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Promoting Children's Physical Activity in Physical Education: The Role of Active Video Gaming

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Abstract

Approximately half of the children in the United States do not meet the global physical activity guidelines, and many children adopt sedentary lifestyles. Given the fact about two-thirds children are classified as overweight or obese, traditional video games have been blamed as a major contributor to children's sedentary behavior and excessive weight. However, active video gaming is a new solution to fight increasing sedentary behaviors and childhood obesity. The major purpose of this study was to review the prevalence of sedentary behaviors in children and examine the factors contributing to the trend of decreasing physical activity in children. The second purpose of this study was to examine the extent to which video games are used by children and potential benefits associated with active video gaming, specifically to promote physical activity in children. The additional purpose was to offer an argument for educational professionals in the school setting to integrate active video games as a way to combat sedentary behaviors and obesity utilizing the self-determination theory and expectancy-value model as theoretical frameworks.

Keywords: *Active video games, motivation, physical activity, obesity*

Introduction

Obesity is a condition in which excess body fat has accumulated in an individual's body to the extent that it may cause negative effects on health (U.S. Department of Health and Human Services [USDHHS], 2008, 2010; World Health Organization [WHO], 2010). It is documented that approximately two-thirds of children in the United States are considered either overweight or obese (Centers for Disease Control and Prevention [CDC], 2015). These circumstances can be directly attributed to multifaceted factors such as unhealthy diets and physical inactivity (WHO, 2010). Physical activity can be defined as any bodily movements that are produced by skeletal muscles and result in energy expenditure beyond what may occur during typical activities of daily living (USDHHS, 2008). As a form of physical activity, exercise refers to structured and planned physical activity which an individual chooses to do in order to achieve a health objective, such as lifting weights to increase muscle mass, or running to improve cardiovascular functioning (USDHHS, 2010).

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Recent physical activity recommendations for children (ages 5-17) are to accumulate at least 60 minutes of moderate-to-vigorous physical activity per day, with most of the physical activity being aerobic in nature (USDHHS, 2008). However, the number of children around the world who regularly participate in physical activity is staggeringly low, with experts estimating that approximately fifty percent of them fail to meet the physical activity recommendations (USDHHS, 2010; WHO, 2010). For instance, only twenty-seven percent of American children engage in recommended levels of physical activity (USDHHS, 2010).

According to National Health and Nutrition Examination Survey (NHANES) in 2008, approximately thirty percent of children were considered overweight and at least seventeen percent were considered obese (Odgen & Carroll, 2010; USDHHS, 2010). It is known that obesity increases the risk of type 2 diabetes, hypertension, coronary heart disease, and even obstructive sleep apnea (CDC, 2015; Foley & Maddison, 2010; Lee, Lai, Chou, Chang, & Chang, 2009). These risks are just a few of the medical problems that obese or overweight children may face. However, being overweight or obese can also lead to mental and psychological challenges as well. Some of these challenges include but are not limited to: low self-esteem, difficulties in peer relations, and issues with behavioral and emotional stability (Lee et al., 2009). Taken together, this evidence indicates a significant issue that must be addressed to prevent such conditions as being overweight or becoming obese (CDC, 2015).

Lee and colleagues (2009) completed a qualitative study exploring the views among obese pre-adolescents on exercise and their reasons for not exercising. The results indicated that most participants held positive perceptions of exercise and were clear on the direct health benefits of exercise, such as increased energy and prevention of health disorders. Participants were also aware of the negative effects of not engaging in exercise, such as gaining weight, having less energy, or increased risk of health problems. However, participants indicated feelings of discomfort (e.g., exhaustion, soreness) as reasons not to exercise (Lee et al., 2009), suggesting that while the health benefits of exercise are evident, this knowledge has not necessary led to achievement of requisite physical activity levels. In addition to feelings of ambivalence toward exercise, participants also identified several common excuses for not exercising, such as lack of time, finances, disinterest, and injury (Huang, Lee, & Chang, 2007; Lewis & Sutton, 2011; USDHHS, 2010).

Therefore, the primary purpose of this study was to overview the association between prevalence of technology and sedentary behaviors in children. The secondary purpose was to examine the extent to which video games are used by children and potential benefits associated with active video games, with specific attention paid to promotion of physical activity in children. Moreover, an additional purpose was to identify implications for practice related to promoting physical activity in the context of video gaming among children utilizing the self-determination theory and expectancy-value model as theoretical frameworks. We intend to review how both theories can be used in unison when implementing active video gaming to promote greater physical activity among children during school physical education.

Technology and Sedentary Behaviors

The industrial revolution and the technology age have changed our lifestyles. Technology and our mechanized workplaces have influenced our daily routines at work and during leisure time. In particular, leisure-time physical activity decreased from approximately 31% in 1988 to around 25% in 2008 (USDHHS, 2010). Perhaps the most detrimental to physically active lifestyles has been the migration of technology into an individual's leisure activities, replacing traditional sport and exercise with screen time. Not surprisingly, screen-time activities (e.g., television viewing, internet browsing, and video games) account for the largest percentage of children's sedentary time (Foley & Maddison, 2010). Although various physical activity interventions have aimed to reduce children's sedentary time in the past decades, producing the desired effect remains a challenge. One reason might be due to the fact many children view these sedentary activities as valuable, and as a result they choose an activity

that is more "fun" and has less aversive effects. Thus, screen-time activities such as sedentary video games become the preferred choices among this population over traditional sports and physical activities such as soccer or riding a bicycle.

Prevalence of Sedentary Video Games

While television, cinema, and internet browsing provide an entertaining alternative to physical activity, traditional video games are perhaps the most influential and pervasive form of entertainment in today's children. In fact, sedentary video games are considered one of the fastest growing forms of recreation among children (Wang, Khoo, Liu, & Divaharan, 2008). For example, *World of War Craft* (WOW) is one of the most influential and popular games currently in the world. This game is played online and involves users creating their own characters to accomplish collective goals with the members in their groups. The appeal of this video game is the level of commitment gamers typically must invest. Przybylski and colleagues (2010) found at least 10 million players engaged in WOW every week, with an estimated 225 million collective hours devoted to accomplishing the tasks set by the players and their online group members (Przybylski, Rigby & Ryan, 2010).

Global recommendations for physical activity in children recommend at least 60 minutes of moderate-to-vigorous physical activity on a daily basis, but people who play WOW, one of many games to choose from, play roughly three hours per day (Przybylski et al., 2010; USDHHS, 2010). The fact that children are more likely choose an activity that is enjoyable and has less aversive effects may explain why so much time was devoted to traditional video gaming and so little time to physical activity (Foley & Maddison, 2010). Thus, how does one introduce an intervention that promotes children's level of physical activity, maintains their interest, and helps preserve strong levels of motivation? Perhaps active video games are a part of the solution. Thus, it is necessary to examine children's motivation in gaming and physical activity.

Motivation in Gaming and Physical Activity

Motivation is defined as the degree of determination, drive, or desire with which an individual approaches or avoids a behavior (Deci & Ryan, 2000; Ryan & Deci, 2007). Motivation is often thought of as a multi-dimensional construct that can be viewed on a continuum with amotivation at one extreme, various levels of extrinsic motivation comprising the interim area of the continuum, and intrinsic motivation representing the other extreme based on the self-determination theory (SDT; Ryan & Deci, 2007). Intrinsic motivation typically emanates from within a person's free choice to engage in a behavior (Zhang, Solmon, Kosma, Carson, & Gu, 2011); whereas extrinsic motivation is often derived from external rewards (Deci & Ryan, 2000; Frederick-Recascino & Schuster-Smith, 2003). According the SDT, four extrinsic motivations fit within this continuum: 1) *external regulation*, which means behavior is externally controlled by such things as rewards, (2) *introjected regulation*, which means an individual now desires social approval and any form of disapproval motivates behavior, (3) *identified regulation*, which means individuals act by their own choice based upon interests, abilities, or a desire to achieve, and (4) *integrated regulation*, which means individuals engage in an activity as a part of their lifestyles (Ryan & Deci, 2007; Wang et al., 2008; Zhang et al. 2011). As individuals continue to engage in a behavior, they progress along the continuum and in theory become intrinsically motivated.

In a study designed to determine the underlying motivational processes in gaming, Wang and his colleagues (2008) found that harmonious passion in gamers correlates with higher levels identified regulation and intrinsic motivation. When individuals are motivated from these dimensions, they are more likely to continue to playing; specifically when they experience feelings of enjoyment. Pryzbylski and colleagues (2010) also found gamers experience high levels of intrinsic motivation due to the fact that they hardly receive any sort of external reward (external regulation), consequently they play for

the mere satisfaction and resulting experience (intrinsic motivation). Thus, they posited that there was good reason to expect that active video gaming could indeed satisfy basic psychological needs. When active video games satisfied the needs for competence, autonomy, and relatedness, a gamer was able to become more fully immersed into the gaming experience (Przybylski et al., 2010).

For many years, males were the dominate audience for video games with research suggesting that games have been designed (characters, storylines, etc.) as primarily masculine in nature. This in turn leaves females forced to take on roles they may have difficulty relating to (Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010). Greenberg et al. (2010) also found that for both genders, competition and challenge were the primary motivators for game play. Further, boys were more motivated to play by achievement or competence factors, while girls were more motivated by affiliative or social factors (Tauer & Harackiewicz, 1999; Yee, 2006). With active video games like *Wii Fit* and Xbox Kinect or Wii *Just Dance* reaching both genders, the opportunity to implement active video games as an intervention becomes even more likely. Thus, it is evident that when trying to understand the behavior of active video gaming, it is best to understand the context of an individual's motivation to play. Recent studies (Gao, 2013; Gao, Podlog, & Huang, 2013) confirmed that students who had fun and mastery experiences active video gaming were motivated to continue to play, had high physical activity levels and general enjoyment.

Although SDT is popular in explaining the multi-dimensional motivation in recent years, the expectancy-value model is also an important theoretical model to examine children's motivation in physical activity (Xiang, McBride, Guan, & Solmon, 2003). The expectancy-value model posits individuals' expectancy-related beliefs and subjective task values influence their decisions about engaging in certain activities, their amount of effort given, and their persistence to perform (Gu, Solmon, & Zhang, 2012, 2014; Zhang, Solmon, & Gu, 2012). If a child has a positive belief in his or her ability to complete a task such as being physically active, and the value placed on completing this task is high, then this child will more likely choose to engage this task and similar tasks in the future (Zhang et al., 2012). However, this also means that if the cost of engaging in a behavior such as exhaustion, use of time, or financial cost outweighs the value placed on the task, then a child will be less likely to engage in this behavior.

Based on the expectancy-value model, there are four major components of subjective task values that can influence achievement behavior (Gu et al., 2012, 2014). The first component, *importance*, is related to the quality of performance or the idea of doing well; it is most often related to one's feeling of competency. The second component, *interest*, is related to the level of enjoyment or likeability of the task. The third component, *usefulness*, is related to one's belief that this task can be helpful or utilized in one's life. The last component, *cost*, is related to the negative side effects of engaging in a behavior, such as feeling exhausted from exercising (Xiang et al., 2003). Understanding these components of the expectancy-value model are important when examining active video games.

Active Video Gaming

While researchers and other professionals in the physical activity field have viewed traditional video games as a primary threat to physically active lifestyles, a recent shift in perspective identified the potential of active video games as a component in physical activity interventions. Indeed, 68% of U.S. households have a video game console (About the concept, 2015). Thus access to video gaming is not a barrier for a large number of people in the U.S. Based on the fact that obesity and gaming are almost equally prevalent, playing games that require moderate-to-vigorous physical activity appears to be a potential avenue to lower the childhood obesity rate in a manner that children would most enjoy (Gao, 2013). The challenge is to shift player participation from sedentary video games like WOW to active video gaming systems, which include the Nintendo Wii U, Microsoft's Xbox 360/One *Kinect*, and Sony's Playstation 4.

The Nintendo Wii is a motion gaming console system that gives users the feeling of playing their favorite sports activities and adventures through movements. With this new development, children have the option to become more active and immersive than ever before (Nintendo, 2015). The Xbox 360/ONE Kinect allows gameplay with no controller device in hand, but simply by the Kinect Sensor which is engaged by the movements and voice of the user (Microsoft, 2015). In addition, the *Move* is an adaption developed for the Playstation 4 console which works very similar to the Wii by tracking movement of a motion controller via an Eye Sensor.

Children are influenced by technology. Instead of trying to reduce screen time, the preceding physically active video games may be prime candidates for placement in school physical education. In fact, it has been evident that active video gaming intervention has potential in promoting physical activity in school physical education. Gaming has been linked to deep levels of motivation, significant amounts of physically active time, and has the potential to target boys and girls in schools (Lafreniere, Vallerand, Donahue, & Levigne, 2009). Thus, it will be more effective than shifting to active video games in promoting physical activity levels in school physical education (Sun, 2015).

Benefits of Active Video Gaming

The major benefit of active video games is that they allow gamers to utilize body movements as a mode of interaction, which would allow active video gaming to become part of the solution against childhood obesity (Gao, Zhang, & Stodden, 2013; Pasch, Bianchi-Berhouze, Dijk, & Nijholt, 2009). Specifically, the first benefit is the increases in energy expenditure while participating in active video gaming. Several studies have indicated that active video gaming can result in moderate to high levels of energy expenditure for children (Biddiss & Irwin, 2010; Maddison et al., 2007; Ridley & Olds, 2001; White, Schofield, & Kilding, 2011). In addition, active video gaming has been shown to have higher levels of energy expenditure when compared to television watching or traditional sedentary gaming (Gao, Chen, Pasco, & Pope, 2015; Gao et al., 2013; White et al., 2011). Particularly, with an interactive multimedia curriculum, improvements in psychosocial outcomes including self-efficacy, social supports, and outcome expectancies of physical activity are attainable so that children are more likely to increase future physical activity levels (Gao & Chen, 2014; Goran & Reynolds, 2005). If children could be encouraged to reduce sedentary gameplay by one hour and devote that time to playing an active video game, sedentary time would decrease and physical activity would increase (Lanningham-Foster et al., 2006). Due to active video gaming having increases in metabolic rate above resting levels, researchers (Gao & Chen, 2014; Sun, 2015; White et al., 2011) recommended that active video games can be used to encourage sedentary children to be more physically active at home or school physical education.

In addition to increased energy expenditure, research has also discovered that active video games have been shown to demand a large amount of cognitive engagement (Sun, 2012, 2015), specifically in the areas of spatial abilities (De Lisi & Wolford, 2002), motor skills (Fery & Ponserre, 2001), and problem solving skills (Ko, 2002). Beyond these particular motor skills and problem solving skills can be enhanced by active video gaming, another important element that active video gaming can offer gamers as opposed to sedentary video games is the development and creation of mental models, which help an individual perform successfully in an actual real-life experience (Lin & Zhang, 2011; Hayes & Silberman, 2007; Sun, 2015).

The expectancy-value model suggests that when a child is able to place a higher value on a physical activity (i.e. baseball) and reduce the cost (embarrassment or discomfort) of participating, the child is more likely to engage in this activity on a regular basis (Gu et al., 2012, 2014). With games that engage children in sports play, active video games enhance children's mental models for sport engagement while also improving motor skills needed to engage in the real-life versions of the games (Donaldson & Ronan, 2006; Slutzky & Simpkins, 2009; USDHHS, 2008). While active video gaming can help facilitate familiarity of a sport or activity through the development of mental models and

increase energy expenditure, they can also help in the improvement of psychological well-being including enhanced exercise self-efficacy, motivation, enjoyment and improved mood in children both with normal weight or overweight/obesity (Baranowski, Buday, Thompson, & Baranowski, 2008; Staiano & Calvert, 2011).

It is well-documented that when individuals engage in activities that satisfy the needs for competence, autonomy, and relatedness, it leads to more intrinsic levels of motivation and continued participation (Deci & Ryan, 2000; Frederick-Recascino & Schuster-Smith, 2003; Zhang et al., 2011). Further, Greenberg and his colleagues (2010) outlined six basic motives for playing games: *challenge*, *competition*, *fantasy*, *arousal*, *social interaction*, and *diversion*, with self-challenge being found as the most important to gamers. Children who feel competent, autonomous, and connected to others during active game play have been linked with feelings of enjoyment and increased levels of intrinsic motivation (Gao & Chen, 2014; Gao et al., 2013). When children place a high value on a task, in this case, challenge, competition, enjoyment, and reduced cost through active video gaming, they will more likely choose to engage in activity. Baranowski et al. (2008) has provided some recommendations in video gaming designs. They suggested adding stories and roles of the players in order to arouse and meet their enduring psychological needs with increased game immersion; providing barriers in the stories as challenges and diversion to reinforce behavioral-change messages; as well as giving scenarios for active imagination with engagement for fantasy and social interaction. While active video gaming interventions designed upon the self-determination theory and expectancy-value model can be beneficial in reducing sedentary behavior in children, it also important to gain the support from physical education teachers in schools (Zhang et al., 2012).

Gaining Support among Physical Educators

School physical education teachers are a major factor in active video gaming because physical education teachers are the ones who provide the children with the games in classes, the ones who decide the amount of time devoted to these games, and most often set the example of a physically active lifestyle (Lin & Zhang, 2011). Maloney et al. (2008) examined the influence of the game Dance Dance Revolution (DDR) on children's physical activity and sedentary behavior. They found the significant others such as teachers and parents were already encouraging children to be physically active, and they believed that active video gaming like DDR could help develop positive relations with peers and their own relations with children (Maloney et al., 2008; Olson, 2010). In addition to improved relationships, one of the most intriguing aspects of most active video games is the lack of violence, an aspect of gaming that many significant others such as parents may not approve of (Olson, 2010). Because active video gaming is mostly centered on sports and dance, like that of *Just Dance* or PS3's *Sport Champions*, there is very little violence, if any at all, involved in the game. Despite the fact that active video gaming can present many benefits for increased physical activity, there are also many challenges professionals must face.

Challenges of Active Video Gaming

Utilizing active video gaming to promote physical activity seems successful; however, there are many challenges that must be faced (Lafreniere et al., 2009). One of the most common challenges of implementing a new intervention is the cost, specifically if the goal is to implement the intervention within an educational setting due to budget concerns. In addition, since lower income in the U.S. has been correlated with lower physical activity (Lox et al., 2010), it might be difficult for those low income families to afford the cost of active gaming devices. For instance, both the Xbox One and PS4 game consoles require the user to purchase the active gaming accessories. A PS4 console alone costs around $250-$350, and brand new PS4 games cost around $60. However, the EYE and MOVE controller(s) must be purchased additionally at a cost of around $100-$150.

Another challenge when using active video gaming to promote physical activity is game design. While some active video games have been shown to increase energy expenditure, some are less active.

Wii Boxing and *Wii Fit* have been shown to produce energy expenditure similar to self-paced walking (White et al., 2011), but some active video games that focus on sports like bowling or golf, may not produce sufficient amounts of energy expenditure. When games focus on only upper body movements, they may only elicit small amounts of energy costs, whereas when a game focuses on whole body movements (e.g., Wii *Just Dance),* it can produce higher amounts of energy expenditure (Ridley & Olds, 2001). These challenges may hold to the idea that active video games are not sufficient substitutes for traditional exercise as White and his colleagues suggest. In fact, a recent study showed that active video gaming stations did not provide any moderate or vigorous physical activity from the participants (Sun, 2012). Research suggests that while active video games may have a high demand for cognitive functions, the physical demand was entirely too low to consider active video games as a replacement for traditional sports and physical activity (Gao, 2013; Sun, 2012).

In addition to some active video gaming not producing sufficient amounts of energy expenditure, there is also the challenge of maintaining interest. When children play a new game with new challenges, the interest level is relatively high at the beginning. However, over the course of time children may lose interest (Graves, Ridgers, Atkinson, & Stratton, 2010; Maloney et al., 2008). If games are repetitive in nature and children lose the challenge aspect, this can be a major issue when trying to promote physical activity. Sun's studies (2012, 2013) showed that prolonged exposure to exergames could decrease the perceived situational interest as well as motivation to engage in exergames-based physical activity.

A final challenge is to maintain energy balance and focus on a nutrient rich energy intake. To illustrate this point further, if a child spends two or three hours playing a sedentary game, he or she may or may not need a snack. However, being active requires more caloric intake, thus when children engage in active video games (i.e., *Wii Just Dance)* they will most likely seek out something to replenish their output of energy. If a child is playing at home and all there is to eat is "junk" food, then it would seem there is a counter-productive routine developing (Lanningham-Foster et al., 2006; WHO, 2010). While active video gaming can present many health benefits, the challenges are equally comparable (Dammann, 2012). There are ways, however, in which professionals can overcome some of these challenges in school physical education.

Overcoming Challenges of Active Video Gaming

It was mentioned that covering the costs of active video gaming consoles can itself be a major obstacle to overcome, specifically within low income families. However, while cost is something that will not be eliminated, it can be reduced. One way to do this would be to purchase pre-owned game systems. Used systems and accessories can be purchased for significantly less at participating stores or even online. There are also package deals that can be found online. For example, PS4 typically bundles the *Move* accessories (eye and controllers) with a game, such as *Sport Champions.* Nintendo Wii U does not require any additional active gaming accessories other than more controllers. The Wii U can also be purchased at a lower price than its competitors, as in *Kinect.*

When faced with the challenge of insufficient levels of energy expenditure due to game design, professionals can make sure they purchase games that involve large muscle groups and whole body movements (e.g., boxing, dancing) as these types of games have been shown to have increases in energy expenditure over games with only upper body movement (Biddiss & Irwin, 2010). Although some active video gaming may not be sufficient substitutes for traditional physical activity, they can help children become familiar with other sports (Buns & Thomas, 2011).

Perhaps one of the best ways to make sure active video gaming interventions be successful is the need for professionals to purchase games that appeal to all ages and promote challenge in school physical education, but not too much challenge in that children get too frustrated to continue playing. Another suggestion is to play the workout mode as opposed to the game mode. As such, children play the games all the time without stopping to pick the games and difficulty of the games (Gao, 2013).

Finally, it is recommended that children don't eat any "junk" food when they engage in active video games. In doing so, children may have good energy expenditures during their exercise. These are just few recommendations on how to fight some of the challenges professionals may face when implementing active video gaming interventions in the school setting.

Implications for Practice

After reviewing the contributing factors of childhood obesity and the role screen-time activities have played in the trend of increased sedentary behaviors, it is evident that active video gaming can help reduce this trend. Professionals can now begin to design interventions utilizing active video gaming in school physical education and to promote greater physical activity among children based upon the self-determination theory and expectancy-value model. Optimal uses of game-based stories, interactivity, fantasy and behavior change technology by collaborations of video game designers with health experts are likely to increase the importance, interest, and usefulness of the interventions (Baranowski et al., 2008; Gao & Chen, 2014). While active video gaming is not recommended as a replacement for traditional physical activity, it is recommended to be introduced in order to encourage sedentary children to be more active (Gao & Chen, 2014). Moreover, because competition has been found to be a major factor in gaming for both boys and girls, this is important to take into account when considering an active video gaming intervention in school physical education. The competition is key because it facilitates peer interaction in school physical education.

For those professionals working in a school setting (i.e., physical education teacher), one way to incorporate active video gaming is have it set up in an activity rotation. For example, many physical education teachers have children rotate stations that require students to participate in various activities, so in consequence, a teacher can have a Wii U or PS4 Move set up as one station. This allows all children the opportunity to play and possibly get more excited when it is their turn to come to that station. This could also facilitate more peer-based learning. For example, one child may have a lot of experience with gaming systems at home, whereas, another child may have no such experience. Therefore, the experienced child can help his or her classmate understand the controls and how the game works. Once active video gaming devices have been implemented into school physical education, they can attract children who have typically had negative thoughts towards physical education class and actually get them excited about participating, as well as it may help physical educators see active video gaming as a valuable addition to their teaching requirements and curriculum.

While empirical research evidence has been limited, many school physical education teachers may not be opposed to most active video gaming due to reduced violence and the idea that they promote peer interaction while encouraging children to be physically active (Sun, 2015). Because active video games have been linked to strong levels on intrinsic motivation and continued participation, they should be considered by professionals as a way to reduce increasing levels of sedentary behavior. The issue of childhood obesity can only be solved with a multi-faceted approach, and active video gaming should simply be thought of as one component that could be a more enjoyable medium to transition to more physical activity (Gao & Chen, 2014). Traditional sedentary video games may have been a major contributor to childhood obesity over the years, but active video gaming can help contribute to the decrease of childhood obesity (Murphy et al., 2009; Sun, 2015). For future researchers and professionals, there are several directions we could consider when looking into the benefits and challenges that active video gaming presents for future interventions.

Future Research Direction

For future research direction, we recommend several areas that professionals should consider when planning research in physical education in the gaming contexts. First, current active video

gaming literature is saturated with studies devoted to increases in energy expenditure. Therefore, we recommend those interested in this area devote their studies to more limited areas. While we did provide some research on teachers' support and involvement, literature in this area is relatively insufficient. In addition, it would be beneficial to take into consideration the perspective of physical educators; find out how active video gaming will affect their roles in implementation in school physical education curriculum.

While previous research has looked into how sedentary video gaming affects cognitive and executive functioning (i.e., increased spatial abilities, problem-solving), it would be beneficial to study how active video gaming can affect these areas (Sun, 2015). Moreover, research should look into the possibility that while many active video games can help increase physical activity, this may only happen at the beginning when children are interested in the game. Therefore, researchers should look into the possibility that active video gaming may not present long-term maintenance of physical activity (Gao & Chen, 2014). Researchers should also consider studying the differences active video games can have on obese and non-obese children. Results may show the benefits for active video gaming may not be the same for both, which may shape the implementation of active video gaming interventions in the school setting. For example, Garn, Baker, Beasley, and Solmon (2012) found that some of the obese individuals who participated in their study preferred the Wii Fit game over traditional physical activity. Thus, it would be beneficial to discover if being obese or overweight can affect their choice to participate in school physical education.

Future directions for research should also include the influence of active video games on special population in schools, specifically within the realm of health and injury rehabilitation. Perhaps the required motions of the Wii, Kinect, or Move can help those recovering from an injury or suffering from a condition like arthritis, regain some of their desired movement. Dietary consumption is another topic that should be considered, specifically among children. Perhaps future study can examine how when children engage in active video games, they would want to consume some type of food afterward (Baranowski et al., 2008), thus research can look into whether there is a possibility that active video gaming can help increase healthy food consumption. For example, when children finish playing an active video game, a researcher could give children only healthy options to choose from (i.e., fiber bar, fruit smoothie, or vegetables) and see whether or not they choose to take one of the given options to satisfy their hunger. It might also be necessary to see whether or not gaming experience can affect levels of motivation and participation. A topic that Garn and his colleagues (2012) touched upon in their study previously mentioned, which sought to discover the effects of modern active video gaming devices on physical activity. They discovered that various levels of experience actually contributed to differing levels of cardiovascular functioning during interactive game play (Garn et al., 2012).

While motivation was a major topic in this study and many other studies surrounding gaming devices, the concept of motivation and the interaction of active video gaming should be examined further. Perhaps future research can examine motivational differences between sedentary and active gaming consoles. The link between psychological well-being and continued gaming participation has been looked into (Gao & Chen, 2014). However, further research is needed to discover if such a connection truly exists. It is evident from these suggestions that there are many routes professionals can take when considering active video gaming and their implications for reduced sedentary behaviors and increased physical activity. Interactive video games are prevalent in today's young population, and they will continue to grow and become an integral part of current and future generations. It is wise for professionals to see and understand this in order to help contribute to future physical activity interventions in the school setting.

In conclusion, this study has outlined the prevalence of screen-time activities, specifically sedentary video games, and how they have led to increased sedentary behavior among children. It is evident that professionals in the field of physical activity have begun to examine the possibility of considering active video games as a means to intervene on increasing sedentary behaviors. While research has focused primarily on energy expenditure, other researchers have begun to examine the

psychological benefits of active video games. This study should be viewed as an outline of where active video games stand within the field of physical activity and health. There are many areas professionals can examine when considering active video games as a means to increasing physical activity. After examining the current literature, it is evident that active video games will likely become a large focus within research and possibly considered as a major component in the battle against childhood obesity.

References

About the Concept. (2015). *Exergame: Powered by motion fitness.* Retrieved from http://www.exergamefitness.com.

Baranowski, T., Buday, R., Thompson, D. I., & Baranowski, J. (2008). Playing for real: Video games and stories for health-related behavior change. *American Journal of Preventive Medicine, 34*, 74-82.

Biddiss, E., & Irwin, J. (2010). Active video games to promote physical activity in children and youth: A systematic review. *Journal of American Medical Association, 164*, 664-672.

Buns, M., & Thomas, K. T. (2011). Congruent validity between a sport video game and real sport performance. *Sports Technology, 4*, 1-11.

Brownlow, M. (2015). *Smartphone statistics and market share.* In Email Marketing Reports. Retrieved from http://www.email-marketing-reports.com/wireless-mobile/smartphone-statistics.htm#smartphones.

Centers for Disease Control and Prevention. (2015). *Basics about childhood obesity.* In Overweight and Obesity. Retrieved from http://www.cdc.gov/obesity/childhood.

Dammann, J. (2012). *Exergaming in the modern school.* Retrieved from http://www.exergamefitness.com/blog/article.php?show=exergaming_in_the_modern_school

De Lisi, R., & Wolford, J. L. (2002). Improving children's mental rotation accuracy with computer game playing. *The Journal of Genetic Psychology, 163*, 272-282.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268.

Donaldson, S. J., & Ronan, K. R. (2006). The effects of sports participation on young adolescents' emotional well-being. *Adolescence, 41*, 369-389.

Fery, Y. A., & Ponserre, S. (2001). Enhancing the control of force in putting by video game training. *Ergonomics, 44*, 1025-1037.

Frederick-Recascino, C. M., & Shuster-Smith, H. (2003). Competition and intrinsic motivation in physical activity: A comparison of two groups. *Journal of Sport Behavior, 26*, 240-254.

Foley, L., & Maddison, R. (2010). Use of active video games to increase physical activity in children: A (virtual) reality? *Pediatric Exercise Science, 22*, 7-20.

Gao, Z. (2013). Motivated but not active: The dilemmas of incorporating interactive dance into gym class. *Journal of Physical Activity and Health, 9*, 794-800.

Gao, Z., Podlog, L., & Huang, C. (2013). Associations among children's situation motivation, physical activity participation, and enjoyment in an active dance video game. *Journal of Sport and Health Science, 2*, 122-128.

Gao, Z., Zhang, T., & Stodden, D. (2013). Children's physical activity levels and psychological correlates in interactive dance versus aerobic dance. *Journal of Sport and Health Science, 2*, 146-151.

Gao, Z., & Chen, S. (2014). Are field-based exergames useful in preventing childhood obesity? A systematic review. *Obesity Reviews, 15*, 676-691.

Gao, Z., Chen, S., Pasco, D., & Pope, Z. (2015). Effects of active video games on physiological and psychological outcomes among children and adolescents: A meta-analysis. *Obesity Reviews, 16,* 783-794.

Garn, A. C., Baker, B. L., Beasley, E. K., & Solmon, M. A. (2012). What are the benefits of a commercial exergaming platform for college students? Examining physical activity, enjoyment, and future intentions. *Journal of Physical Activity and Health, 9,* 311-318.

Goran, M. I., & Reynolds, K. (2005). Interactive multimedia for promoting physical activity (IMPACT) in children. *Obesity Research, 13,* 762–771.

Graves, L. E., Ridgers, N. D., Atkinson, G., & Stratton, G. (2010). The effect of active video gaming on children's physical activity, behavior preferences and body composition. *Pediatric Exercise Science, 22,* 535-546.

Greenberg, B. S., Sherry, J., Lachlan, K., Lucas, K., & Holmstrom, A. (2010). Orientations to video games among gender and age groups. *Simulation & Gaming, 41,* 238-259.

Gu, X., Solmon, M. A., & Zhang, T. (2012). Using expectancy-value model to examine students' physical activity engagement and cardiovascular fitness in physical education. *International Journal of Sport Psychology, 43,* 385-402.

Gu, X., Solmon, M. A., & Zhang, T. (2014). Understanding middle school students' physical activity and health-related quality of life: An expectancy-value perspective. *Applied Research in Quality of Life, 9,* 1041-1054.

Hayes, E., & Silberman, L. (2007). Incorporating video games into physical education. *Journal of Physical Education, 78,* 18-24.

Huang, C., Lee, L., & Chang, M. (2007). The influences of personality and motivation on exercise participation and quality of life. *Social Behavior and Personality, 35,* 1189-1210.

Ko, S. (2002). An empirical analysis of children's thinking and learning using a computer game context. *Educational Psychology, 22,* 219-233.

Lafreniere, M. K., Vallerand, R. J., Donahue, E. G., & Levigne, G. L. (2009). On the costs and benefits of gaming: The role of passion. *CyberPsychology & Behavior, 12,* 1-6.

Lanningham-Foster, L., Jensen T. B., Foster, R. C., Redmond, A. B., Walker, B. A., Heinz, D., & Levine, J. A. (2006). Energy expenditure of sedentary screen time compared with active screen time for children. *Pediatrics, 118,* 1831–1835.

Lee, P., Lai, H., Chou, Y., Chang, L., & Chang, W. (2009). Perceptions of exercise in obese school-age children. *Journal of Nursing Research, 17,* 170-178.

Lewis, M., & Sutton, A. (2011). Understanding exercise behavior: Examining the interaction of exercise motivation and personality in predicting exercise frequency. *Journal of Sport Behavior, 34,* 83-97.

Lin, L., & Zhang, T. (2011). Playing exergames in the classroom: Pre-service teachers' motivation, passion, effort, and perspectives. *Journal of Technology and Teacher Education, 19,* 243-260.

Lox, C. L., Martin-Ginis, K. A., & Petruzzello, S. J. (2010). *The Psychology of Exercise: Integrating theory and practice* (3ed.). Scottsdale, Az: Holcomb Hathaway Publishers.

Maddison, R., Mhurchu, C. N., Jull, A., Jiang, Y., Prapavessis, H., & Roders, A. (2007). Energy expended playing video console games: An opportunity to increase children's physical activity. *Pediatric Exercise Science, 19,* 334-343.

Maloney, A., Bethea, T. C., Kelsey, K., Marks, J., Paez, S., Rosenberg, A., Catellier, D. J., Hamer, R. M., & Sikich, L. (2008). A pilot of a video game (DDR) to promote physical activity and decrease sedentary screen time. *Obesity Journal, 16,* 2074-2080.

Microsoft. (2015). *Xbox 360 + Kinect.* In XBOX. Retrieved from http://www.xbox.com/en-US/?xr=mebarnav

Murphy E. C., Carson L., Neal W., Baylis C., Donley D., & Yeater R. (2009). Effects of an exercise intervention using Dance Dance Revolution on endothelial function and other risk factors in overweight children. *International Journal of Pediatric Obesity, 4,* 205-214.

Nintendo. (2015). Wii Controls. In Nintendo. Retrieved from http://www.nintendo.com/wiiu

Olson, C. (2010). Children's motivation for video game play in the context of normal development. *Review of General Psychology, 14,* 180-187.

Ogden, C. K., & Carroll, M. (2010). *NCHS Health E-Stat.* In Centers for Disease Control and Prevention. Retrieved from http://www.cdc.gov/nchs.

Pasch, M., Bianchi-Berhouze, N., Dijk, B. v., & Nijholt, A. (2009). Movement-based sports video games: investigating motivation and gaming experience. *Entertainment Computing, 1,* 49-61.

Przybylski, A., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of General Psychology, 14,* 154-166.

Ridley, K., & Olds, T. (2001). Video center games: Energy cost and children's behaviors. *Pediatric Exercise Science, 13,* 413-421.

Ryan, R. M., & Deci, E. L. (2007). Active human nature: Self-determination theory and the promotion and maintenance of sport, exercise, and health. In M.S. Hagger & N.L.D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport (pp. 1–19).* Champaign, IL, Human Kinetics.

Sun, H. (2012). Exergaming impact on physical activity and interest in elementary school children. *Research Quarterly for Exercise and Sport, 83,* 212-220.

Sun, H. (2013). Impact of exergames on physical activity and motivation in elementary school students: A follow-up study. *Journal of Sport and Health Sciences, 2,* 138-145.

Sun, H. (2015). Operationalizing physical literacy: The potential of active video games. *Journal of Sport and Health Sciences, 4,* 145-149.

Slutzky, C. B., & Simpkins, S. D. (2009). The link between children's sport participation and self-esteem: Exploring the mediating role of sport self-concept. *Psychology of Sport and Exercise, 10,* 381-389.

Staiano, A. E., & Calvert, S. L. (2011). Exergames for physical education courses: Physical, social, and cognitive benefits. *Child Development Perspective, 5,* 93-98.

Tauer, J. M., & Harackiewicz, J. M. (1999). Winning isn't everything: Competition, achievement orientation, and intrinsic motivation. *Journal of Experimental Social Psychology, 35,* 209-238.

U. S. Department of Health and Human Services. (2008). *2008 Physical Activity Guidelines for Americans.* Hyattsville, MD: U. S. Dept of Health and Human Services.

U. S. Department of Health and Human Services. (2010). *Healthy People 2020: Improving the Health of Americans.* Retrieved from http://www.healthypeople.gov/2020/

Wang, C. K., Khoo, A., Liu, W. C., & Divaharan, S. (2008). Passion and intrinsic motivation in digital gaming. *CyberPsychology, Behavior, & Social Network, 11,* 39-45.

White, K., Schofield, G., & Kilding, A. E. (2011). Energy expended by boys playing active video games. *Journal of Science and Medicine in Sport, 14,* 130-134.

World Health Organization. (2010). *Global strategy on diet, physical activity and health. In World Health Organization.* Retrieved from http://www.who.int/dietphysicalactivity/publications/9789241599979/en/index.html.

Xiang, P., McBride, R., Guan, J., & Solmon, M. (2003). Children's motivation in elementary physical education: an expectancy-value model of achievement choice. *Research Quarterly of Exercise and Sport, 74,* 25-35.

Yee, N. (2006). Motivations for play in online games. *Cyberpsychology & Behavior, 9,* 772-775.

Zhang, T., Solmon, M. A., & Gu, X. (2012). The role of teachers' support in predicting students' motivation and achievement outcomes in physical education. *Journal of Teaching in Physical Education, 31,* 329-343.

Zhang, T., Solmon, M. A., Kosma, M., Carson, R. L., & Gu, X. (2011). Need support, need satisfaction, intrinsic motivation, and physical activity participation among middle school students. *Journal of Teaching in Physical Education, 30,* 51-68.