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Original Article

Photorealistic Avatar and Teen Physical Activity: Feasibility and Preliminary Efficacy

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Abstract

Objective: Exergames played with a photorealistic avatar may enhance motivation to play, in addition to frequency, duration, and intensity of game-play. This article reports the feasibility and preliminary efficacy of an exergame played with a photorealistic avatar on physical activity (PA) intensity in a laboratory-based study.
Materials and Methods: Teens (12–14 years old) were recruited from a large, metropolitan area of the southwestern United States. Parents provided written informed consent. Teens completed online data collection, played an exergame with a photorealistic avatar in an observed laboratory setting, and then participated in postassessment data collection that included online questionnaires and a telephone interview.
Results: The program was feasible: 42 out of 48 teens recruited (87.5%) completed all data collection activities; game enjoyment was 21.9 ± 8.4 out of possible score of 32; immersion, 49.7 ± 15.6 out of a possible score of 88; avatar identification, 43.9 ± 16.5 out of a possible score of 68; and program satisfaction, 15.6 ± 3.6 out of possible score of 20. Objectively assessed PA indicated that 15.88 minutes of the laboratory-based gameplay session (74.9% of total time) was in vigorous PA; small effect sizes were observed in autonomy (ES = 0.45; $P = 0.01$) and competence (ES = 0.36; $P = 0.03$). Little change was observed in relatedness (ES = 0.04; $P = 0.82$) Qualitative data confirmed participants enjoyed playing the game with a photorealistic avatar and provided suggestions to enhance the gameplay experience.
Conclusion: Playing an exergame with a photorealistic avatar holds promise as a method for increasing PA among youth. Additional research is needed to further explore its effects on gameplay frequency, intensity, and duration in nonlaboratory setting.

Keywords: Physical activity, Adolescents, Exergame, Avatar, Feasibility, Preliminary efficacy

Background

Federal recommendations for physical activity (PA)[1] have been established to promote healthy lifestyles and reduce risk of obesity[2] and other chronic diseases such as certain cancers,[3,4] cardiovascular disease,[5] and type 2 diabetes.[6] National data reveal an alarming picture: few teens meet the PA recommendation[7] and, even more disturbingly, there is evidence that PA patterns established during youth track into adulthood.[8] Further, although interventions to increase teen PA have had some success in increasing moderate or vigorous PA, there has been little increase in overall PA.[9] Given that this period is a particularly vulnerable time for PA,[10] research is urgently needed to identify ways to increase teen PA in sustainable ways.

Enjoyable activities are more likely to be maintained.[11] Videogames are an enjoyable activity,[12] and teens play them often.[13] Exergames are a specific type of interactive videogame that require body movement to play.[14] Evidence regarding exergame effectiveness at encouraging PA in children and teens is equivocal.[15] Although there is some evidence of their short-term effectiveness,[15] evidence regarding their long-term effects on habitual PA is lacking.[16] Therefore, additional research is needed to investigate ways in which to use this promising approach to promote habitual PA among teens.

Exergames are typically navigated by an avatar (i.e., digital image representing the player during gameplay).[17] Evidence suggests that players develop a parasocial relationship with their avatar.[18] Appearance appears to play an

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important role in this relationship, with some research indicating that self-representational avatars (i.e., avatars that closely resemble the player) are associated with the player engaging in avatar-protective behaviors. For example, a series of experiments by Fox and Bailenson[19] demonstrated that an individual's exercise behavior was modified by its effect on a virtual representation of self (i.e., weight gain, loss); this was not observed, however, when the image did not resemble the participant. They suggested several mechanisms through which this may occur, including vicarious reinforcement and affect. Research with teens revealed favorable reactions to navigating an exergame with an avatar that looked like them.[13] Therefore, an avatar customized to the player's appearance (i.e., photorealistic avatar) may be an effective method for enhancing PA in an exergame.

Earlier research reported the development of an exergame for teens that was navigated by a photorealistic avatar customized to the player's appearance.[13] The purpose of this article is to report the results of a laboratory-based pilot study investigating the feasibility and preliminary efficacy of that exergame.

Methods

Research design

A one-group design was utilized. Data were collected at baseline, during laboratory-based gameplay, and post-intervention. Feasibility data were collected (e.g., *recruitment duration, program satisfaction).*

Participants and sample size

The recruitment goal was 48 participants, stratified by gender, BMI, and PA to ensure a diverse sample. Because there is lack of consensus on acceptable sample sizes for feasibility studies,[20] 48 participants were thought to provide an adequate sample with which to assess feasibility and preliminary efficacy. Inclusionary criteria included being 12–14 years old; healthy; living in or near Harris County, TX, and fluent in English. Exclusionary criteria included having conditions that limited ability to fully participate in the study (e.g., uncontrolled asthma).

To facilitate stratification, during recruitment self-report of the teen's gender (male, female), height (feet), weight (lbs), and usual PA level (number of days physically active for ≥ 60 minutes a day) were obtained. Height and weight were used to calculate BMI, informed by the 2000 age and gender-specific growth charts.[21] BMI stratification criteria were <85th percentile (healthy weight) vs. $\geq$85th percentile (overweight/obese).

Recruitment

Participants in this study were recruited from a large, metropolitan area in the southwestern United States using the USDA/ARS Children's Nutrition Research Center's volunteer database and standard recruitment techniques (e.g., newsletter and volunteer website notices). Interested families contacted the study recruitment coordinator, who explained the study in detail; she then screened interested families for eligibility and assessed stratification criteria. Written informed consent and assent were obtained before participation in study activities. Ethics approval to conduct the research was obtained from Baylor College of Medicine (H-31426) and the University of Houston (12549-01).

Avatar creation system

Three-dimensional scans of the player were converted into an avatar and inserted into the game. Specifically, Structure Sensor (Occipital, Inc.) and the itSeez3D app loaded on an iPad scanned the player multiple times and generated a 3D model. The scanner consisted of a depth camera and a standard camera operating in parallel. In the initial scan, a rough 3D model of the player from top to bottom was generated, followed by additional scans from different angles to create more geometric details and fill holes. Finally, a skeleton model was created to facilitate animation of the avatar during gameplay. For additional description and a figure portraying this process, please see Thompson et al.[13]

Exergame description

The exergame and its development is described in greater detail elsewhere;[13] a brief description is provided here for context (see Appendix Table A1). The exergame was an endless runner genre, where players used physical movement in the real world to control their in-game character (i.e., photorealistic avatar). To navigate their avatar through game-play, players jumped over obstacles, crouched, and jogged in place in the real world; these actions were repeated by their avatar in the game-world. Game duration was set at 20 minutes. Before gameplay, players chose from three difficulty levels based on their own self-assessment of their activity level. Level difficulty was determined by the amount of obstacles the player encountered and duration of the resting period the players were allowed to take. The game machine used in this study was Xbox 360, and the size of the TV screen was 50 inches.

The game was entitled ''The Nightmare Runner'' and begins with the player's avatar falling asleep where it realizes they are trapped in a dream world. While exploring this world, the avatar finds a dark cave, and unintentionally awakens the monster who frequents its nightmares. This initiates active gameplay, where the player navigates his/her avatar in an attempt to outrun the monster by dodging dream-world obstacles. While running, the player continuously loses stamina or energy (referred to as ''dream energy''). If an obstacle is not overcome, more dream energy will be lost. Dream energy can be replenished by collecting ''dream shards'' that periodically appear in the game.

At the end of the game session (i.e., end of gameplay), if the avatar was not caught by the monster, an ending cut scene was shown where the avatar runs into a large gap in the dream world that appears too large to jump. Faced with a choice between the monster and a leap of faith, the avatar must gather up his/her energy and jump. The avatar ends up safely on the other side, and realizes that since it is a dream, they are in control. The avatar uses his/her remaining dream energy to fire a magic bolt at the monster, killing it. The avatar then escapes from the dream world, and gameplay ends.

Data collection

Several types of data were collected, including self-report questionnaires at baseline and postassessment and gameplay data, including objective-assessment of in-game PA. Post-assessment telephone interviews were also conducted by trained interviewers. Logs maintained by study staff tracked recruitment and data collection.

Self-report. Teens completed self-report questionnaires hosted on a secure, password-protected website at baseline and after completion of the laboratory-based study (post-assessment). They were provided with a private password to complete the questionnaires. Teens received a $60 gift card at completion of laboratory-based data collection, and a $50 money order upon completion of the self-report questionnaires and postassessment interview.

Self-report measures. Demographic characteristics (gender, race/ethnicity, age), technology use, and PA were assessed at baseline using questions adapted from the Youth Risk Behavior Surveillance System.[22] The ''Psychological Need Satisfaction in Exercise Scale'' assessed basic psychological need satisfaction (autonomy, competence, relatedness)[23] at both assessment periods. It has a 3-factor structure; all subscales have displayed high internal consistency (Cronbach's alpha >0.90) and construct validity. Game enjoyment, immersion, avatar identification, and program satisfaction questionnaires were completed at postassessment only. Game enjoyment was assessed with an 8-item scale that exhibited acceptable psychometrics with undergraduate students ($\alpha = 0.96$).[24] Items were rated on a 5-point Likert scale ranging from strongly disagree to agree a lot. Immersion was assessed with a 20-item scale rating videogame immersion that exhibited acceptable psychometrics with 4th and 5th graders ($\alpha = 0.92$) (D Thompson; unpublished data). The scale is an adaptation of the immersion scale used in a serious videogame developed for 10–12-year-olds,[25] which was based on the Green and Brock[26] narrative transportation scale. Items were rated on a 5-point Likert scale, ranging from strongly disagree to agree a lot. Sample items included were ''The characters seemed real''; ''The things happening in the game seemed real''; and ''When I played the game, I was not aware of things happening around me.'' Avatar identification was assessed with the 17-item ''Avatar Identification Subscale'' of the ''Player Identification Scale.''[27] The subscale is comprised of three dimensions–perceived similarity, wishful identification, and embodied presence. Items were rated on a 5-point Likert scale, ranging from strongly disagree to strongly agree.

Objective assessment of in-game PA. PA intensity during gameplay was assessed with a GT3X+ accelerometer (Actigraph; Pensacola, FL). An accelerometer was placed on the teen's waist before gameplay and worn throughout the testing session.

Telephone interviews. Telephone interviews were conducted by trained interviewers following a semi-structured script. Sample questions included: ''What was it like to play the game with an avatar that looked like you?'' and ''If you could help us re-create the game, what, if anything, would you change?'' Probes and prompts were used to clarify, expand, and understand responses as needed.

Feasibility

Feasibility studies are an early step in the development of a new intervention or approach. Their purpose is to assess whether a study can be conducted and whether it should proceed to efficacy testing.[28] Therefore, to make a determination as to whether this approach was feasible, recruitment (total, duration), completeness of data collection, psychometrics of self-report measures, and program satisfaction were examined.

Statistical analysis

Self-reported weights and heights were used to calculate BMI using 2000 CDC Growth Charts for the United States.[21] Responses to self-reported psychological measures were summed and descriptive statistics calculated. Numerical and graphical methods tested for data normality. Paired *t*-tests were used to examine the difference in basic psychological needs subscales between pretest and post-test. Effect sizes were calculated. All statistical analyses were run using the Statistical Analysis Software (SAS) (version 9.4; SAS Institute Inc., Cary, NC, 2011).

Accelerometer data were collected in 10 second epochs; epochs were collapsed so that all values of PA were expressed in minutes using the customized the SAS macros developed by the National Cancer Institute.[29] The Evenson cutpoints were used to segment the accelerometry counts into intensity levels.[30]

Qualitative data

Qualitative data were analyzed using thematic analysis.[31] Using an a priori list of codes, two coders independently coded the transcripts; emergent codes were added as coding progressed to capture the nuances of the data. Differences were discussed and resolved. After coding was complete, codes were examined and themes identified. Relevant quotes were identified to provide insight into responses.

Results

Recruitment began in September 2015, and was completed in November 2015. All stratification cells were filled (gender, BMI, PA), resulting in a total enrollment of 48 teens. The most challenging stratification cell to fill was the one for teens who were physically active less than 5 days a week and who had a BMI $\geq 85^{th}$ percentile. All 48 teens completed baseline surveys; 42 also completed the laboratory-based study and postassessment surveys. The six teens not completing the study were unable to participate in the laboratory-based session during the specified data collection period (October-December 2015). Only those with complete data were included in the analyses.

Participant characteristics

Of the 42 teens completing all data collection activities, equal numbers of boys and girls participated (50.0% each). Teens were diverse, 45.2% White; 40.5% Black; and 14.3% Other racial/ethnic groups. Age ranged from 12 to 14 years old (12.8 ± 0.8), with slightly more 13-year-olds in the sample (40.1%). Teens reported being physically active from 0 to 7 days per week, with most reporting an average of

Table 1. Demographic Characteristics (n = 42)

Characteristic	n	%
Sex		
Male	21	50
Female	21	50
Ethnicity/race		
White	19	45.2
Black	17	40.5
Mixed	6	14.3
Age (year)		
12	16	38.1
13	17	40.5
14	9	21.4
# of days PA per week		
0	2	4.8
1	2	4.8
2	2	4.8
3	3	7.1
4	12	28.6
5	13	31
6	3	7.1
7	5	11.9
BMI		
Under or normal (BMI%tile <85th)	20	47.6
Overweight (BMI%tile: ≤85th & <95th)	11	26.2
Obese (BMI%tile: ≥95th)	11	26.2

PA, physical activity.

5 days per week (31.0%), followed by 4 days (28.6%). About 52.4% were overweight or obese (Table 1).

Psychosocial variables

Average game enjoyment was 21.9 ± 8.4 out of a possible score of 32 ($\alpha = 0.9$). Average immersion was 49.7 ± 15.6 out of a possible score of 88 ($\alpha = 0.9$), and average avatar identification was 43.9 ± 16.5 out of a possible score of 68 ($\alpha = 0.9$). Program satisfaction was 15.6 ± 3.6 out of a possible score of 20 ($\alpha = 0.8$) (Table 2). Small effect sizes were observed for autonomy (ES = 0.45; $P = 0.01$) and competence (ES = 0.36; $P = 0.03$). Little change was observed in relatedness (ES = 0.04; $P = 0.82$) (Table 3). Cronbach's alphas for self-report measures ranged from 0.8 to 0.9.

Objectively assessed PA

Teens wore the accelerometer for an average of 21.2 ± 0.8 minutes. Approximately 74.9% of game-play (15.9 ± 5.8 minutes) was spent in vigorous PA and 15.7% (3.3 ± 4.7 minutes) was spent in moderate PA. Approximately 10% of total time was spent in light PA (1.6 ± 1.9 minutes) or sedentary (0.40 ± 0.6 minutes) activity (Table 4).

Table 2. Game Reactions (n = 42)

	Mean	*SD*	*Alpha*
Game enjoyment	21.9	8.4	0.9
Immersion	49.7	15.6	0.9
Avatar identification	43.9	16.5	0.9
Similarity identification	19.0	5.6	0.8
Embodied presence	15.4	7.6	1.0
Wishful identification	9.5	6.0	0.9
Satisfaction	15.6	3.6	0.8

SD, standard deviation.

Table 3. Basic Psychological Needs (n = 42)

	Pretest			*Post-test*				
Need	*Mean*	*SD*	*Alpha*	*Mean*	*SD*	*Alpha*	*ES*	P
Autonomy	1.4	0.6	0.9	1.6	0.4	0.8	0.45	0.01
Competence	1.3	0.5	0.9	1.4	0.5	0.9	0.36	0.03
Relatedness	1.3	0.6	0.8	1.3	0.6	0.9	0.04	0.82

ES, effect size.

Qualitative findings

The qualitative data supported that teens had favorable reactions to the game and playing it with a photorealistic avatar. The majority of teens enjoyed the game, saying it was fun, cool, or good. As one teen stated, "It was a pretty cool game. I liked how they took all of almost any features of me and inserted it. I thought that was pretty cool," while another said, "It was very nice. I liked how it was like a very fun, active game."

However, a few had less favorable reactions, based on the intense level of PA needed to be successful in the game. For example, a teen said "It was hard…well [be]cause I was out of breath and [my] legs felt wobbly"; while another said, "I thought it was really challenging especially because the time length was so long, trying to keep up."

A few others expressed mixed opinions—although they liked the game, they thought it was boring, repetitive, or too challenging, as exemplified by these statements: "I felt it was good in general, but very repetitive. Just the different moves you did [be]cause everything you did was just running, jumping, and crouching," and "I thought it was fun, but it was really hard because you couldn't jump over the rocks easily."

When asked if they would make any changes to the game, the most often heard suggestions were related to obstacles and game features. For example, some recommended modifying the obstacles to adjust for different height players or to add additional obstacles: "Add more items or things that you could do…more obstacles. Maybe things that help you overcome obstacles" or "I think there should be not just trees but like other stuff we can duck under and jump over, or cracks in the pavements that we were running on or something."

Teens also suggested adding different types of challenges and features, such as scenarios, options for the avatar, running speeds, and more graphics. As one suggested, "I would change the game mode, like a different genre. I don't know,

Table 4. In-Game Physical Activity (n = 42)

	%	*Minutes*	*SD*
Vigorous PA	74.9	15.9	5.8
Moderate PA	15.7	3.3	4.7
Light	7.5	1.6	1.9
Sedentary	1.9	0.4	0.6

like a role playing or open world. I'd change the place, and I'd change the graphics and stuff for the monster. You could change how you run. You can speed it up and you can add power ups, when you find power ups, you can upgrade your speed or something.''

Most participants liked playing the game with an avatar that looked like them. When asked how much the avatar resembled them, most thought the avatar looked like them and thought it was fun to play the game with a photorealistic avatar, as captured in these statements: ''It was really fun. I felt like I was a character in the game. It looked like me a lot'' and ''It was really cool to see my face and me doing all those things. It looked exactly like me. It even had my ponytail holder.''

Most also stated that navigating the game with an avatar that looked like them had a positive effect on gameplay. They said that because they felt a connection to the avatar, they had greater interest in playing the game and were motivated to play it harder. For example, ''I think it made [me] wanna play harder and take less breaks because it's almost as if [it] was me, like if I were in the videogame I would want to get away from the monster.'' And finally, ''It really helped me feel more connected to my avatar and not ready to die, than having an avatar that didn't look like me, I probably wouldn't feel as connected to it…''

Discussion

The results of this study demonstrated that navigating an exergame with a photorealistic avatar was feasible, and that a vigorous level of PA can be obtained with a diverse group of teens in a laboratory-based setting. Others have demonstrated that exergames can increase light to moderate PA in children,[15,32] and there is some evidence that laboratory-based exergames have attained a vigorous level of PA.[33] Evidence is mixed regarding its effect on sustained PA, however.[16] No research could be located on the short- or long-term effects of playing an exergame navigated by a photorealistic avatar on PA intensity over time. Therefore, the next step in this line of research would be to conduct a randomized control trial to determine the effect on sustained PA.

Understanding the mechanisms of effect is an important dimension of game design.[34] Psychosocial variables, derived from theory, have been viewed as behavioral mediators, or the mechanisms through which theory exerts its effect on behavior.[35] Examining the psychosocial variables assessed in this study (basic psychological needs, player identification, immersion, enjoyment) may provide important insights for exergame design and identify areas of needed research to further elucidate and clarify potential mechanisms of effect, and thus, effective game design. In this study, small effect sizes were observed in two of the basic psychological needs (autonomy and competence), but not in the third, relatedness. Increases in autonomy and competence are consistent with theoretical expectations, given the degree of choice and control (autonomy) the player had in game-play and whether they successfully completed the game and ''beat'' the monster (competence).[36] These findings are consistent with research by others.[37] However, it is surprising that relatedness, defined as an assessment of the degree to which a player feels connected to self or important others, did not also increase, particularly given that the game was navigated by a photorealistic avatar. This is likely an artifact of the measurement scale used in this study, however, which assessed relatedness to exercise companions, but not relatedness to self. It is likely that a different dimension of relatedness is tapped by a photorealistic avatar, which may not be perceived as a companion, but rather, as an extension of or connection to self.[38]

Examination of the avatar identification results supports this conjecture. In this study, avatar identification was higher than that reported by Van Looy et al.[27] in which players constructed a nonphotorealistic avatar and navigated it through a massively multiplayer online game. This suggests teens felt more connected to their avatar than in a game navigated by an avatar that did not resemble them. Caution is needed when making comparisons, however; in this study, teens (12–14-year-olds) navigated a photorealistic avatar in a single-player exergame, while Van Looy et al. examined avatar identification in a massively multiplayer entertainment-oriented online game with young adults with a nonphotorealistic avatar. This conjecture is supported, however, by the qualitative findings, thus attenuating potential concerns regarding these differences.

Immersion, which is influenced by both plot and characters[25] in that the plot typically unfolds through characters,[39] is also an avenue of investigation that needs further elucidation in this context. Compared to preadolescents who played a serious videogame with a multicultural set of protagonists, teens in this study reported higher immersion.[25] Story, an important component of immersion, has been linked to player identification.[40] The qualitative findings provide indications that players were not captivated by the story; this suggests immersion was driven by favorable reactions to a photorealistic avatar. Future research is needed to more fully investigate this potentially important component of videogame design.

Players reported modest game enjoyment. Enjoyment has been linked to identification[41] and competition in digital games.[42] Although players identified with their avatar, the game was single-player. Therefore, adding an element of competition by playing against others may enhance the level of enjoyment. Difficulty has been found to detract from game enjoyment.[43] Qualitative findings from this study indicated players thought the game was strenuous and challenging (i.e., difficult), which may have detracted from enjoyment. Even so, a vigorous level of PA was achieved during gameplay. It may be that while a high level of enjoyment is not important for short-term gameplay, it may be important for sustained PA. This is supported in research reported by Lyons et al.[44] who found that enjoyment varied by game theme and suggested that investigating entertaining games that integrate strenuous activity into game-play may be an important avenue to investigate. Further, work by Ryan et al.[37] demonstrated that autonomy and competence were associated with game enjoyment. Research is needed to further investigate this dimension of game design.

Finally, additional theoretical frameworks need to be explored. Work by Fox and Bailenson[19] suggests that the impact of a highly representational virtual model on behavior may exert its effects through vicarious reinforcement and affect rather than motivation. Additional research is needed to identify the pathways through which a photorealistic avatar influences PA.

Limitations and strengths

Limitations of this research include a small sample and a one-group design, which limit the ability to draw statistical conclusions; and conducting this research in only one area of the United States, which limits generalizability. However, the purpose of this study was to assess the feasibility of this approach, which is typically carried out with limited samples and whose purpose is not to assess statistical significance. Although the sample was stratified to enhance diversity, it is possible it could have resulted in selection bias. However, this research explored exergames navigated by a self-representational avatar as a potential method for increasing PA among teens, rather than a specific segment of the population, such as avid gamers. Strengths include an objective assessment of PA; collection of data regarding motivation and basic psychological needs, which may be key motivators of long-term PA; and use of an exergame designed with feedback from the targeted age group.

Conclusions

This research provides promising research that exergames led by a photorealistic avatar appeal to teens and can achieve a vigorous level of PA.

Future Directions

Future research is needed to examine the effects of this approach on PA intensity and motivation over time, as well as its effects on frequency and duration of gameplay in nonstructured environments, such as home.

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Author Roles

D.T. and Z.D. were Co-Principal Investigators and co-led the overall design of this project. D.T. drafted the article, oversaw recruitment, qualitative research, online data collection, and analysis of qualitative and quantitative data. Z.D. oversaw development and programming of the exergame, avatar creation system, and gameplay database, and the laboratory-based study. D.C. was responsible for recruitment, online data collection, and coordination with the University of Houston; C.C. was responsible for recruitment and led the qualitative data analysis. Y.L. was responsible for quantitative data analyses. M.R., M.R., and Y.Z. were responsible for the development of the exergame, the organization and implementation of the avatar creation workflow, and performing the laboratory-based study. All authors read, edited, and approved the article.

Author Disclosure Statement

No competing financial interests exist.

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(Appendix Table A1 follows →)

Appendix

Table A1. Characteristics of a Videogame for Health: Nightmare Runner

Health topic(s):	Physical activity
Targeted age group(s):	12–14 year olds
Other targeted group characteristics:	Stratified by gender, PA, BMI
Short description of game idea:	Can PA be increased by navigating a photorealistic avatar
Target player(s): (check one)	[X] Individual [ ] Dyad [ ] Small group [ ] MMOG [ ] Other: ______
Guiding knowledge or behavior change theory(ies), models, or conceptual framework(s):	Self determination theory
Intended health behavior changes:	Increased PA
Knowledge element(s) to be learned:	na
Behavior change procedure(s) (taken from Michie inventory) or therapeutic procedure(s) employed:	na
Clinical or parental support needed? (please specify):	No
Data shared with parent or clinician:	[ ] Yes [X] No
Type of game: (check all that apply)	[X] Active [X] Action [X] Adventure [ ] Role-playing [ ] Simulation [ ] Strategy [ ] Sports [ ] Casual [ ] Educational [ ] Other: ______
Story (if any)	
Synopsis (including story arc):	Player falls asleep and encounters a nightmare monster
How story relates to targeted behavior change:	Must be physically active to escape
Game components	
Player's game goal/objective(s):	Player navigates avatar and attempts to outrun the nightmare
Rules:	Avoid obstacles, collect power ups; depleted dream energy = end
Game mechanic(s):	Controls avatar using Kinect
Procedures to generalize or transfer what's learned in game to outside the game:	none
Virtual environment	
Setting (describe):	Nightmare world – set of floating islands with mystical sky and fog
Avatar	
Characteristics:	Photorealistic representation of player
Abilities:	mimics player actions in real world
Game platform(s) needed to play the game: (check all that apply)	[ ] Smart phone [ ] Tablet [X] Kinect Xbox [ ] Wii [ ] PlayStation [ ] Computer [ ] Handheld device [ ] Other: ______
Sensors used:	Kinect
Estimated play time:	20 minutes for lab-based study—variable