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Original article

Teen reactions to a self-representational avatar: A qualitative exploration

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Abstract

Purpose: This research presents findings from a qualitative exploration of the reactions of adolescents (12−14 years old) to navigating an exergame with an avatar created from multiple scans of the player (referred to as a self-representational avatar).

Methods: Post-gameplay interviews were conducted with adolescents following participation in a 20-min laboratory session (21.2 ± 0.8 min, mean ± SD) where the self-representational avatar was navigated through an exergame. Verbatim transcripts ($n = 40$) were coded and analyzed by 2 independent coders using hybrid thematic analysis for this secondary data analysis. Codes were reviewed to identify themes representing adolescents' reactions.

Results: Four themes emerged. Adolescents connected with their avatars and felt protective toward them, which influenced their actions in the exergame and contributed to their overall game enjoyment.

Conclusion: Creating exergames navigated by a self-representational avatar was an enjoyable experience and influenced gameplay. Future research should explore the effect of this approach on gameplay frequency and intensity over time.

Keywords: Avatar; Exergame; Physical activity; Relatedness; Self-determination theory

1. Introduction

Physical activity is an essential component of a healthy lifestyle; however, few children and adolescents meet the current physical activity guidelines, which places their current and future health in jeopardy.[1] Furthermore, there exists evidence that physical activity decreases over the lifespan, with substantial decreases occurring in late adolescence and continuing into adulthood.[2,3] Identifying ways to avoid these declines is an important public health issue.

It stands to reason that enjoyable activities are more likely to be continued.[4] Youths enjoy videogames and play them often.[5] Exergames, also known as active or interactive videogames,[6,7] require the player to move his or her body to play the game. Exergames are popular among youths, and there is some evidence they can increase moderate-intensity physical activity.[6−8] Research by Johnson et al.[9] revealed that the motivation to play a videogame decreases over time, which may partially explain why there is little evidence that exergames result in sustained increases in physical activity.[10]

Exergames often employ an avatar (i.e., virtual representation of self) that the player navigates through the virtual world.[6] Adolescents reported that avatars are an important aspect of gameplay,[5] and there is evidence that players develop parasocial relationships with their avatars.[11−13] Neural imaging studies have confirmed that players identify with their avatars, experience meaningful emotions, and form authentic attachments with them.[14]

Appearance may play a role in the strength of this relationship. Research by Jin[15] demonstrated that players are more motivated by an avatar that represents their ideal *vs.* actual self. Alternatively, Fox and Bailenson[16] revealed that when an avatar highly resembles an individual, exercise behavior is modified based on how it affects the avatar's weight (virtual weight gain or loss); however, this is not observed when the avatar's appearance is dissimilar. Similar results were observed by Navarro et al.[17]

Self-determination theory[18,19] may offer a behavioral framework through which to understand this relationship and

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its effect on physical activity and gameplay. Self-determination theory posits that autonomously motivated behavior (i.e., personally endorsed behavior) is driven by the satisfaction of 3 basic psychological needs: autonomy (having choice and control), competence (having the knowledge and skills to perform the behavior), and relatedness (connection to important others). Relatedness has also been defined as a connection to self (i.e., personally endorsed values).[20] An environment, whether real or virtual, that provides choices, creates opportunities to experience mastery, and fosters a sense of belonging or connection facilitates internalization and integration of the behavior into one's sense of self, thus increasing the likelihood the behavior is autonomously motivated.[18] When this occurs, individuals choose to act because the activity is perceived as enjoyable, important, and self-endorsed, as opposed to because someone is telling them they should engage in the behavior.[18,21] Autonomously motivated behaviors are more likely to be sustained.

Because players often feel connected to their avatars[12] and have been shown to engage in avatar-protective behaviors, particularly when they perceive the avatar as similar to themselves,[16] it is possible that a highly self-representational avatar could result in a greater connection (i.e., relatedness) and a greater desire to protect it (i.e., self) from danger in the virtual world. In an exergame, feeling connected to the avatar and having a desire to protect it from danger could result in greater physical activity intensity and a higher frequency of gameplay. Therefore, the purpose of this paper was to explore player reactions to navigating a self-representational avatar through an exergame and their perceptions regarding its effect on gameplay. Understanding the player's relationship to their avatar and how it influences gameplay may offer insight into exergame design in terms of promoting engagement as well as gameplay frequency and intensity.

2. Methods

2.1. Participants and study design

The findings reported in this article resulted from a secondary analysis of the qualitative data obtained from the post 1 interview with adolescents who participated in a 1-group 20-min laboratory-based gameplay session to assess the feasibility and acceptability of an exergame (Nightmare Runner, University of Houston, Houston, TX, USA) navigated by a self-representational avatar. The semi-structured interviews, referred to as the post 1 interview, were conducted with each adolescent after completing the laboratory-based session and online surveys.

2.2. Recruitment

Participants were recruited from a large city in the Southwestern United States. Adolescents were recruited using the volunteer database at the United States Department of Agriculture/Agricultural Research Service Children's Nutrition Research Center, Baylor College of Medicine, as well as by utilizing standard recruitment techniques (website announcements and flyers). Approval to conduct the research was received from both Baylor College of Medicine and the University of Houston. Written consent was obtained from parents prior to the adolescent's participation in research activities.

The recruitment goal was 48 adolescents, stratified by sex (male or female), body mass index (BMI) (<85th percentile or ≥85th percentile) using the Centers for Disease Control and Prevention cutoffs, and usual physical activity (number of days physically active for ≥60 min) in order to ensure a diverse sample. To enable stratification, parents were asked to provide the adolescent's birth sex, height in feet and inches, weight in pounds, and how many days each week the adolescent was usually physically active for at least 60 min (<5 days a week or ≥5 days a week) during recruitment. Height and weight data were used to calculate BMI according to the Centers for Disease Control and Prevention 2000 Age and Gender-specific Growth Charts.[22] Inclusionary criteria were: being 12−14 years old; healthy; living in or near Harris County, TX, USA; and fluency in English. Exclusionary criteria included having conditions that limited an adolescent's ability to fully participate in the study (e.g., uncontrolled asthma). Recruitment began in September 2015 and closed in November 2015. This age range was selected because physical activity declines dramatically between early and mid-adolescence;[23] thus, early adolescence offers a critical intervention period for impacting physical activity. Further, as this was a proof-of-concept study designed to determine feasibility and acceptability of this approach with 12−14-year olds, the research team deemed this age range acceptable. The sample was limited to healthy children because of concerns about the potential impact of health issues on physical activity requirements and/or the ability to be physically active. Participants needed to be fluent in English due to budgetary constraints, that is, funding did not permit in-game messages and notifications to be provided in multiple languages.

2.3. Avatar creation

Prior to gameplay, avatars were created from multiple 3-dimensional scans of the players, which were then digitized and inserted into the exergame. Although more fully described elsewhere,[5,24] the process through which the avatar was created is briefly summarized below.

Each individual player was scanned using a structure Sensor (Occipital, Inc., Boulder, CO, USA) with the itSeez3D app (Occipital, Inc.) on an iPad. The scanner included depth and regular cameras operating in parallel. A rough 3-dimensional model of the entire body was scanned initially, followed by scans from different angles in order to generate more geometric details of the body and to fill holes in the scan data. A skeleton model was manually created to facilitate avatar animation in the Kinect game (e.g., making various poses during gameplay). Once created, customization features were offered to the player—e.g., shoe type, eyeglasses, hairstyles, and corresponding colors. A Maya Plug-in (Version 1.0; University of Houston, Houston, TX, USA) was developed that allowed the user to customize the avatar's visual appearance, bind animation sequences, and provide connections with the game.

To navigate the avatar through the exergame, the player had to move their body (i.e., run, jump, and squat) in the real world, movements that the avatar then mimicked in the virtual world. The exergame was played using a Kinect game system.[24] Players wore an accelerometer (3TGX+; Actigraph, Pensacola, FL, USA) during gameplay to obtain an objective measure of physical activity intensity.

2.4. Exergame description

Nightmare Runner is an action−adventure exergame prototype designed to promote physical activity in 12−14-year olds developed by our team in partnership with adolescents.[5] The game is played by an avatar created from multiple 3-dimensional scans of the player. Scans were converted to an avatar that was an exact replica of the player (i.e., facial features, clothing, and body shape/size). The player then navigated the fully functional, self-representational avatar through the exergame.

The game begins with the player's avatar falling asleep. The avatar then awakens and finds itself trapped in a dream world. Through exploration, the avatar discovers the lair of the monster that inhabits its dreams. Discovery awakens the monster, thus initiating gameplay. During gameplay, the player's avatar continuously loses "dream energy" (stamina). Additional dream energy is lost if an obstacle encountered during gameplay is not overcome. Alternatively, collecting "dream shards", i.e., objects that appear in the "game", enhances dream energy. At the end of the session, if the avatar has avoided capture, it encounters a gap that appears too wide to jump across. The player has to quickly decide whether to gather up the avatar's dream energy and jump across the gap or be captured by the dream monster. After safely making it to the other side, the avatar realizes he/she is in control and can use remaining dream energy to fire a magic bolt at the monster and destroy it. The avatar then awakens as the session ends.

A laboratory-based proof-of-concept study ($n = 42$) established the feasibility and acceptability of this approach with adolescents. The accelerometer was worn an average of 21.2 ± 0.8 min (mean $\pm$ SD). Approximately 74.9% wear time (15.9 ± 5.8 min) was spent in vigorous physical activity.[24]

2.5. Data collection

At baseline and post assessment, players completed online self-report surveys assessing key psychosocial constructs. Additional constructs were also evaluated at post assessment. The results of the feasibility study have been reported elsewhere and are not repeated here.[24]

Following completion of the gameplay session and online surveys, players participated in a telephone interview (i.e., post 1 interview) in order to more fully understand the experience of playing the exergame with a self-representational avatar. The interviews, which ranged from 25 min to 45 min, were conducted by trained staff and digitally recorded. Data collection occurred from October 2015 through December 2015.

The interview guide consisted of 15 open-ended, non-leading questions (e.g., "Let's start by talking about the game. What did you think about it?"). During the interview, rating scales were used to obtain specific reactions and/or perceptions (e.g., "On a scale of 1 (*not very much*) to 4 (*a lot*), how much physical activity did you get while you were playing the game?"); this was followed up with a request for the player to explain their responses. Probes (i.e., unplanned requests to expand a particular response) and prompts (i.e., requests to provide more information about a specific topic or reaction not mentioned in the initial response) were used as needed to expand, clarify, and more fully understand player responses. This secondary investigation utilized a procedure similar to that reported by Pihlaskari et al.[25] insofar as it reviewed the full transcripts for players' reactions to navigating a self-representational avatar through an exergame as well as for their perceptions regarding its effect on gameplay, regardless of the original question. Coders were blinded to player demographic characteristics during coding (e.g., BMI, physical activity level). Theoretical saturation—the point at which no new information emerges—was attained.

2.6. Qualitative coding and analysis

An iterative, inductive thematic analysis, consistent with Braun and Clarke's 7-step approach[26] was followed to code and analyze the transcripts for the secondary analysis reported here. Briefly, the steps included: (1) transcription, (2) reading and familiarization of the transcripts, (3) coding, (4) preliminary theme identification, (5) reviewing themes, (6) defining and naming themes, and (7) finalizing analyses. Transcripts from the post 1 interview were professionally transcribed and reviewed for accuracy prior to analysis. In Step 2, the analysis team (EB and DT) individually reviewed 2 transcripts and identified codes associated with player perceptions toward the avatar and gameplay effects. The team met to discuss the codes. The codes were then applied to 2 additional transcripts. This process continued until a preliminary coding framework was developed (approximately 10 transcripts). The codebook, consisting of codes and definitions, was then finalized and applied to the remaining transcripts. As new codes were identified, they were defined, added to the master codebook, and applied to remaining transcripts. Previously coded transcripts were reviewed to ensure codes were applied equally to all transcripts. Throughout the process, the team routinely met to compare coding, discuss differences, and update definitions as needed. When coding was complete, transcripts were reviewed a final time to ensure codes were consistently applied (EB). Discrepancies were discussed and resolved. After coding was complete, codes were reviewed and grouped into themes. A thematic network[27] was created in order to provide a visual representation of how the themes fit together.

3. Results

3.1. Participants

Forty-two 12−14-year olds participated in the laboratory-based feasibility study. The sample was racially diverse (45.2%

Caucasian, 40.5% African American, 11.9% Asian, 2.4% mixed race) and about one-half females (50%), with a BMI of ≥85th percentile (52.4%), and an average age of 12.8 ± 0.8 years. Due to technical issues, 2 players were unable to fully view their avatars during gameplay and so were excluded from analysis, leaving a total of 40 transcripts for interpretation.

3.2. Thematic network

Player reactions to navigating an exergame with a self-representational avatar were grouped into 1 global theme (game enjoyment), supported by 2 organizing themes (avatar protection and gameplay) and 1 basic theme (avatar connection) (Fig. 1). Each theme is described below, beginning with avatar connection and building to game enjoyment. Verbatim quotes provide context and insight. To provide additional context while maintaining anonymity, quotes are identified by sex and BMI.

3.3. Avatar connection

The majority of players reported positive reactions to their avatar and felt it looked like them: as a player said, "It's really cool to see yourself as an avatar" (female, BMI < 85th percentile). They also reported feeling connected to it: "I liked it because I was playing with myself, and I was trying to do a new experience" (female, BMI ≥ 85th percentile). Alternatively, a player mentioned feeling a connection through racial identification: "It makes it funner. Other games where you pick a player, sometimes it makes—I'm African American, and usually they have two, I don't know, Caucasian characters" (female, BMI < 85th percentile). Some reported that playing the game with an avatar that looked like them made them feel as though they were in the game, suggesting a self-representational avatar may promote immersion: "It makes you feel that you're actually in the game, since it looks like you and you're there ... that's kinda what happened because I was running away from the monster, and if I actually feel like I'm in the game, then I'd do the same thing in real life" (male, BMI ≥ 85th percentile). Another player specifically described how the sense of connection impacted their behavior in the game: "It gives the player a connection to the character because it's like the person in the game is you. You actually have to play the game in order for you in the game to live...because now it's like "Yes, let's go". If you start running, they (the avatar) start running, so it's like "I'm running in the game—that means I'm running away from the monster". It starts to become reality or something" (female, BMI ≥ 85th percentile).

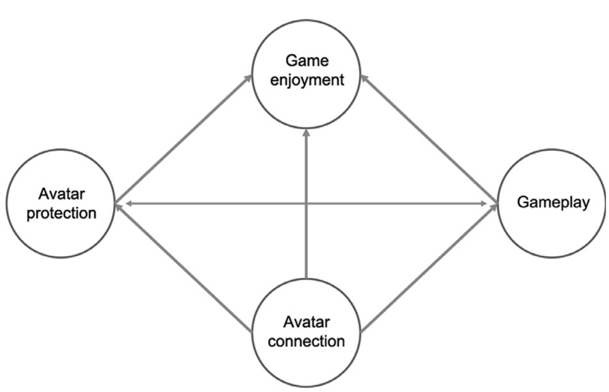

Fig. 1. Thematic network. Player perceptions associated with playing an exergame with a self-representational avatar.

3.4. Protection

Connection extended to feeling protective toward the avatar as a representative of self. For example, as a player said, "It's almost as if it was me, like if I were in the videogame, I would want to get away from that monster" (female, BMI < 85th percentile). Others felt connected with the avatar to such an extent, they referred to avoiding personal injury when talking about the avatar: "I didn't want to get hurt because it was rude, like what if that really was me? I would be so hurt ... if it wasn't me, I would just be like", "I don't care what happens to him—it's not me", "I would definitely say I don't care" (male, BMI < 85th percentile). Another explained it as, "you wouldn't wanna kill yourself whilst in the game. You wanna see yourself succeed" (male, BMI ≥ 85th percentile). Another explained it in terms of a parent/child relationship: "It made me wanna try harder because I didn't wanna see him get hurt because it's me. It's like seeing my own son get hurt. That's sad ... it was appropriate and it made you wanna work harder because it's the avatar" (male, BMI < 85th percentile).

3.5. Gameplay

The majority of players reported that playing the game with a self-representational avatar influenced the way they played the game. In general, they reported exerting more effort ("It made me work harder ... I tried real hard to finish the game" (male, BMI ≥ 85th percentile)) because the avatars so closely represented themselves: "I think that I put a little bit more effort just because it was a lot easier to visualize myself in the game because there was an avatar like me in the game" (female, BMI < 85th percentile). The desire to protect the avatar and to make both the player and avatar succeed were also brought up by players during the interview: "Because it just looks like it's you, so you're actually helping yourself out, I guess. Something like that ... rather than it just being another character, I'm actually working to make my avatar, myself, look good" (female, BMI < 85th percentile). Although players realized they were being physically active, the focus seemed to be on the fun associated with playing the game with a self-representational avatar: "Because it made it fun to be running, and jumping, and ducking because you have to do it with an avatar. It wasn't on your mind that you were actually exercising" (female, BMI ≥ 85th percentile). Having control ("It is cool because you can pretty much control all of your character's actions" (male, BMI < 85th percentile)), encouragement to do better ("It pushes me to do better" (male, BMI < 85th percentile)), and a desire to be successful ("Yeah, it really increased my effort because I was really trying to make it over those rocks and I was really trying to make it over those trees" (female, BMI ≥ 85th percentile)) were also mentioned. A few players, however, stated that playing the game with a self-representational avatar did not influence the way they played the game: “No, not really … I don’t think it really affected me at all” (female, BMI < 85th percentile).

3.6. Avatar protection and gameplay interaction

An interactive relationship was observed between avatar protection and gameplay. As noted above, players appeared to consciously engage in gameplay activities to protect their avatars: “. . .now you have to run away from the monster . . . you care about yourself so you have to run. If it was like Mario or another cartoon character, you wouldn’t really care because that’s somebody else. Now this is you running away” (female, BMI ≥ 85th percentile). Connection with their avatar also appeared to impact their interest in playing the game: “I was really more interested in playing it. It was real when I had hit myself—stuff like that” (female, BMI ≥ 85th percentile).

3.7. Enjoyment

The global theme that emerged from this dataset was that playing an exergame with a self-representational avatar was an enjoyable experience. This experience was supported by a strong sense of connection with their virtual representative, which engendered feelings of protectiveness and impacted gameplay. Although players realized the game required effort to play, it was also fun to play it with a self-representational avatar: “I was talking with my mom and my sister . . . It was really hard, but it was really fun. I liked how I was the avatar especially” (female, BMI < 85th percentile).

4. Discussion

This research revealed that playing an exergame with a self-representational avatar created from a series of 3-dimensional scans of the player was perceived as an enjoyable experience by adolescents. This sense of enjoyment was supported by a strong sense of connection with the avatar, which contributed to gameplay actions designed to protect the avatar from the monster and failure in the virtual world. The adolescents who participated in the study spent nearly all of the proof-of-concept study at a vigorous level of physical activity and found it to be an enjoyable experience. Future research is needed to explore the effect of this approach on gameplay frequency and intensity over time.

A key finding that emerged from this work is that players reported they felt connected to their avatars. This finding is consistent with other studies reporting that players form a parasocial relationship with their avatars,[11,12] experience real emotions and feelings, and form authentic attachments.[13] To protect their self-representative avatars or “beat the monster” in the exergame, players reported that they worked harder. This is consistent with work done by Fox and Bailenson,[16] who found that players modified their exercise behavior when an avatar highly resembled the player. Navarro et al.[17] reported similar findings. Another potentially critical dimension of connection with the avatar was racial representation. Few videogames offer the option to create racially diverse avatars,[28] and diversity in general appears to be a longstanding issue in videogames.[29] To promote sustained gameplay in exergames, offering more racially diverse avatars may be an important consideration and warrants further investigation in future research. Racial identification has been associated with immersion, or sense of being in the game, and desirable health outcomes in a serious videogame.[30]

During the interview, players used the pronoun “I” when referring to their avatars or to gameplay in general. This supports the work of Banks and Bowman,[31] who provide evidence that the language a player uses when referring to their avatar serves as a linguistic indicator of the player’s connection to their avatar. Future work should explore language as a potential indicator of how the player perceives his/her avatar and the ways in which language may be used to promote greater connection and sustained gameplay.

In this study, connection with the avatar was viewed as a proxy for relatedness, or sense of connection to important others[18] or self.[20] Satisfaction of basic psychological needs, including relatedness, in a videogame has been associated with enjoyment,[32] time spent playing videogames,[9] and intent to continue to play,[33] all of which are key aspects of autonomously driven motivation. Further, satisfaction of basic psychological needs predicted both enjoyment and intent to engage in future gameplay.[19] Because enjoyable activities are more likely to be continued,[4] ways of satisfying basic psychological needs, including relatedness, is a key research consideration for designing exergames that promote sustained increases in physical activity.

In our study, the players appeared to perceive the avatar as a virtual representation of themselves in the game—i.e., they maintained a sense of control over the avatar. This appears to be dissimilar to the way in which Van Looy et al.[34] conceptualized avatar identification as players inhabiting the avatar as separate from themselves. This suggests additional work is needed to understand the nature of the relationship that develops between the player and their self-representational avatar.

Finally, 74.9% of the gameplay session (21.2 ± 0.8 min) was spent in vigorous physical activity, which differs from the findings of previous studies. A systematic review published by Biddiss and Irwin[8] concluded that when children 21 years old and younger played active videogames, their exercise intensities were equivalent to light-to-moderate physical activity. Systematic reviews by LeBlanc et al.[35] with 3−17-year olds and Liang and Lau[6] with children up to 18 years old came to a similar conclusion. However, a systematic review by Sween et al.[10] that included both children and adults found that most exergames were able to attain moderate physical intensities. Our study is 1 of the first to report vigorous intensity physical activity with children. This suggests that the desire to protect the avatar can have a positive effect on intensity level during gameplay. Future research is needed to more fully understand the pathways through which this occurs as well as its impact on sustained gameplay in non-laboratory-based settings.

Limitations of this research include a focus on only 1 aspect of the data, the limited sample size, the 1-group design of the laboratory-based study, and conducting the research in a single geographic region (Houston, TX, USA). Furthermore, players engaged in only one 20-min session in a laboratory-based setting prior to the interview; providing game access over a longer period of time or in a different setting may have afforded greater insight into the effect of this approach on physical activity and gameplay over time. Finally, themes were not examined with respect to differential weight status (BMI $<$ 85th percentile or $\geq$ 85th percentile) or exergame experience; it is possible current body weight or exergame experience could have altered player perceptions. However, the quotes suggest that perceptions were not influenced by weight status or exergame experience. These limitations must be examined with consideration that the goal of qualitative research is theoretical saturation rather than sample size, and in light of its strengths, which include the use of 2 independent coders and analyses guided by an *a priori* research question. Additionally, although the sample was small for a quantitative study, a sample size of 40 is considered large for a qualitative study,[36] a fact that supports the idea that theoretical saturation was attained and that reactions were independent of body weight or exergame experience.

5. Conclusion

This research provides suggestive evidence that playing an exergame with a self-representational avatar enhances enjoyment, a key factor in behavioral initiation and maintenance.

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Authors' contributions

DT and ZD were co-principal investigators who conceptualized the primary study, obtained funding, and co-led the study; EB led the coding and analysis of the qualitative data and theme identification. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

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