Chapter 6

HIGH SCHOOL STUDENTS' SITUATIONAL INTEREST AND PHYSICAL ACTIVITY LEVELS IN EXERGAMING

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ABSTRACT
The benefits and challenges of integrating exergames in schools to promote young children's physical activity and interest have been evident. Yet, such investigations remain unexplored among older adolescents. Thus, the purpose of this study was to examine the relationships between high school students' situational interest and physical activity levels during exergame play, as well as investigate the gender and grade differences on the study variables. A total of 60 (32 girls; Mean = 16.17 years, *SD* = 1.17) 10th through 12th grade students participated in one session of Reflex Ridge, part of the Xbox 360 *Kinect Adventures* game. Students' physical activity levels were measured by Actigraph accelerometers with percentages of time spent in sedentary, light physical activity and moderate-to-vigorous physical activity as the outcome variables. They also responded to the validated Situational Interest Scale (measuring novelty, challenge, attention demand, exploration intention, and instant enjoyment) at the end of the session. Regression and path analysis indicated that attention demand was a significant positive predictor for moderate-to-vigorous physical activity (ß = 0.41, $p < 0.05$ accounting for 16.7% of the variance) while novelty was a marginally significant positive predictor for light physical activity (ß = 0.25, $p < 0.06$ accounting for 13.4% of the variance). Multivariate analysis of variance revealed no gender effect on sedentary, light physical activity and moderate-to-vigorous physical activity, and that 11th grade students spent significantly higher percentages of time in moderate-to-vigorous physical activity than 10th and 12th grade students (F (6,104) = 2.51, $p < 0.05$). Findings suggested high school students displayed higher moderate-to-vigorous physical activity when they felt the activity demanded greater attention but demonstrated higher light physical activity when they deemed the activity only provided novelty. The motivational power of exergaming may be an opportunity to intervene and attenuate the increasingly sedentary daily activities currently engaged in by adolescents. However, physical educators should consider the motivational power of attention (i.e., cognitive) demand to physically engage high school students in exergaming experiences.

Keywords: situational interest, attention demand, exploration intention, instant enjoyment

INTRODUCTION
Playing video games is commonplace among children and adolescents daily routine. According to a large-scale study with a nationally representative sample, 88% of American youth between ages 8 to 18 years play video games at least occasionally (Gentile, 2009). Further, research has indicated playing sedentary video games have long been associated with various risks for both mental and physical health including (1) provocation of seizures, tendon injuries, and social introversion related to game addiction (Fischer, 1994; Dorman, 1997); (2) hostility, aggressive behaviors, effects on school performance related to playing violent video games (Gentile, Lynch, Linder, & Walsh, 2004); and (3) increased body mass index related to overplaying sedentary video games (Vandewater, Shim, & Caplovitz, 2004). A decade ago, a

new type of video game genre called exergames‘ or active video games‘ emerged. Exergames refer to video games that are also a form of exercise (Gao & Chen, 2014). Exergames necessitate physical activity as a means of interacting with the game. In the last decade, researchers have extensively investigated the potential of exergames to promote children/adolescents‘ physical activity participation. In a recent meta-analysis on the effects of exergames on children/adolescents‘ physiological and psychological health-related outcomes, Gao, Chen, Pasco, and Pope (2015) indicated that exergames (1) have a large effect on children/adolescents‘ physiological and psychological outcomes as compared to sedentary behaviors; (2) produce the equivalent magnitude of effect as light-to-moderate intensity physical activity; and (3) are more attractive and enjoyable for children/adolescents in comparison with traditional physical activity. Taken together, these findings suggest that exergames are a viable option to promote children/adolescents‘ physical activity and health based on their attractiveness in comparison with traditional physical activity. Despite the attractiveness of exergames among youth, few studies investigated children/adolescents‘ experiences of exergaming through the lens of the situational interest (Sun, 2012; Sun, 2013; Huang & Gao, 2013). Situational interest has been defined as an activity‘s appealing effect on an individual(s) (Hidi & Anderson, 1992) and emerges from an instant person-activity interaction in which the person recognizes a specific feature of this activity while being engaged in it (Mitchell, 1993). According to Hidi and Harackiewicz (2000), a highly interesting activity can immediately attract individuals‘ attention and provide positive feelings about the activity. Within the context of physical activity, Chen, Darst and Pangrazi (1999, 2001) identified five sources of situational interest: novelty, challenge, attention demand, exploration intention, and instant enjoyment. Novelty is conceptualized as a gap between information known and unknown in an activity (i.e., information deficiency). According to Spielberger and Starr (1994), novelty functions to elicit individuals‘ participation in this activity. Challenge has been defined as the level of difficulty relative to one‘s own ability and has been identified as a motivational factor that may predispose student‘s engagement in an activity (Harter, 1978). Regarding attention demand and exploration intention, these constructs represent the stimulation generated by the person-activity interaction that create a perception of situational interest in the activity. According to Deci (1992), the power of the preceding two constructs increases the individual‘s intrinsic motivation to engage in the activity. Finally, instant enjoyment refers to individuals’ emotional engagement with an activity (Hedi & Anderson, 1992). Sun (2012) explored the impact of an exergaming unit on students’ physical activity levels and situational interest compared to a traditional fitness-education unit in elementary school physical education. Fourth grade students participated in a four-week exergaming unit and a four-week fitness unit. Results showed that the children‘s physical activity levels during the exergaming unit was significantly lower than in the fitness unit but did indicate students‘ situational interest during exergaming to be significantly higher than in the fitness unit at the beginning and end of the intervention. Sun (2013) conducted a follow-up study with the same group. Fifth grade students from the previous study below participated in an exergaming unit. The results indicated that students’ physical activity intensity increased over time while their situational interest decreased significantly with the exception of attention demand and instant enjoyment. Finally, Huang and Gao (2013) found that novelty was a significant predictor of moderate-to-vigorous physical activity during exergame play with a population of 135 middle school students ranging from 12 to 15 years old. Students participated in an exergaming unit (Dance Dance Revolution) for two weeks. Results suggested that students demonstrate higher physical activity levels if they feel the exergames provided new information (i.e., novelty). Given the preceding literature review and available evidence, it is clear exergames have great potential to promote children‘s physical activity participation and situational interest in physical education. Yet, such investigations

remain unexplored among older adolescents. Thus, the purpose of this study was to examine the relationships between high school students' situational interest and physical activity levels during exergame play, as well as investigate the gender and grade differences for the study variables.

METHODS

Participants

A cross-sectional design was used to examine the relationships between objectively-measured physical activity levels and self-report situational interest in exergaming. The study was conducted in an inner city high school in a medium-sized metropolitan area of the northwest region of France. Participants were 10th to 12th grade students' ages 15-20 years (N = 60; 28 boys, 32 girls; Meanage = 16.17, SD = 1.17). They participated in one session of Reflex Ridge, part of the Xbox 360 *Kinect Adventures* game. Following the University Institutional Review Board and school district requirements, student assent forms and parental consent were obtained. All participants were eligible to participate in the study, as the game has limited physical risks. Therefore, all of the students participated in the study.

Instruments

Physical Activity Levels. To collect student physical activity levels, the researchers utilized Actigraph GT3X+ accelerometers (Pensacola, FL, USA). The Actigraph GT3X+ measures motion in three dimensions and provides triaxial vector data in metabolic equivalents. It is 4.6 x 3.3 x 1.5 cm in size and can be worn on the wrist, waist (hip), arm or ankle. In this study, students wore the accelerometer on the hip using an elastic belt. Data from the hip has been shown to be the best location for providing data to detect a range of everyday activities (Cleland et al., 2013). The GT3X+ is widely used in physical activity research and has demonstrated acceptable criterion validity and reliability for recording physical activity in the field and converting activity counts into different intensity levels of physical activity (Flynn, Coe, Larsen, Rider, Conger, & Bassett, 2014). Accelerations from the Actigraph GT3X+ were converted into activity counts, summed and recorded using a specified interval of time called an epoch' ranging from 5 seconds to 1 minute. In the present study, the epoch was set at 5 seconds. Cut points were established using Puyau, Adolph, Vohra, and Butte (2002) study to determine sedentary (0-399 counts per 30s), light (400-1599 counts per 30s), and moderate-to-vigorous physical activity (≥1600 counts per 30s). Students' percentage of time spent in moderate-to-vigorous physical activity, light physical activity and sedentary were used as the outcome variables.

Situational Interest. The French 19-item Situational Interest Scale (Roure, Pasco, & Kermarrec, 2015) was used to measure students' situational interest during the exergaming session. The scale includes five situational interest constructs: Novelty (i.e., what the researchers did today was new to me), Instant Enjoyment (i.e., what the researchers did was enjoyable for me), Exploration Intention (i.e., I wanted to analyze and have a better handle on what the researchers were learning today), Attention demand (i.e., what the researchers were learning demanded my high attention), and Challenge (i.e., what the researchers were learning was hard for me to do). The items are randomly arranged and each is attached to a five-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Roure et al., (2015) established the construct validity of the French Situational Interest Scale using exploratory and confirmatory factor analyses. They also reported internal consistency (Cronbach's alpha) for novelty (0.83), instant enjoyment (0.84), exploration intention (0.79), attention demand (0.76), challenge (0.77), and total interest (0.85) among middle and high school students.

Procedures

The data were collected at the end of the 2014 school year, the researchers did not have a chance to implement the exergaming session into physical education class curriculum. Instead, the exergaming program was setup in a large empty room beside the school library. Students were informed about the opportunity to participate in the study through paper information and flyers. If the students expressed interest to participate, they were required to enroll in the program through the librarian. Then, the researchers created a schedule with two students playing for a 30-minute exergaming session. Data were collected during one week. Before the students engaged in exergame play, the researchers collected their demographic information such as grade, age, gender, height and weight. Such information was needed to initiate accelerometers in order to collect accurate physical activity measures and, as such, was entered into the ActiLife software prior to placing the accelerometers on the adolescents. After placing the accelerometers to the students, the researchers introduced and demonstrated how to play the exergame. Students played the Reflex Ridge game one time with two players in the spilt screen. Reflex Ridge is one of the top ten Kinect games. It is a track-and-field inspired game played on a moving platform in an environment similar to a wooden roller coaster or mine cart. Players raced on a platform, jumped over hurdles, leaned away from obstacles, and limbed to avoid hitting their heads on low beams. Jumping in place made the platform move faster along its rail. Adventure pins were earned by avoiding obstacles or touching ones scattered throughout the course. The game was timed, with extra time left over at the end of the course added to the Adventure pin total. In the present study, the students competed one to another to collect more pins. In addition, the students reported their situational interest at the end of the session.

Data Analyses

Students‘ responses to the situational interest scale were aggregated to the five constructs (novelty, instant enjoyment, exploration intention, attention demand, and challenge). Means and standard deviations were calculated for each situational interest construct, moderate-to-vigorous physical activity, light physical activity and sedentary. Then, a multivariate analysis of variance was performed to examine the effect of gender and grade on students‘ moderate-to-vigorous physical activity, light physical activity and sedentary, respectively. Finally, three stepwise multiple regression analyses were used to determine if any of the five situational interest dimensions predicted students‘ moderate-to-vigorous physical activity, light physical activity and sedentary, respectively.

RESULTS

Descriptive Statistics

Descriptive statistics for each variable are presented in Table 1. As shown in Table 1, means scores for novelty, exploration intention and attention demand were slightly above the midpoint (i.e., 10). The mean score for instant enjoyment was the highest (13.93) while the exergaming session was not a challenge for students as referenced by the lower mean score of 5.82. Additionally, students‘ spent more than 78% of their time in moderate to vigorous physical activity during exergame play. Table 2 presents descriptive statistics for each variable by gender and grade. Results indicate that average percentage of time in moderate-to-vigorous physical activity during the exergaming session was 78.09% and 79.35% for girls and boys, respectively. A multivariate analysis of variance was performed to examine the effect of gender and grade on students‘ moderate to vigorous physical activity. Results revealed a significant main effect for grade, $\lambda = 0.76$, $F(6,104) = 2.51$, $p = 0.02$, $n2 = 0.12$. Pairwise comparisons indicated significant differences between 10th and 11th graders as well

as 11th and 12th graders but no difference between 10th and 12th graders. No significant gender differences were found in the percentage of time spent at different physical activity levels, however ($p = 0.85$ for sedentary, 0.87 for light and 0.69 moderate-to-vigorous physical activity levels respectively). Pairwise comparisons indicated significant differences between 12th grade students and both 10th and 11th grade students on exploration intention ($p < 0.05$). No significant differences were found for novelty, instant enjoyment, attention demand and challenge based on students‘ grade levels.

Correlation and Regression Analyses

Correlation analyses indicated that the five constructs of situational interest are significantly related to one another. However, attention demand was the only dimension significantly related to moderate-to-vigorous physical activity (Table 3). A stepwise multiple regression analysis was performed to determine how students‘ situational interest dimensions predicted their physical activity levels. Results indicated that attention demand emerged as a significant predictor of moderate-to-vigorous physical activity, ß = 0.41, $p < 0.05$ accounting for 16.7% of the variance for this intensity of physical activity while novelty was found to be a marginally significant predictor of students‘ light physical activity, ß = 0.25, $p < 0.06$ accounting for 13.4% of the variance in this variable.

DISCUSSION

Researchers have suggested that exergames may present an opportunity to promote children/adolescents‘ physical activity especially as an alternative to sedentary activities (Gao et al., 2015). Based on the attractiveness of exergames among children and adolescents, this study was designed to examine the impact of playing an exergame on high school students‘ physical activity levels and situational interest by gender and grade. Students participated in one session of Reflex Ridge, part of the Xbox 360 *Kinect Adventures* game. Students‘ physical activity levels were measured with Actigraph GT3X+ accelerometers with percentage of time spent in sedentary, light physical activity, and moderate-to-vigorous physical activity as the outcome variables while students self-reported their situational interest during the session using the French Situational Interest Scale (Roure et al., 2015). Data indicated that students spent 78% of the session time in moderate-to-vigorous physical activity when playing the exergame with no significant differences between boys and girls. The findings also indicated that 11th grade students spent significantly higher percentages of time in moderate-to-vigorous physical activity than 10th and 12th grade students while attention demand emerged as a predictor for moderate-to-vigorous physical activity. Finally, novelty was marginally predictive of light physical activity. When Trost et al., (2002) reported age and gender differences in objectively measured daily physical activity among youth, they found that (1) Physical activity declines rapidly during childhood and adolescence; and (2) boys engaged in significantly greater moderate-to-vigorous physical activity participation than girls (with the exception of grades 1-3). Our study revealed that high school students‘ experiences during exergame play do not follow this trend. Students spent most of their time in moderate-to-vigorous physical activity when playing the exergame as 11th grade students were more active than 10th and 12th grade students in addition to boys and girls were equally active. This might be due to the attractiveness of exergaming among youth— especially in a competitive situation (i.e., side-by-side two-player action). Previous studies (Huang & Gao, 2013; Sun, 2012) provide empirical evidence to support the motivating nature of exergaming. Sun (2012) found high levels of instant enjoyment, exploration intention and challenge among elementary children when they played exergames in class. Huang and Gao (2013) reported high levels of novelty as the sole predictor for

moderate-to-vigorous physical activity among middle school students. Exergaming provided a unique and new experience in which boys and girls were challenged, explored the game situations, and focused on key elements of the games that led to high levels of enjoyment. As Sun (2012) concluded: "The motivation derived from the exergaming activity can be conceived to be representative of typical intrinsic motivation rarely seen in children and even older learners" (p. 217). Therefore, the motivational power of exergaming may be an opportunity to attenuate the increase of sedentary activities throughout childhood and adolescence. The findings also revealed that high school students' perceived attention demand was a predictor of their time spent in moderate-to-vigorous physical activity. Additionally novelty approached significance for the prediction of students' light physical activity. Huang and Gao (2013) found that novelty was the only significant predictor of students' moderate-to-vigorous physical activity suggesting that middle school students would engage in higher amounts physical activity if they felt the exergame provides new information. Our results show that, although novelty may be enough to physically engage middle school students in exergames, it is not enough for high school students. Further, according to the findings of the present study, novelty may only lead to light physical activity among this age group. In other words, high school students may not exercise at a moderate-to-vigorous physical activity level if they feel the exergame only provides novelty but not the need for increased attention demand—a fact which limits the adolescent from deriving the health benefits associated with moderate-to-vigorous physical activity. Given that exergames are not a new concept for adolescents anymore, exergames should provide attention demand to support high school students' moderate-to-vigorous physical activity. Specifically, attention demand refers to cognitive engagement. This cognitive engagement is typically facilitated as a result of students' need to generate mental models quickly during exergame play in order to successfully navigate the game. Mental models have been defined as ―a special kind of mental representation, an analog representation, which individuals generate during cognitive functioning‖ (Vosniadou, 1994; p. 48). According to Hayes and Silberman (2007), exergames players develop a wide range of mental models to help them decide how to succeed in various game situations. In the current study, students playing Reflex Ridge had to constantly decide which position to take on the platform and if they would have to squat or jump to avoid the obstacles or to make the platform move faster along its rail. The generation of mental models helps them to make better and faster decisions in these exergame situations. The results of this study on the role of cognitive demand are consistent with findings in previous studies (Chen & Darst, 2001). Cognitive demand is the key to physically engage high school students in exergaming experiences. Accordingly, physical educators should consider the motivational power of cognitive demand on students' physical activity levels when they use exergames. In conclusion, the findings from this study provided evidence that exergaming can be a powerful source of situational interest motivation and lead to health benefits among high school students. However, physical educators should receive professional training to use exergames effectively to promote physical activity.

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