enough people to fit our criteria. We ran subjects from mid-fall 2009 semester into mid-winter 2010 semester. At the end of this period of data collection, we had run 40 useable subjects (10 per condition).

Those that were eligible were contacted initially by e-mail or phone, and scheduled for one hour laboratory sessions between noon and 7 pm. Reminder e-mails were sent out twice in the week preceding the laboratory session. If the subject did not reply to the reminder e-mails, they were then contacted via provided telephone numbers in order to confirm the session.

Subjects were randomly assigned to one of four conditions: 1) high immersion and playing the game, 2) high immersion and watching a recorded gaming session, 3) low immersion and playing the game and 4) low immersion and watching a recorded gaming session. In all four conditions the subject first went through the game's tutorial, either watching it or playing it. The playing and watching sessions each lasted between 20 and 25 minutes.

Following the gaming session, subjects were asked to fill out the modified Lombard presence inventory (mounted online) while still in the laboratory. In the presence inventory they were also asked to provide a rating between 1 and 5 (1 = low, 5 = high) concerning their level of enjoyment during the session.

Finally, subjects were instructed on how to log on to the dream collection website and record their dreams upon waking for the next 14 days. This was done in order to account for a possible delay in processing and/or incorporation as identified by Nielsen, Kuiken, Alain, Stenstrom and Powell (2004). We then gave the subjects the dream recall tips handout. The way in which the remainder of the credit was assigned was also explained to the participants. Subjects were then sent an e-mail with a link to the dream collection site.

Subjects were instructed to fill out a questionnaire (merged with the online dream collection survey) for each dream regarding any possible elements of their dream that they think might relate to the video game they played in our lab and/or their media use throughout the day. If they did not recall a dream they still needed to log on a minimum of five times per week in order to get credit for that week. Subjects who had not logged on for three days in a row were sent reminder e-mails, politely requesting that they remem-

ber to login and record their dreams. Subjects were only contacted by telephone as a last resort, in instances where either they were not responding to e-mails, or the e-mail address provided was not functional. Once the subjects had completed the 14 days of dream collection they were sent an e-mail containing the debriefing information. All subjects were provided with contact information for the researchers in case they had any questions or problems.

3. Results

For the 40 participants whose data was usable, a mean total exposure to Mirror's Edge play time of 25.53 minutes (min. = 18.53, max. = 31.81). Because subjects were randomly assigned and selected along the same criteria, we did not expect any cell differences in prescreening selection information. But, to be sure that there were not any differences between the four conditions, all prescreening questions were examined as a function of the two independent variables. Specifically, questions pertaining to sex, age, susceptibility to nausea, motion sickness, epilepsy and fear of heights, frustration with video game play, several typical dream recall questions, multiple video game play habit questions, and prior exposure to Mirror's Edge were all tested as a function of cell assignment.

All but two prescreening variables were evenly distributed across cell assignment. There was a significant interaction, $F(1,36) = 6.742$, $p < .014$, partial Eta squared = 0.158) found with an ANOVA on interactivity (playing vs. watching) x fidelity (high immersion vs. low immersion) for frustration when trying to learn a new video game. A significant interaction, $F(1,36) = 6.128$, $p < .018$, partial Eta squared = 0.145) was also found when conducting an ANOVA on interactivity x fidelity for typical dream recall. These two uneven distributions informed subsequent analyses.

3.1. Game Play versus Dream Presence Analysis

An ANOVA was conducted for interactivity x fidelity for the total of all post-game presence questions, $F(1,33) = 0.397$, ns, with no condition effects. When frustration for learning a new game was controlled for however, a main effect for fidelity approached conventional levels of significance, $F(1, 35) = 3.21$, $p < .082$, partial eta2 = 0.084). Not surprisingly, high fidelity (goggles and headphones) was seen as higher in presence ($M = 61.1$, $SD = 14.2755$) than low (TV monitor) fidelity ($M = 52.55$, $SD = 12.915$).

For the dream collection portion of the study, subjects were asked to login once a day for two weeks to record a dream from the night before. In total, 380 entries into the online dream recording system were identified, resulting in 124 total dreams in 120 entries. When more than one dream was entered in one diary session all dreams were discarded from subsequent analysis because it could not be determined what dream the post-dream questionnaire responses referred to. Thus 117 dreams were fully useful.

Of the 117 usable dreams, 36 dreams (31%) were in the high interactivity, low fidelity condition, 30 dreams (26%) were from the low interactivity, low fidelity condition, 29 dreams (25%) were in the low interactivity, high fidelity condition, and 22 dreams (19%) were in the high interactivity, high fidelity condition. A chi-square analysis on this distribution was not significant (X2 (1) = 1.498). Therefore there was no bias as a function of cell assignment as to number of dreams reported. The amount of dreams recorded per participant ranged from 0 dreams (N=4) to 12 dreams (N=1), with an average of 3.1 dreams.

The dream presence scale was an adaptation of the one used for game presence. That is, there was the same wording on the dream items as on the game items. All but two of the game items were easily adapted to dreams (see Table 1 for specific items). Given the relatively even distribution across cells of dreams from subjects, it was then possible to do an ANCOVA on fidelity (goggles/TV) by interactivity (play/watch) by presence (game/dream). As noted, while equal distribution across cells of prescreening subject characteristics was desired, they ended up differing along two dimensions (frustration in learning a new game and general dream recall). Therefore these subject selection variables were used as covariates in this analysis.

While some respondents did not report any dreams, there were seven to nine reports per cell. Therefore the sum of game presence, sans two items which did not translate well into dream presence, and the sum of dream presence were computed and differences examined as a function of interactivity and fidelity. As with the case of 10 subjects per cell, with these slightly fewer numbers per cell, the same two prescreening variables showed cell differences (interactivity x fidelity interaction for typical dream recall, $F(1, 28) = 5.472$, $p < .02$, *partial eta*$^2 = 0.179$; interactivity x fidelity interaction for frustration for learning to play new games, $F(1, 28) = 6.094$, $p < .027$, *partial eta*$^2 = 0.163$). As before, no other prescreening variable showed cell differences. Therefore, typical dream recall and learning frustration self reports were used as covariates. The 2 (interactivity: play/watch) X 2 (fidelity: goggles/TV) X 2 (presence sum: game/dreams) ANCOVA with typical dream recall and frustration for learning a new game was computed. No main effects or interactions were significant. Thus contrary to expectation there was no difference in presence self reports between dreams and games as a function of fidelity and interactivity during game play.

3.2. Presence Items Analysis

This flies in the face of what seems to be so phenomenologically obvious and at the least questions the call for dreams as the "gold standard" for presence. While nights where the subject thought that the game was incorporated into their dream might result in some state of consciousness difference, there were too few dreams falling into each cell on such nights to justify such an analysis. However, if these self reported nights of incorporation of the Mirror's Edge game were collapsed across conditions then there were enough such dreams to compare game to dream presence on each item.

Thus in order to further investigate any state of consciousness difference in presence, it was thought useful to examine this presence inventory item by item across conditions. Only those dreams that the dreamer indicated might have some Mirror's Edge incorporation were included in this comparison of presence scores by item. Table 1 breaks down the presence scores into item scores as a function of state of consciousness with dreams as cases. That is, each dream has both a presence rating for the dream and the presence rating given the game during the laboratory session by the subject who had the dream.

Of the 12 paired t-tests on individual dream versus game items for dreams that the subject thought included some aspect of the game played, three evidenced state of con-

Table 1. Paired T-tests, Means, Number of Dreams, and Standard Deviations on Dream versus Game Presence Items.

Sig.	Item	*N*	*M*	*SD*
Pair 1	dr8. How involving was the dream?	23	5.13	1.817
	gm2. How involving was the media experience?	23	5.17	1.302
Pair 2	dr9. To what extent did you feel mentally immersed in the dream?	23	5.39	1.803
	gm3. To what extent did you feel mentally immersed in the experience?	23	5.17	1.497
Pair 3	dr10. How completely were your senses engaged in the dream?	23	5.00	1.706
	gm5. How completely were your senses engaged?	23	4.96	1.147
Pair 4	dr11. How much of a sense of physical movement did you feel during the dream?	23	4.70	1.636
	gm6. How much of a sense of physical movement did you feel during the media experience?	23	4.70	1.460
Pair 5	dr12. The dream caused real feelings and emotions for me.	23	4.96	1.846
	gm7. The experience caused real feelings and emotions for me.	23	3.87	1.604
Pair 6	dr14. I was so involved in the dream that I lost track of time.	22	4.95	2.214
	gm8. I was so involved in the media experience that I lost track of time.	22	4.50	1.766
Pair 7	dr15. After the dream ended and I woke up I had to adjust back to waking reality.	22	3.41	2.108
	gm9. After the media experience ended I had to adjust back to the immediate physical surroundings.	22	3.95	2.081
Pair 8	dr16. …sound like they would if you had experienced them in waking reality?	22	4.36	2.083
	gm10. …sound like they would if you had experienced them directly?	22	4.86	1.583
Pair 9	dr17. …look like they would if you had experienced them in waking reality?	21	4.857	2.2646
	gm11. …look like they would if you had experienced them directly?	21	4.48	1.078
Pair 10	dr18. To what extent did you experience a sense of 'being there' inside the dream?	22	5.55	1.683
	gm12. To what extent did you experience a sense of 'being there' inside the environment you saw/heard?	22	4.77	1.270
Pair 11*	dr19. How much did you feel like the events of the dream were happening to you?	22	5.41	1.843
	gm14. How much did you feel like the events you saw/heard were happening to you?	22	3.59	1.623
Pair 12	dr20. How often did you feel "My body was in bed, but my mind was inside my dream"?	22	3.45	2.345
	gm15. How often did you feel "My body was in this room, but my mind was inside the environment I saw/heard"?	22	4.45	1.503

* $p < .05$ with Bonferroni Step-down correction

sciousness differences. These were experiencing real feelings, a sense of being there and things happened to you. In all three cases, as expected, dreams evidenced higher ratings of presence than game play reports. Because there were 12 comparisons a Bonferroni Step-down (Holm, 1979) correction was used and that resulted in only one comparison as significant (i.e., How much did you feel like the events of the dream were happening to you?) and favoring dreams. This is a bit of a quandary as this item essentially asks about the entire presence concept. However, it is the best comparison of waking to dream presence as it involves dreams that the dreamer thinks are like the waking experience (game incorporated into the dream).

3.3. Non-incorporated Dreams and Presence

While not the best comparison, it was thought to be informative to examine presence scores for all 117 dreams collected from these 37 individuals whereby a more complex picture emerged. In part this is justified on the assumption that dreamers themselves do not always recognize incorpo-

ration of waking stimuli into later dreams. This time seven of the 12 paired comparisons were significant but after the Bonferroni Step-down correction only four remained significant. They were:

1. The dream/game caused real feelings and emotions for me. (t(114)=3.241, p<.018; Dream: X=4.33, N=115, SD=2.159; Game: X=3.66, N=115, SD=1.474)
2. Overall how much did the things/people in the dream/game look like they would if you had experienced them in waking reality? (t(1143)=4.733, p<.001; Dream: X=5.24, N=114, SD=1.830; Game: X=4.30, N=114, SD=1.021)
3. How much did you feel like the events of the dream/game were happening to you? (t(114)=8.295, p<.0012; Dream: X=5.22, N=115, SD=1.829; Game: X=3.25, N=115, SD=1.594)
4. How often did you feel "My body was in bed, but my mind was inside my dream" or "My body was in this room, but my mind was inside the environment I saw/heard"? (t(114)=-6.176, p<.0011; Dream: X=2.87, N=115, SD=2.117; Game: X=4.49, N=115, SD=1.591)

In three of the four significant differences dreams were rated as higher in that aspect of presence. The only one that favored the gaming situation regarding the subjects felt sense of their body.

3.4. Dream Presence Further Inquiry

All collected dreams were also content analyzed in two ways. One content analysis was for incorporation of the game into the dream and is reported in Gackenbach et al. (2010). The second was a dream content analysis using one of the most widely used systems developed by Hall and VandeCastle (1966). Since our concern here is dream presence the full Hall and VandeCastle (HVDC) analysis will not be reported but can be found in Gackenbach et al. Thus in order to examine if there are any elements of the content of a dream which are especially relevant to dream presence, a varimax rotated factor analysis was computed on the 12 dream presence items and the 11 sum scores from the HVDC analysis. This was done for all 117 collected dreams thus 21 variables is justified to include in this factor analysis. This factor matrix can be seen in Table 2.

Of the 7 factors that were above the eigenvalue of 1, only one had dream presence and dream content loaded when a .4 cutoff was utilized. This factor, Factor 1, accounted for 21% of the variance and loaded most of the dream presence items with dreamt aggression. It's not terribly surprising that high end gamers would dream about aggression and that such dreams would be seem as the most 'being there' type of dream.

The next analysis attempted to drill down on this aggression-presence association in dreams. Those items from the dream presence scale that previously loaded with the HVDC aggression sum were entered into another factor analysis along with the subscales which made up the aggressive sum score from the HVDC. In the varimax rotation, the dream presence items clustered together with no association to dream aggression but when the principle component analysis was examined then all of the dream presence items were associated with two aggression subscales with loadings of .4 or greater. They were dreamer involved in the aggression and acting as the aggressor. One other factor loaded a dream presence item and subscales from the HVDC aggression scale. On this factor the lack of the dream eliciting emotions in the dreamer was associated with witnessing aggression and physical aggression.

3.5. Game Content and Dreamed Aggression Analyses

In order to examine further this dream presence-aggression link, information about aggression in the games played the night before a dream was gathered. There were 33 dreams where the dreamer indicated having played a game the day prior to the dream. Some of these were the target video game but some were not. Of these, only 30 dreams had the 50 plus words required to do a HDVC analysis. Due to the small number of cases, the dream presence items were collapsed into factor scores. That is a factor analysis on dream items for these 30 dreams was computed and the scores saved. The first factor in this varimax rotation accounted for 41% of the variance and had most of the dream presence items loaded. Thus it could be considered a general dream presence factor. The second factor accounted for 19% of the variance and loaded visual and sound, looks like the dream, with felt sense of it was happening to you. This might be labeled dream sensations. The last factor, 16% of the variance, loaded lack of physical movement with awareness that the body was in the bed. This could be labeled REM dream transition, as during REM one is paralyzed from the neck down. These three dream presence factor scores were then loaded into a varimax rotated factor analysis along with HVDC aggression sum and several indices of game play while awake. This factor analysis is portrayed in Table 3.

In this factor analysis two factors were above the .1 eigenvalue. The first factor accounting for 37% of the variance again found dreamed aggression as associated with general dream presence using a .3 cutoff. What is provocative here is, contrary to what one might expect, the amount of waking aggression experienced in the various games played the day prior to the dream was inversely related to the dreamed aggression and dream presence. The second factor accounting for 19% of the variance, had the highest dreamed aggression factor loading but this time it was inversely related to another dream presence factor score, REM Dream Transition Factor Score and to the ESRB violence terms associated to the game played.

4. Discussion

The call for dreams as the "gold standard" for understanding presence has been recently made by several theorists (Revonsuo, 2006; Moller & Barbera, 2006). While on the surface of it this seems obvious, no attempt to measure dream presence and compare it to VR presence has been made. In this inquiry self-reported presence after a VR like experience and after related dreams was compared. Both fidelity and interactivity were manipulated in the waking measurement of presence after exposure to a video game called Mirror's Edge. Dreams were then collected for two weeks following the manipulation. After each reported dream, presence in terms of the dream was again assessed. The self-report presence inventory used in both circumstances was an adaptation of Lombard and Ditton (1997).

These two manipulations are not fully a waking control condition, which would be presence assessed in a non-electronic media waking experience. However, the low fidelity (TV monitor) – low interaction (watching) condition does

Table 2. Varimax rotated factor analysis on dream presence items and Hall and VandeCastle sum scores for all dreams.

	Component						
	1	2	3	4	5	6	7
8. How involving was the dream?	.795	.140	.255	.102	.134	-.041	-.083
9. To what extent did you feel mentally immersed in the dream?	.871	-.027	.100	.134	.102	.030	-.111
10. How completely were your senses engaged in the dream?	.889	-.014	.067	.006	.003	.116	.060
11. How much of a sense of physical movement did you feel during the dream?	.703	.126	.327	-.188	-.091	-.030	.147
12. The dream caused real feelings and emotions for me.	.434	.040	.332	.440	.148	-.120	-.292
14. I was so involved in the dream that I lost track of time.	.623	-.008	.032	.535	.105	-.169	-.118
15. After the dream ended and I woke up I had to adjust back to waking reality.	.261	-.079	.228	.755	-.006	-.006	-.061
16. …sound like they would if you had experienced them in waking reality?	.298	.172	.700	.209	-.002	.210	.189
17. …look like they would if you had experienced them in waking reality?	.205	.101	.703	.065	.105	.075	.056
18. To what extent did you experience a sense of 'being there' inside the dream?	.744	.026	.457	.218	-.064	-.058	.003
19. How much did you feel like the events of the dream were happening to you?	.527	-.075	.609	.191	.043	.064	-.129
20. How often did you feel "My body was in bed, but my mind was inside my dream"?	-.068	-.101	.044	.812	-.178	.115	.248
characters	.158	.623	-.135	.067	.540	.105	.211
aggression	.528	.306	-.379	.185	.049	.153	.223
friendliness	-.256	-.046	.280	-.142	.693	-.189	.264
sexuality	-.015	.036	.100	.198	.056	.789	-.115
activities	-.024	.754	.150	-.112	.315	.156	.122
misfortune	.038	-.096	.096	-.338	-.218	.582	.034
good fortune	.013	.110	.089	.072	.027	-.091	.836
emotions	.286	.208	-.017	-.030	.670	-.018	-.237
settings	-.215	.469	-.061	-.134	-.267	-.205	.020
objects	.115	.762	.129	-.052	.053	.052	.096
modifiers	.165	.672	.031	.071	-.055	-.331	-.292

approximate such a control. There were no main effects or interactions for either waking game play or dream presence sum scores. Thus on a global measurement level, perhaps the gold standard claim for presence in dreams needs to be adjusted to at least consider that both VR and dreams represent comparable presence experiences.

4.1. Dream/Game Presence Item Analysis

However, because of the apparent face validity of the claim of dreams as the gold standard for presence individual item analyses were computed across conditions. That is, comparisons of game versus dream for each presence item with dreams as cases were computed. This was initially done for only those dreams that the subject reported had some element of Mirror's Edge incorporated. Only one of 12 items showed state of consciousness difference favoring dreams.

However, dreamers are not always clear about what constitutes incorporation of waking events into dreams, thus an additional item analysis on all dreams collected was computed. When dream presence scores from all dreams were considered item by item and compared to the waking presence item scores, three aspects of presence emerged as

Table 3. Varimax rotated factor analysis of dream and game variables.

Variable	Factor 1	Factor 2
HVDC sum aggression	-.359	-.719
General Dream Presence Factor Score	-.544	-.193
Dream Sensations Factor Score	.082	.374
REM Dream Transition Factor Score	-.290	.836
ESRB Rating*	.801	.277
Aggression rating for game level comment**	.782	.172
Sum of ESRB violence ratings***	.489	.660
Length play session	.716	-.243

*1-Early Childhood 2- Everyone 3-Everyone 10+ 4-Teen 5-Mature 6-Adult

**These categories were taken from the HVDC scale and applied to the comments made by the Subject about the level that they playerd prior to sleep: 8=murder, 7=physical harm, 6=aggressive act to character, 5=aggressive act to other, 4=serious verbal threat, 3=other negativistic behavior, 2=character is critical or scowls, 1=covert aggression

***The ESRB provides on their website a list of specific categories, beyond the rating itself, that the game was coded on. This list includes sexual content, drugs, language as well as violence. This score is the number of ESRB words listed which were related to violence in the game.

favoring dreams with one favoring gaming presence.

The strongest element of presence, that discerned state of consciousness difference, asked about the dream/game feeling like it was happening. Dreams were reported as more likely to feel like they were happening to the subject. This is a bit puzzling as the item asking about 'being there' in the dream/game evidenced no difference. 'Happening to you' is more action based than 'being there', so perhaps that accounts for the difference. Also favoring dream presence as stronger were two other items, one dealing with emotions and the other dealing with how the content looks like it would in reality. Dreams are widely acknowledged as emotional regulators (Levin & Nielsen, 2009) and while games can be very emotional, perhaps the brief exposure to Mirrors Edge was insufficient to evoke much emotion. As for looking like it did in reality, while the graphics of games are definitely getting better they still are not as good as waking reality and the information used by the biological system that generates nighttime mentation. Dreams emerge from the information that was stored from waking sensory experiences of reality. Thus these three features of dreams, 'happening to you', 'looking like', and 'real feelings' capture especially the quality of dreams and thus it makes sense that they generate higher senses of presence than in waking game play. None-the-less, we must not lose sight of the eight items showing no difference and one item favoring games.

4.2. Waking/Dreaming Aggression and Presence

Given that the item approach was more fruitful in examining dream versus game presence the question became, what element of dreams are likely to generate this higher dream presence? These dreams were content analyzed using a standard system (Hall and VandeCastle, 1966) which generated 11 sum scores on key content variables. Of these 11 scores only one loaded with most of the dream presence items: dreamt aggression. Given the features of how dream presence is rated as higher than game features just discussed, perhaps this is not terribly surprising. That is, aggression is emotional and it's often action based. And indeed when another factor analysis was computed looking specifically at the subscales of the dream aggression sum score it was those subscales that had the dreamer as the aggressor that were associated with dream presence. There was also a second factor on this analysis loading both dream presence and aggression subscale scores. In this second factor, dreamt watching aggression and dreamt physical aggression did not elicit emotions in the dreamer. This speaks to the oft lamented worry that engaging in virtual violence will numb the player to the effects of violence (Anderson, et al, 2003).

In order to examine if simply playing a violent game the day before the dream was associated with this aggression-presence linkage, 33 dreams where the subject reported playing a specific video game prior to sleep were examined with about one-third of these being Mirrors Edge. It was found that dreamt aggression, in this subset of dreams, was inversely related to pre-sleep video game play violence. This does not speak to the absolute amounts of aggression but rather to the association of dreamt aggression to presence. Indeed, absolute amounts of aggression in dreams of gamers tends to be less than in dreams of non-gamers (Gackenbach, et al, 2009b) but when there is aggression in gamers' dreams it is more brutal. Also this analysis is based upon 28% of the total dreams collected so it may not be representative of even this sample of subjects. Over 100 entries into the diary had played a game, but only about 1/3 of those also had a dream.

One reviewer of this study pointed out that one "could argue that the strength of presence in dreams is related to the momentary intensity of dream production, and that the most intense and stongest presence dreams will reveal to us what kind of dreams are functionally the most significant dreams; dreams where the dream production system creates its highest-fidelity presence experiences. If it is aggression, fighting etc., this could be interpreted that these kinds of experiences are closest to the original function of dreaming, for example. Low-presence contents of dreams, respectively, would reflect non-functional or random dreams."

Another line of inquiry in our lab bears on this interpretation. The relationship between threat simulation in dreams and waking aggressive gaming. In our first study we found no association between gaming and threat in subsequent

dreams but a positive association of dreamt threat to violent movies viewed the day before the dream by those low in gaming (Gackenbach & Kurvilla, 2008a). In the second study on military gamers (Gackenbach, Ellerman, & Hill, in press), we found that when affect load and distress were controlled there were several indices of lower threat in dreams which happened while in the military than in recent dreams by high end but not low end gaming soldiers. Finally, we have considered which genres of games are more likely to exhibit higher presence (Gackenbach & Bown, 2011). Casual genre's had the least presence overall while the classically hard core genres, Action, Adventure, Role Playing all of which typically involve aggression, were highest in overall presence. These previous finding are further informed herein by the last factor analysis. The first factor showed an association between dreamt aggression and dream presence. But it also showed that waking aggression in gaming was inversely associated with dreamt aggression which supports the idea that gaming may fulfill the threat simulation function of dreams.

4.3. Limitations

This study represents an initial foray into presence in two imaginal realms. While more of the various analyses resulted in no differences between dream and game presence, this could be due to false negatives and/or low statistical power. Thus design refinement might further partial out these findings. Specifically, larger cell sizes, more dreams collected, and a fully waking control group would be desirable. Also dream content analysis systems need to incorporate the variations of virtual worlds as they appear in dreams. We have begun this in our lab (Gackenbach & Rosie, 2009; Gackenbach, Sample, Mandel, & Tomashewsky, 2011; Gackenbach, Rosie, Bown, & Sample, 2011)

4.4. Conclusion

While preliminary, there is some indication that today's increasingly sophisticated world of virtual realities may be comparable in some ways to the sense of being there in dreams. VR continues to develop and become widely available, as with the recent introduction of 3-D games and refinement of chemical senses in VR. It may begin to rival the highest presence in intensified dreams, such as PTSD nightmares and lucid dreams. Further, as VR experiences become more widely available, the resultant confusion of VR and reality has already begun to emerge (Blascovich & Bailenson, 2011) including with gaming. This has long been understood in the lucid dreaming and PTSD nightmare literatures, but is only beginning to be appreciated in the world of electronically mediated virtual realms. Thus, dream studies have much to offer emerging problems with VR like experiences. Examinations of presence in dreams, as it is widely done in the VR literature, should be further considered.

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Notes

[1]One participant was disabled and in a wheelchair, and therefore we were unable to maintain standardized laboratory conditions while running him. We decided to run the participant regardless with no intention of using his data, in order to provide him with the full experience of participating in research. Another two participants were dropped from analysis because of excessive exposure to the game Mirror's Edge just prior to the laboratory session (despite requests in e-mail and verbal form to please not play or watch said game prior to the laboratory session or in the 2 weeks following the laboratory session). The last 2 participants that we couldn't use were because of outside interruptions that directly interfered with the participants' experience in the laboratory, and caused a loss of experimental standardization.

[2]Twelve minutes was the maximum allowed playtime for Training and Playground 1 combined. If a full two minutes on Playground 1 would have exceeded this 12 minute maximum, the participant was allowed to play up until this maximum was reached.

[3]After 7 subjects had been run, it was determined that the pre-recorded gaming session was too short, as all of the interactive conditions surpassed the video duration by at least 3 minutes. In order to assure comparable levels of exposure

to Mirror's Edge stimulus between conditions, the researcher added a 'time-balancing' procedure. The average exposure to Mirror's Edge was calculated for the high and low interactivity conditions, and playback of the pre-recorded video game session was rewound in order to increase the overall average of exposure time to the low interactivity conditions. Low interactivity participants were 'matched' with high interactivity conditions in order to determine how much additional time would be added to playback. In order to try and keep the overall exposure times in the four conditions balanced, equal numbers of matches were made between all of the conditions and comparable levels of time were added between all of the conditions.

[4]Items were reworded for the post-dream questionnaire to be appropriate to a dream rather than a media experience. Therefore an item like this on the game presence scale "How involving was the media experience?" became "How involving was the dream?" on the dream presence scale. These data are not presented herein. A final few questions were asked after the dream collection which dealt with their Media Use the day before the dream. This information is also not presented herein.

[5]A dream content analysis tool focused on the video game Mirror's Edge was developed in order to analyze recorded dreams and to identify elements of Mirror's Edge appearing in dreams. A grounded theory approach was used which examined the material in a specific context that has real-world patterns (Patton, 1990). These results are available elsewhere (Gackenbach, Rosie, Bown, & Sample, 2011).

[6]The sum for the game playing condition was based on one exposure while the sum for the dream condition was the average sum of all dreams which were reported as evidencing incorporation.

[7]Most of the subjects reported playing video games each day they signed in but they did not report dreams.