Dream Incorporation of Video Game Play as a Function of Interactivity and Fidelity

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RUNNING HEAD: Gaming Incorporation into Dreams

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Grant MacEwan University

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Abstract

Video game play offers the opportunity to investigate the continuity hypothesis. By using interactive video games, rather than passive films, as a controlled manipulation an engaging pre-sleep experience is possible. Several researchers have successfully used video games to investigate dream incorporation. In the current study interactivity and fidelity were the independent measures manipulating immersion in a commercially available video game. Interactivity was either passive or active, while fidelity was high screen resolution and stereophonic headset audio versus low. We expected the highest dream incorporation in the high fidelity/high interactivity condition. Incorporation was assessed by subject self-report and judges' evaluations. The independent variable of fidelity was especially strong both in the manipulation and in the subsequent dream incorporation for self report while interactivity became the dominant variable when viewed from the judges' perspectives. The effects of demand characteristics and emotionality were also considered.

Dream Incorporation of Video Game Play as a Function of Interactivity and Fidelity

A wide range of evidence has supported the continuity hypothesis of dream function. Events, personality, and pathology (Schredl & Hofmann, 2003) have all been demonstrated to show a waking to dreaming impact. An easily controlled and impactful pre-sleep event is the use of a film to demonstrate dream incorporation. Films have been used to investigate stress (Lauen, Riemann, Lund & Berger, 1987), aggression (Foulkes & Rechtschaffen, 1964), dream intensity (Foulkes, Pivik, Steadman, Spear, & Symonds, 1967), sound incorporation (deKoninck & Koulack, 1975) and dream lag effects (Nielsen, Kuiken, Alain, Stenstrom, & Powell, 2004).

As our media landscape is changing, so too are our opportunities to use media while awake to investigate issues of dream incorporation. The problem with film, television or radio is that they are all unidirectionally presented, or 'pushed' at the passive viewer. In real life we are not passive viewers, but active participants. This active participatory element is captured in computer use and video game play. It is increasingly being incorporated into previously push media in forms such as viewer call-ins or online voting to determine contest winners. While these early efforts at a push/pull media approach increase audience engagement, they pale in contrast to video game play. Thus video gaming offers an ideal pre-sleep stimulus to further investigate the continuity hypothesis.

The effects of video game play have been investigated in a variety of ways. This research has often focused on the potential negative effects of play (Anderson, et al, 2003). There is evidence for modeling aggression, and becoming addicted. Research focusing on the positive educational and psychological effects of video game play is also increasing. These positive effects include cognitive and perceptual benefits (Boot, Kramer, Simons, Fabiani, &

Gratton, 2008) as well as psychosocial benefits (Durkin & Barber, 2002), including stress reduction (Russoniello, O'Brien, & Parks, 2009). Thus, it is becoming increasingly clear that video game play represents a complex experience of childhood, and increasingly of adulthood, not easily reduced to simple condemnations or accolades.

Dreams of Gamers, Games in Dreams

Stickgold, Hobson, Fosse and Fosse (2001) used the method of pre-sleep video game play to investigate if episodic memories transitioned from waking to sleep. Isolated elements of the video game Tetris were incorporated early in the sleep cycle, but nothing appeared about the context of playing the game (i.e., computer, keyboard). They concluded that the lack of context cues in subsequent dreams argues that the incorporation was not episodic. This study demonstrated the usefulness of video game play to investigate dream incorporation factors. 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. They found that 30% of verbal reports after various sleep lengths were related to the video game and concluded that, "the nature of this cognitive 'replay' effect was altered with increasing durations of sleep, becoming more abstracted from the original experience as time into sleep increased." (p. 59).

In another recent study using the video game Doom as a stimulus, Ribeiro and Pantoja reported their efforts to investigate learning effects in sleep (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.

It is important to keep in mind that video games are not only a potential independent variable to be manipulated pre-sleep, but that because they are increasingly pervasive in today's youth culture, broader questions of their impact on dreams need to be considered. The video game playing history of all potential research participants in any study where video gaming is manipulated as a pre-sleep stimulus should be taken into account. The long term effects of video gaming have been the focus of inquiry in a series of studies by Gackenbach and colleagues and are summarized in Gackenbach, Kuruvilla, Dopko and Le (2009). Thus far they have found that video gamers report more lucid and control dreams, thus presumably allowing for conflict resolution in the dream (Gackenbach, 2006; 2009a). Additionally, it is possible that video games fulfill the threat simulation role of REM sleep (Gackenbach & Kuruvilla, 2008a). They also report increased bizarreness in video gamers' dreams which they showed was not associated with day before the dream media exposure. Additionally, they found an association between video gaming, dream bizarreness and creativity (Dopko & Gackenbach, 2009).

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 presleep stimuli except by Nielsen, Saucier, Stenstrom, Lara-Carrasco and Solomonova (2007). They found differences in participant self-reports of stimuli incorporation into dreams over the two weeks following exposure to varying levels of sensory immersion and interactivity in a game like VR maze. Thus if video games are to be more widely used as a presleep stimuli the conditions of their presentation are important to consider.

In the present inquiry we aimed to increase the difficulty of the video gaming environment as compared to the maze task used in the study by Nielsen et al. (2007) experiment, while still keeping the video game tasks achievable, and the interface controls simple enough to accommodate some variation in the levels of subject video gaming ability. We wanted to do this in the hopes of maintaining a balance of skill, challenge and interest in the video gaming task and thus increase the likelihood of its incorporation. As with Nielsen et al, we asked for self reports of incorporation but we also gathered judge's evaluations. We predict that the Nielsen et al. (2007) results will be replicated in that the high fidelity and high interactivity conditions will have more stimuli incorporation into dreams.

Method

Participants

The participants were primarily male and consisted of first year psychology students at a western Canadian University, who were generally 18 to 20 years of age. They received course credit for participation. Of the over 2000 potential research participants, 1169 filled out the pre-screening inventory. 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. In order to meet minimum participant numbers per condition, participants were also accepted when a participant claimed to remember dreams several times a month <u>and</u> claimed that they could remember a dream from the night or week before,.

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. 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. In this instance, questions also included susceptibility to motion sickness and epilepsy, frustration when learning new video games and fear of heights. This was 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 in the video game chosen as presleep stimuli. Finally, dream recall history was inquired about as used in Dopko and Gackenbach (2009).

2) Multimedia Devices: the video gaming console used was a Sony Playstation 3. The video game was Mirror's Edge, which is a first person action-adventure video game selected because of its maze or obstacle course style. This video game is 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 video gaming and virtual reality is demonstrating the cruciality of the 1st person perspective when trying to achieve an immersive in-body experience (Petkova & Ehrsson, 2008). It is rated T for Teen by the Entertainment Software Rating Board (ESRB).

A research associate was video-recorded going through the training map, a practice time trial, and through three time trial courses. 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 inch video goggles with surround sound speaker headphones were used for the high fidelity condition while a 20 inch tube television with built-in mono 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 were 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 was 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 7-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 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, 2009). 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.

Procedure

Subjects 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 telephone 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 and Ditton (1997) presence inventory (mounted online) while still in the laboratory. In the presence inventory they were also asked to provide a rating between 1 and 7 (1=low, 7=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 the online dream collection survey for each dream. This included 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 remember 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.

Dream Content Analysis Tool for Mirror's Edge: 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).

Researchers developed this tool over a period of a month and a half, with many steps involved. Categories which emerged indicating incorporation included Primary and Secondary elements, Conceptual themes, Physiological and Psychological responses that could be associated with Mirror's Edge, and Laboratory elements originating from the experimental setting.

Reliability trials were conducted with the researcher and one colleague to see if we were able to accurately code participant dreams in terms of the categories we had built. Six dreams were coded by both judges and the results compared. We assessed reliability in 2 ways: 1) we divided the number hits (a word or phrase coded as fitting the criteria for Mirror's Edge stimulus) that we both scored exactly the same by the combined number of total hits we both had. 2) We added up the number of discrepancies between individual words being coded between the coders, and divided this by the total amount of words. We were able to achieve 83% with method 1, and 99% with method 2 in the analysis of 10 dreams. Table 1 lists the conceptual scales with sample categories for each.[1]

Insert Table 1 about here

Results

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). 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)[2], 15% were female (N=6), 85% male (N=34), with an average age between 18 and 25 and 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 ($F(1,36) = 6.742$, $p<0.014$, 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 ($F(1,36) = 6.128$, $p<0.018$, partial Eta squared = 0.145) was also found for typical dream recall. These two uneven distributions informed subsequent analyses.

Game Play Analysis

ANOVAs were conducted for interactivity x fidelity for performance times ($F(1,36) = 0.096$, ns [not significant]), self-reported enjoyment of the gaming session ($F(1,33) = 0.397$, ns), and the total of all post-game presence questions ($F(1,33) = 0.397$, ns). Because performance time was not an issue for the non-play conditions, additional t-tests (high versus low fidelity) on all time measures for only high interactivity also resulted in non-significance.

This lack of cell differences as a function of the two independent variables, does not support our manipulation of the variables, and was contrary to expectation. However, because frustration in learning a new video game was differentially distributed across cells, additional analyses were computed with frustration as a covariate. This time several effects emerged. There was a main effect for enjoyment of the task and for game presence but no effects for total time playing. The main effect for game enjoyment was for interactivity ($F(1,35) = 5.222$, $p<.028$, partial $eta^2 = 0.13$). Not surprisingly, high interactivity (mean = 5.65, standard deviation = 1.531) was more enjoyable than low (mean = 4.65, standard deviation = 1.531). The sum of the game playing presence items ANCOVA was marginally significant for a fidelity main effect ($F(1, 35) = 3.21$, $p < .082$, partial $eta^2 = 0.084$). Again not surprisingly, high fidelity (goggles and headphones) was seen as higher in presence (mean = 61.1, standard deviation = 14.2755) than low (TV) fidelity (mean = 52.55, standard deviation = 12.915).

When frustration for learning a new video game was controlled, it was apparent that the manipulation worked to some degree. The data collected for game incorporation over the two weeks of dream diarying will now be examined.

Dream Analyses

In total, 380 entries into the online dream recording system were identified, resulting in 124 total dreams in 120 entries, of which 117 were fully useful. 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.

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 (X^2 (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.

Word counts for every dream were then obtained in order to see if any differences in dream content might simply be a result of some subjects being more verbally descriptive than others and as an estimate of dream recall. A univariate ANOVA for interactivity x fidelity on words per dream resulted in a significant main effect for interactivity ($F(1,112) = 11.837$, $p<0.001$, partial Eta squared = 0.532), where those in the high interactivity conditions had significantly higher mean dream word counts than the low interactivity conditions (mean high interactivity = 121.44, standard deviation = 103.62; mean low interactivity =64.6468, standard deviation = 54.62). For this reason, word count was used as a covariate in subsequent dream content analyses. This is thought to be a more accurate dream recall measure than the prescreening question of “typical dream recall”, which was ascertained in the prescreening as differentially distributed across conditions.

We were primarily interested in stimuli incorporation into dreams as a function of the experimental manipulation. These typically occur the night after an event (Domhoff, 2000). Delay in stimulus incorporations into dreams has been identified by Nielsen, et al. (2004), therefore we looked specifically at 1st, 6th and 7th nights' dreams after the experimental manipulation. In order to get larger cell sizes, 1st, 6th and 7th night data was collapsed. Thus 29 dreams were recorded and were relatively evenly distributed across cells for incorporation nights (high interactivity/high fidelity = 8; high interactivity/low fidelity = 8; low interactivity/high fidelity = 6; and low interactivity/low fidelity = 7). Not surprisingly, more dreams were reported on the other 11 nights of the two week reporting period nights (high interactivity/high fidelity = 14; high interactivity/low fidelity = 28; low interactivity/high fidelity = 23; and low interactivity/low fidelity = 23). The chi-square for incorporation nights (X^2 (1) = 0.042) and for non-incorporation nights (X^2 (1) = 2.503) were not significant.

Because of this relatively even distribution of dreams across conditions it was thought to be justified to do a 2 (interactivity: high/low) x 2 (fidelity: high/low) x 2 (incorporation: 1st,6th,7th/other nights) ANCOVA on self reported incorporation of Mirror's Edge into the dreams with number of words in the dream as a covariate. There were two significant interactions (interactivity x fidelity: F (1, 107) = 5.636, p <.019; interactivity x fidelity x incorporation: F (1, 107) = 4.846, p < .043). The 3-way interaction is portrayed in Figure 1.

Insert Figure 1 about here

The 2-way interaction is basically reflected in the 3-way interaction for the potential incorporation nights (1st/6th/7th). It can be seen that on potential incorporation nights, as expected, the highest self reported incorporation was for individuals assigned to the high interactivity and high fidelity condition. On nights where incorporation would not be expected, fidelity, across interactivity conditions, was self-rated as more likely to evidence incorporation.

Dream Content Analyses

Dream content analysis was undertaken in two ways, standard content analysis and one designed specifically to look at Mirror's Edge incorporation. For the Mirror's Edge dream content analysis, all dreams were used regardless of length (n=117), while for the Hall and Van de Castle content analysis, dreams consisting of 50 or more words were used (n=77). The reported dreams were stripped of all dream commentary (for example: background setting for the dream, or actual real-life activities occurring before, between or after dreams).

The dreams were analyzed by a trained judge using the Hall and Van de Castle dream coding system (see Table 2). This was done to determine if these dreams of relatively high end video gamers were generally like those collected in previous research by this laboratory (Gackenbach et al, 2009).

Insert Table 2 about here

This table breaks down what percentages of specific dream elements appeared in the participants' dreams (all participants across all conditions) as compared to Hall and Van de Castle standardized norms. The results were similar to findings in previous research done by Gackenbach and associates (Gackenbach et al., 2009b). Most notably, video gamers have more dead and imaginary characters, less misfortune, and fewer dreams with aggression but more intense aggression when aggression did occur. Various other differences between video gamers and norms were found which also generally echo earlier studies.

For the second method of dream content analysis, the dreams were scored by two blind judges using the dream content analysis tool for Mirror's Edge. Dream content was categorized into the following groups: primary in-game elements, secondary in-game elements, conceptual themes from Mirror's Edge, physiological and psychological responses that could be associated with Mirror's Edge and finally laboratory elements originating from the experimental setting (see Table 1 for details).

Initially an ANCOVA with word count as the covariate was computed for interactivity x fidelity x incorporation on the sum of all variables from the Mirror's Edge content analysis. An interaction for interactivity x fidelity approached conventional levels of significance ($F (1, 107) = 12.922$, $p < .089$, partial $eta^2 = .027$) such that there was no difference in overall Mirror's Edge incorporation scores for low interactivity across fidelity conditions (low interactivity/high fidelity mean = 2.032, standard error = .48; low interactivity/low fidelity mean = 2.151, standard error = .456) but a large difference under the high interactivity condition. Additionally, as expected, across all days of dream collection (i.e. across the incorporation independent variable), the high interactivity, high fidelity condition showed the most instances of incorporation (mean = 2.915, stand error = .473) while the fewest judge assessments of Mirror's Edge incorporation occurred in the high interactivity, low fidelity condition (mean = 1.47, stand error = .42).

Separate ANCOVAs were then conducted for each general category of the Mirror's Edge coding tool. In all cases main effects and/or interactions were found, except for secondary game elements. See Table 3 for descriptive statistics for each general category of Mirror's Edge dream content analysis.

Insert Table 3 about here

An ANCOVA for interactivity x fidelity x incorporation on the sum of primary elements with word count as a covariate returned a significant 2-way interaction (Interactivity x Fidelity: $F(1, 107) = 10.49$, $p<0.002$, partial $Eta^2 = 0.089$). It can be seen in Table 3 that the 'pure' conditions (i.e. high interactivity, high fidelity and low interactivity, low fidelity) showed the most primary elements, while the ‘mixed’ conditions showed the fewest primary elements.

The same ANCOVA on conceptual elements found in the dreams returned one marginal main effect for expected incorporation nights ($F (1, 107) = 3.547$, $p < .062$, partial $Eta^2 = .032$). As expected, nights where incorporation was expected evidenced more conceptual game elements (mean = 0.1979, standard deviation = .0585) than nights when incorporation would be less expected (mean = 0.05145, standard deviation = 0.195).

The physiological and psychological game elements ANCOVA (interactivity x fidelity x incorporation), with word count as a covariate, resulted in a slightly different pattern of results. There was a main effect for fidelity ($F (1, 107) = 5.201$, $p < .025$, partial $Eta^2 = .046$) and an interaction between fidelity and incorporation ($F (1, 107) = 4.796$, $p < .031$, partial $Eta^2 = .043$). It can be seen in Table 3 that the physiological and psychological game elements were most evident in high fidelity conditions on nights when incorporation was expected.

An ANCOVA for interactivity x fidelity x incorporation on laboratory elements originating from the experimental setting, with word count as a covariate, returned five significant or near significant results. There were two main effects (interactivity: $F(1, 107) = 7.43$, $p < .007$, partial $Eta^2 = .065$; fidelity: $F(1, 107) = 4.751$, $p < .031$, partial $Eta^2 = .043$), two 2-way interactions (interactivity x fidelity: $F(1, 107) = 7.913$, $p < .006$, partial $Eta^2 = .069$; interactivity x incorporation: $F(1, 107) = 3.446$, $p < .066$, partial $Eta^2 = .031$) and a 3-way interaction (interactivity x fidelity x incorporation: $F(1, 107) = 3.229$, $p < .075$, partial $Eta^2 = .029$). The strongest effect was across dream incorporation days for interactivity x fidelity and is shown in Table 3. Interestingly, low interactivity shows more laboratory incorporations under the high fidelity condition, than does high interactivity. This could be because the participants' attention was less on the game as they were not actually playing it and more on the setting they found themselves in which was quite unique in that they were wearing the high fidelity goggles.

Dream Emotions

It's generally been agreed upon in the dream research literature that one of the major functions of dreams is mood regulation (Levin & Nielsen, 2007). Thus incorporation of waking experiences into dreams is likely moderated by their emotional impact, especially if negative. To examine if incorporation in the present inquiry was related to emotions, both during the game and in the dream emotion information was computed in several ways. In the post dream questionnaire participants were asked to list the emotions they experienced in the dream in a free recall fashion. The number of emotional adjectives listed, either positive or negative, were computed to determine one of the self emotionality scores. The other was from an item on the post dream questionnaire specifically asking if the dream was emotional. Two assessements of emotionality in the dreams were also obtained from the judges. One assessment was a subitem from the Mirror's Edge content analysis scale and the other was the total emotions from the Hall and Van de Castle scale. Also entered in the factor analysis were two incorporation estimates, one by the dreamer and the primary elements subscale from the Mirror's Edge scale.

A varimax factor analysis was computed. In order to use the Hall and Van de Castle dream content analysis information on emotions, only those 77 dreams were used for the factor analysis. Emotion, incorporation and manipulation of the independent variables was loaded. Specifically, it can seen in Table 4 that two self rated emotions from the dreams, two judges ratings of dream emotions, one self rating of emotional engagement of the game play, judge and subjects dream incorporation estimates and the three independent variables were entered. It was thought justified to enter the independent variables as levels within each represented ends of a spectrum. That is, high versus low interactivity, high versus low fidelity, and dream incorporation versus nondream incorporation days.

Insert Table 4 about here

Using cutoffs of .3, the first factor represents 17.28% of the variance and loaded the two incorporation estimates with the highest likelihood of incorporation days. It can be called the incorporation factor. The second factor accounted for 16.78% of the variance and loaded self reported dream emotions with the high interactivity (i.e., playing the game) condition. Judges emotional judgements loaded together on the third factor along with high likelihood of incorporation days, accounting for 15.28% of the variance. The last factor was marked but fidelity (TV viewing) as associated with not having the game elicit real feelings and unlikely incorporation days. It accounted for 14.36% of the variance.

Contrary to expectation incorporation into game was unrelated to emotions. However, different conditions were associated with self rather than judges assessments of dream emotions. It was playing the game which was associated with dreamers self reported dream emotions while incorporation nights loaded with judges estimates of dream emotions.

Discussion

In an effort to expand upon research looking at the effects of changes to levels of immersion and interactivity with a video game pre-sleep stimulus on subsequent incorporation of the stimulus into dreams, a partial replication and extension of the Nielsen et al. (2007) study was conducted. Subjects were exposed to one of four gaming conditions (playing with goggles, watching with goggles, playing on TV, watching on TV). After the gaming session, self-reported presence scores were collected, as were two weeks of dream diarying with accompanying questionnaires. Dreams were analyzed for self-report and judge assessment of Mirror's Edge incorporation. It was predicted that the Nielsen et al. (2007) results would be replicated, in that high fidelity and interactivity conditions would result in higher levels of game presence and of stimulus incorporation into dreams.

When looking at the data with participant self-rated typical frustration in learning new video games as a covariate (due to uneven distribution across condition cells), differences between conditions emerged. Not surprisingly, those participants playing Mirror's Edge reported higher levels of enjoyment during the gaming session as compared to those watching a recorded Mirror's Edge gaming session. Also not surprisingly, those using the video goggles and surround sound headphones reported higher levels of presence than those using the 20" tube television. These emerging differences between conditions when controlling for frustration in learning new video games could indicate that the learning curve for Mirror's Edge was too steep for the allowed time to get used to the controls. There is evidence for this in the data, as several of the participants were unable to complete the training and/or time trials before time allowances were surpassed. This could also be an indication that using frequency of video game play as a main indicator of high-end gamer status is insufficient in determining level of gamer skill[3]. As an illustrative example, one participant mentioned that she played video games several times a week for many hours, but that she used almost exclusively the original Nintendo gaming console, which is quite simple compared to today's standards (only two buttons and a directional pad, compared to 10 buttons and 3 directional pads on the PS3 controller).

When looking at the actual dream diary entries of participants, the total number of dreams collected was disappointing. Dopko and Gackenbach (2009) received substantially more dreams (n=440) over the same time-span from a comparable number of subjects (n=54). This might in part be due to participants in the current study being given the option in the process of dream collection to indicate that they did have a dream, but that they didn't want to share it. Dopko and Gackenbach’s (2009) participants did not have this option. Additionally, about half of their subjects were low end video gamers and over half were women. Finally, the predominately male sample in the present study, of moderate to high end video gamers, may not be as interested in their dreams even though they were moderate to high dream recallers.

Nonetheless several patterns emerged in this dream data. Our prediction concerning incorporation of video game stimuli into dreams was held up, in that the high interactivity and fidelity condition returned the highest self-reported incorporation on the 1^{st}, 6^{th} and 7^{th} nights, supporting the Nielsen et al. (2007) study results. Contrary to expectation though, the low interactivity and fidelity condition showed the next highest self-reported incorporation into dreams on the 1^{st}, 6^{th} and 7^{th} nights. This could possibly be a result of the small sample size. Alternatively, it could be the result of a lack of any control over whether participants played or watched Mirror's Edge during the dream diarying period, although participants were asked not to do so with a verbal agreement being reached before they left the laboratory.

Additionally, differences in which memories are accessible throughout a night of dreaming have been demonstrated. Wamsley et al. (2010) found that their skiing game showed up most clearly in earlier REM sleep periods, and more abstract referents were evidenced in later REM sleep periods. Nielsen (2004) has argued that experiences during the same day of the dream are likely to show up within the first REM stage and as the experiences get older, they get pushed back into later REM stages. Therefore due to a recency effect, or to the fact that REM clusters later on in the sleep cycle, our request for reporting a remembered dream most likely resulted in reported dreams from the later REM periods, possibly concealing Mirror's Edge incorporation.

Another way to view this higher self-report incorporation on key nights post game play, was that the pure conditions reported the most incorporation. That is, all “on” (high interactivity and high fidelity) or all “off” (low interactivity and low fidelity) were highest in incorporation while mixed conditions (high/low) showed less self-reported incorporation. This result seems less a function of the conditions than of the consistency within the conditions and thus clearer demand characteristics. Alternatively, at least for the low/low condition it could be that those only watching and on an old fashioned tube type TV tried harder to see Mirror’s Edge in their dreams while those actually playing with goggles (high/high) had in fact more incorporation. In any case the judges' evaluations of incorporation shed light on this perplexing finding.

Interestingly, when looking at all of the other dream nights in this 3-way interaction, the high fidelity conditions demonstrated consistently more self-reported incorporation than the low fidelity conditions. This could be a result of possible demand characteristics. Stern, Saayman and Touyz (1978) demonstrated this effect in a laboratory setting when they were able to successfully influence subjects' dreams in their sleep study. Relatedly, Beurrette (2008) showed that mere pre-sleep suggestion affected subsequent dream emotions. In this study the presence inventory responses that the participants completed directly after their gaming session indicated the particular salience of fidelity in the subject's mind. Thus an expectation of what we might be looking for in terms of incorporation could have been evidenced at that point and affected subsequent participant self-report dream diary responses. That is, those experiencing higher levels of sensory immersion (fidelity), and subsequent higher self-reported levels of presence post-game, either consciously or unconsciously determined that we expected them to report higher levels of incorporation, and did so in their dream diary self-report questionnaires. Additionally, in the factor analysis of emotion reports, fidelity loaded with game feelings while awake but not with either dream emotions. This supports the idea that demand characteristics were more salient (increased emotions) under the high fidelity condition.

In order to get non-self-report data concerning incorporation, we wanted to first establish that the dreams collected in fact displayed characteristics of previous and much larger gamer dream samples obtained by Gackenbach et al. (in submission). There was some concern that the relatively low number of reported dreams would exhibit idiosyncratic characteristics. If shown to be typical video gamer dreams, then the effects of the manipulation become more authentic. Dream content analysis was performed on 50+ word dreams with the Hall and Van de Castle system, resulting in virtually identical gamer dream patterns as in the previous Gackenbach et al. (in submission) study. Satisfied that our current sample was in fact representative of gamers' dreams, further content analysis was performed using the Mirror's Edge dream content analysis tool.

As predicted, when looking at the sum of judge assessments of Mirror's Edge elements (i.e., all of the Mirror's Edge content analysis categories) for the full two weeks of dream collection, the high interactivity and fidelity condition showed the most incorporation of stimuli, supporting the Nielsen et al. (2007) results. Interestingly, high interactivity showed the most variation across fidelity conditions, where low interactivity showed little fidelity differences in contrast to the importance of fidelity for self reports (presence and incorporation). This might play more of a key role in determining incorporation of stimuli into dreams. In other words, depending on how you look at the data the emphasis shifts from fidelity primacy (self report) to interactivity primacy (judges).

Adding support to this idea is the dramatic increase in judged laboratory setting elements (i.e., those least associated with Mirror's Edge game play) appearing in the high fidelity, low interactivity condition as compared to the other conditions. Using the video goggles while not having to focus on playing the game resulted in more incorporation of laboratory stimuli into dreams, whereas playing the game with the video goggles resulted in the lowest incorporation of laboratory stimuli into dreams. The opposite result occurred when looking at the primary elements (i.e. those that are the most obvious perceptually, and are the most core elements of Mirror's Edge). The high fidelity watching condition was judged to have incorporated the least amount of primary elements out of all the conditions. It seems likely that in high fidelity conditions, the required attention for those playing the game detracts from focus on immediate environmental settings and emphasizes focus on core game stimuli, while the lack of required attention for those watching allows for more attention to be paid to immediate surroundings and detracts from focus on core game stimuli. While these results could be explained by the manipulation of interactivity, novelty is also a factor. High fidelity technologies such as video goggles are very uncommon and it is probable that few, if any, of the participants had had prior experience with video goggles before this study.

When looking at nights where incorporation would be expected, namely the 1st, 6th and 7th nights, several results emerged. First of all, judged incorporation of psychological and physiological responses that could be associated with Mirror's Edge showed by far the most incorporation on expected incorporation nights in the high fidelity conditions. This suggests that individual responses to game stimuli were much more potent in the video goggle conditions, resulting in an increase in judged instances of the more abstract concepts that could come out of Mirror's Edge (for example, issues of motivation, success and failure, fears and phobias of heights or falling, etc.). And, as it is likely that our subjects' dreams occurred in later REM stages (as discussed earlier), this is consistent with the Wamsley et al. (2010) conclusions, in that abstract concepts are more evident in later REM stages. The increased salience as a result of novel and high fidelity presentation of the game stimulus could have resulted in this increased incorporation on expected incorporation nights.

To summarize, game play has been shown to be incorporated into dreams in several studies. Schredl and Hofmann (2003) make the additional point that interactivity alone is not sufficient for incorporation. Using judges' evaluations, they found that computer game play, but not computer use for work, was associated with the occurrence of relevant dream experiences. They point to the emotional component of game play as the reason for this difference. So too in the present inquiry, there is some support for game play being incorporated into dreams, but the findings are clouded by self-report versus judges' evaluations. Additionally, emotions differed in their association to incorporation. This contrast between self-report and judge dream content assessments has been noted before in the dream literature (Schredl & Doll, 1998) and in the gaming-dreaming association (Lee & Gackenbach, 2009) with regards to the reports of emotions.

Limitations

There are several obvious limitations to this study. We did not collect 'lights out' times or length of sleep and degree of refreshment after sleep, all of which would have allowed us to estimate where in the sleep cycle dreams were recalled from. Due to this, it is possible as discussed by Nielsen (2004) that a mix of recent and more dated experience memories were popping up in dreams. Additionally, when time of logon to the online dream diary was examined it was clear that some of these gamers' sleep cycles were scattered across the 24 hour cycle. Also, it is possible that there was more frequent incorporation of Mirror's Edge stimuli into dreams, but that those dreams were simply not reported in lieu of another dream on the same night. Or, as noted earlier, the option to not record dreams added to the current diary study may have resulted in fewer dreams than in a previous diary study in the same laboratory (Dopko & Gackenbach, 2009).

The sample size is quite small, with only 10 participants per condition. The task of finding sufficient quantities of high end gamers, who also have moderate or high levels of dream recall and who successfully complete two weeks of dream diarying, all in a 100-level university psychology course population, is a difficult one.

The unintended but likely demand characteristics of the laboratory game play session followed by instructions to record dreams for two weeks, may have been exacerbated with the administration of a presence inventory directly after the gaming session, and then subsequent administrations of similar presence questions in the post-dream dairying. It could be that by filling out essentially the same questions after each dream that they had answered about the game they played, the subjects may have further gotten the idea that we were really interested in the game. This would be up and above the full disclosure that we were so interested in dream incorporation of the game. So while reports of incorporation by the subject may have been inflated, it's unclear if the actual dream reports were so affected.[4] As previously discussed, demand characteristic effects have been demonstrated in dreams (Stern et al., 1978), and could have shown up in the current study.

Conclusion

The findings from the Nielsen et al. (2007) study were largely supported in that overall incorporation of game stimuli was more likely with high interactivity and fidelity, depending on how this information was gathered. High fidelity technology demonstrated effects but this may have been due to novelty. The importance of considering concepts over and above simple observable video game stimuli was also demonstrated, as abstract concepts tied to Mirror's Edge and environmental setting impacted the results and was consistent with the literature. Also how dream emotions information is collected continues to present conflicting information (Schedle & Doll, 1998).

In future research on the effects of video games on dreams fidelity and interactivity should be considered as should the novelty of technology used in differing conditions. Additionally, the effects of the administration of post-game and post-dream questionnaires needs to be considered as they could inflate demand characteristics. Similar consideration is warranted for a possible cover story that would minimize demand characteristics.

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Table 1

Mirror's Edge Dream Content Analysis Scale Themes and Illustrative Content Categories

Conceptual Theme	Examples of specific content categories
<u>Primary In-game elements.</u> Game elements that are essential to the mechanics of Mirror's Edge and/or must be interacted with while playing the game. List items can be flagged with 'EG' (extra-game) or 'LE' (laboratory elements) when the particular instance of dream content does not occur in a Mirror's Edge setting and/or context.	1.First-person perspective 2.Barriers (electrified fences, blockades, dead-ends, barbed wire fences) 3.Climbing (structures – inanimate objects) 4.Hanging (hanging from a height, includes shimmying along ledges) 5.Hearing player character breathe (or exertion noises) 6.Heights
<u>Secondary In-game elements.</u> Complementary or reinforcing to primary elements – can either be static parts of setting, interacted with in non-necessary ways or used infrequently. List items can be flagged with 'EG' (extra-game) or 'LE' (laboratory elements) when the particular instance of dream content does not occur in a Mirror's Edge setting and/or context.	1.Visual feedback concerning performance. 2.Following (could be mimicking, chasing, following example, learning by observation,etc.) 3.Loading screens (red silhouetted animated characters fighting during loading screen waits)
<u>Conceptual themes from Mirror's Edge</u>	1. Maze (maze-like, obstacle course-like) 2. Time pressure (any mention of a sense of time pressure)
<u>Physiological and Psychological responses</u> that could be associated with Mirror's Edge.	1. Fears (Acrophobia (heights), Agoraphobia (open space), Batophobia (fear of being close to tall structures), fear of falling) 2. Flow (loss of time, balance of challenge and skill, attentional issues)
<u>Laboratory elements</u> originating from the experimental setting.	1. Controller 2. Lab room 3. Playstation 3 4. Projector 5. Video goggles

Table 2

Hall and Van de Castle content analysis of all collected dreams

Hall and Van de Castle dream content analysis.	All Diary Dreams	Male Norms	*h* vs. males	*p* vs. males	N for Diary Dreams	N for Male Norms
Characters						
Male/Female Percent	60%	67%	-.16	.127	104	873
Familiarity Percent	44%	45%	-.02	.772	204	1108
Friends Percent	30%	31%	-.02	.793	204	1108
Family Percent	05%	12%	-.23	** .002	204	1108
Dead & Imaginary Percent	06%	00%	+.38	** .000	228	1180
Animal Percent	08%	06%	+.07	.307	228	1180
Social Interaction Percents						
Aggression/Friendliness Percent	53%	59%	-.12	.421	51	546
Befriender Percent	39%	50%	-.22	.308	23	203
Aggressor Percent	61%	40%	+.43	* .048	23	253
Physical Aggression Percent	65%	50%	+.30	.066	40	402
Social Interaction Ratios						
A/C Index	.18	.34	-.39		228	1180
F/C Index	.11	.21	-.24		228	1180
S/C Index	.02	.06	-.10		228	1180
Settings						
Indoor Setting Percent	61%	48%	+.25	* .023	97	586
Familiar Setting Percent	70%	62%	+.18	.288	40	320
Self-Concept Percents						
Self-Negativity Percent	53%	65%	-.23	.127	45	809
Bodily Misfortunes Percent	29%	29%	-.02	.956	14	205
Negative Emotions Percent	74%	80%	-.15	.446	27	282
Dreamer-Involved Success Percent	54%	51%	+.06	.848	13	141
Torso/Anatomy Percent	17%	31%	-.32	.101	29	246
Dreams with at Least One:						
Aggression	33%	47%	-.28	* .019	81	500
Friendliness	27%	38%	-.24	* .049	81	500
Sexuality	04%	12%	-.31	* .010	81	500
Misfortune	14%	36%	-.54	** .000	81	500
Good Fortune	02%	06%	-.18	.134	81	500
Success	11%	15%	-.12	.334	81	500
Failure	09%	15%	-.21	.080	81	500
Striving	17%	27%	-.24	* .049	81	500

Note: These ratios do not use the h statistic.

Table 3

Descriptive statistics for general categories of Mirror's Edge dream content analysis as a function of interactivity, fidelity, and incorporation

Mirrors Edge General Category	Hi Fidelity (Goggles)			Lo Fidelity (TV)		
	Mean	StDev	N	Mean	StDev	N
Primary + Extra Game						
Playing	2.00	2.43	22	0.97	1.42	36
Watching	0.68	1.12	28	1.37	1.33	30
Physio & Psycho						
1st,6th,7th	0.57	1.09	14	0.67	0.26	15
all other nights	0.17	0.45	36	0.14	0.40	51
Laboratory						
Playing	0.09	0.29	22	0.11	0.32	36
Watching	0.46	0.92	28	0.07	0.25	30

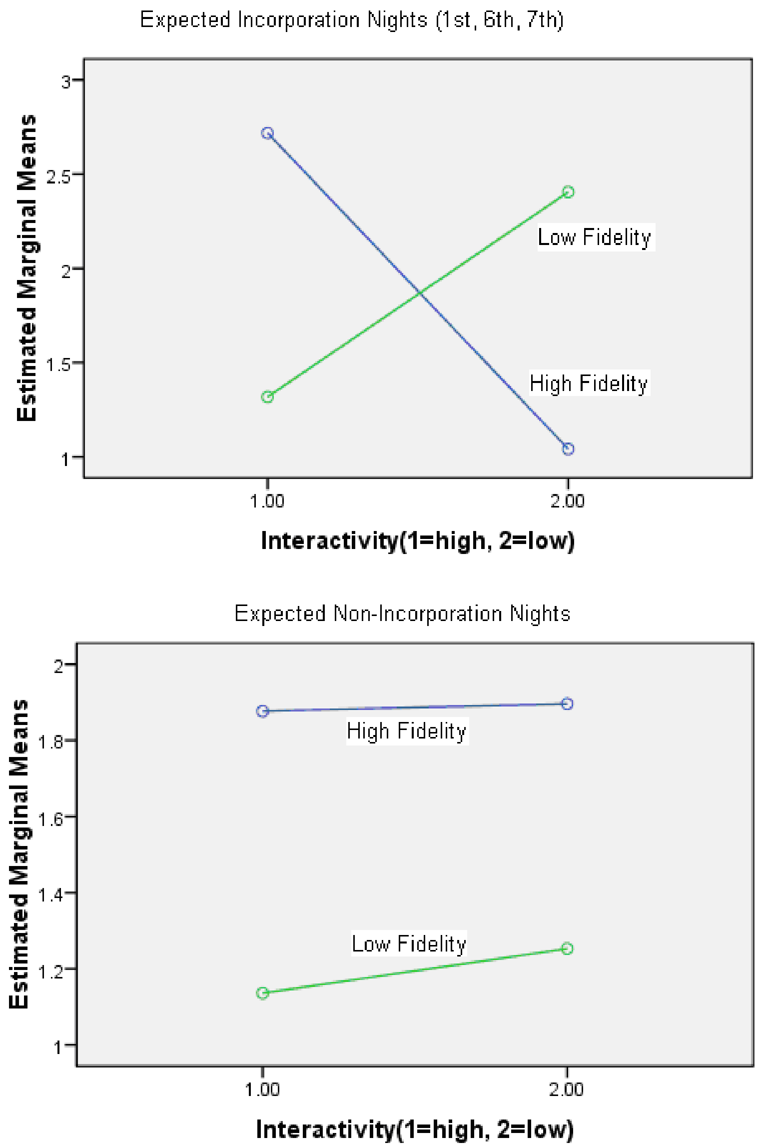
Table 4

Varimax rotated factor analysis on waking and dream emotions from dreamer and judges as well as incorporation estimates and the three independent variables

	Component			
	1	2	3	4
Self: Emotionality in dream item post dream	.019	.767	.152	-.124
Self: Sum of positive & negative emotional adjectives	.088	.760	-.093	-.134
Judge: Emotions rated on Mirror's Edge content analysis	.064	.056	.812	.059
Judge: Emotions sum from Hall & VandeCastle analysis	-.177	.200	.705	-.094
Self: Dreamer rating of game incorporation after dream	.878	-.073	-.027	-.217
Judge: Sum of primary+EG Mirror Edge elements dream	.872	.108	.015	.102
Night: Incorporation vs none incorporation nights (1=1st/6th/7th, 2=all others)	-.372	.056	-.541	.377
Laboratory Condition 1: Interactivity(1=high, 2=low)	.065	-.621	-.153	-.007
Laboratory Condition 2: Fidelity(1=high, 2=low)	.006	-.023	.026	.815
Laboratory Report: Game caused real feelings	.102	.251	.146	-.726

Figure 1:

Interactivity x Fidelity x Incorporation interaction on self reports of game incorporation with number of words in the dream as covariate.



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[1] The first author can be contacted to receive further details on the development of the dream coding instrument.
[2] 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.

[3] Normally four criteria for high end gamer are used in this research program, but because so many other variables needed to be accounted for in this research study only game frequency was used as a pre-screening variable.
[4] It should be pointed out that details about the game and dream presence questionnaires will be presented elsewhere.