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Evaluating the Effects of Exergaming on Physical Activity Among Inactive Children in a Physical Education Classroom

Victoria A. Fogel
*University of South Florida*

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Evaluating the Effects of Exergaming on Physical Activity Among Inactive Children in a Physical Education Classroom

by

Victoria A. Fogel

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts Department of Child and Family Studies College of Behavioral and Community Sciences University of South Florida

Major Professor: Raymond G. Miltenberger, Ph.D. Stephen W. Sanders, Ed.D. Trevor F. Stokes, Ph.D.

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Keywords: childhood obesity, interactive fitness, video games, school interventions, XRcade

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Dedication

I dedicated this manuscript to my husband, Jon. His sacrifice, support, and encouragement over the past seven years have afforded me the opportunity to achieve many professional goals. Jon’s belief that I can excel in my profession truly has brought out the best in me.
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Evaluating the Effects of Exergaming on Physical Activity Among Inactive Children in a Physical Education Classroom

Victoria A Fogel

ABSTRACT

Childhood obesity is a serious concern that requires the attention of the behavioral community. The U.S. Department of Health and Human Services (2007) recommends that children engage in physical activity for 60 minutes per day. Children spend the majority of their day in school, making school an ideal environment to increase the opportunity for physical activity. Simple, straightforward interventions that can be applied in the school setting, which take into consideration the environment and focus on maintenance by making the process of engaging in physical activity reinforcing, are greatly needed. Video games have been noted in the literature as a contributor to childhood obesity; however, newer video gaming technology, called exergaming, has been designed to capitalize on the reinforcing effects of video games to increase physical activity in children. This study evaluated the effects of exergaming on physical activity among four inactive children in a physical education classroom. Results showed that the exergaming condition produced substantially more minutes of physical activity than the PE condition. In addition, the exergaming condition was socially acceptable to both the students and the PE teacher. Exergaming appears to hold promise as a method for increasing physical activity among inactive children and might be a possible intervention for childhood obesity.
Introduction

Childhood obesity is a social problem of great magnitude with data showing that 17% of US children are overweight (U.S. Health and Human Services, 2007). Childhood obesity is roughly defined as occurring when a child’s weight is equal to or greater than the 95th percentile for children of the same sex and age (Reilly et al., 2005; U.S. Health and Human Services, 2007). The percentage of overweight children may seem small, but it should be noted that the number has doubled in the past 20 years and is much higher for adolescents (U.S. Department of Health and Human Services, 2001). Such a rapid increase strongly indicates a serious problem that may continue to grow at a significant pace.

The literature indicates many variables that may contribute to childhood obesity, including an increasing trend in sedentary behavior (e.g. video game-playing, television viewing, computer time, etc.), reduction in physical education time and qualified instructors, reduction in time provided for recess in schools, lack of safe routes for children to walk or bike to and from school, lack of safe and supervised places for children to play before and after school, convenience of fast food, increasing trend in eating out, lack of parent training on effective techniques to modify eating, decreasing physical activity and exercise behavior, and parents modeling non health-related behavior (American Academy of Pediatrics, 2003; Anderson et al., 1998; Crawford, Jeffery, & French, 1999; Daniels et al., 2005; Pisacano et al., 1978; Reilly et al., 2005; Robinson, 1999; Spear et al., 2007; U.S. Health and Human Services, 2007). These variables
correlated with obesity are all associated with decreased exercise or physical activity and/or increased caloric consumption.

Childhood obesity may result in devastating health and social consequences such as heart disease, type 2 diabetes, metabolic disorder, sleep apnea, hypertension, increased chance of being an obese adolescent or adult, premature death, alienation from peers, and/or depression (U.S. Department of Health and Human Services, 2001). Because of the prevalence of obesity and the potential, severe consequences associated with it, some behavioral researchers have focused on changing health related behaviors with children. These articles included functional assessment of eating patterns (Klesges et al., 1983; McKenzie, Sallis, Patterson, et al., 1991) and interventions for weight loss (Aragona, Cassady, & Drabman, 1975; DeLuca, & Holborn, 1992), increasing health food choices (Herbert-Jackson & Risley, 1977; Madsen, Madsen, & Thompson, 1974; Stark, Collins, Osnes, & Stokes, 1986), increasing exercise behavior (DeLuca & Holborn, 1992), and increasing exercise-report correspondence (Wilson, Rusch, & Lee, 1992). Unfortunately, the majority of the articles were published in the late 70’s and early to mid 80’s. It is imperative that the behavioral community take a more active role in investigating strategies that result in long term healthy life style changes. These lifestyle changes include increasing exercise or physical activity and decreasing overeating or consumption of unhealthy foods.

Physical Activity

The terms physical activity and exercise often are interchanged; however, there is a difference between the two. Physical activity is defined as, “bodily movement that is produced by the contraction of skeletal muscles and that substantially increases energy expenditure,” (American College of Sports Medicine, 2006, p.3). A few examples of
physical activity would include walking, raking leaves, washing a car, etc. Exercise is defined as, “Planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness (the ability to perform sport and motor skill performance as well as daily activities)” (American College of Sports Medicine, 2006, p.3). A few examples of exercise would include running, swimming, biking, etc. The main difference between physical activity and exercise is the intensity and duration of the behavior. Unfortunately, data suggest a declining rate of children engaging in both physical activity and exercise (American Academy of Pediatrics, 2003; Brownson, Boehmer, & Luke, 2005).

One of the suspected causes of obesity is an increase in sedentary behavior or a lack of physical activity (U.S. Department of Health and Human Services, 2005). With the advancement of technology, children are exposed to more sedentary activities than ever before such as online communities, state of the art video games, and virtual playgrounds for pretend play (Brownson et al., 2005). In addition, school and community environments may not provide the necessary structure to allow children the opportunity to engage in physical activity. Often these environments lack supervision, equipment, safeguards, and safe routes needed for children to engage in physical activity (Brownson et al., 2005; McKenzie, Cohen, Sehgal, Williamson, & Golinelli, 2006). As a result of the accessibility of sedentary activities and the increasing barriers to physical activity, children may be more likely to engage in sedentary behavior.

The U.S. Department of Health and Human Services (2005) recommends that children engage in daily physical activity for a minimum of 60 minutes at a moderate to vigorous intensity. The statistic on the percentage of American children meeting the national recommendation for physical activity under grade 9 could not be found for this
review. However, data suggest that physical activity levels decrease as children get older and that 75% of adolescents (grades 9-12) do not meet the national recommendations for daily physical activity (U.S. Department of Health and Human Services, 2007). A study by Sallis and colleagues (1997) points to the possibility that young children are not meeting the national recommendations for physical activity. They found that physical education class provided only 18 minutes per week of physical activity that was of moderate to vigorous intensity.

**Interventions**

A wide variety of interventions designed to modify eating, physical activity, and exercise behavior in children have been assessed over the decades. These interventions are comprised of specific behavioral procedures (e.g., goal setting, public posting, and reinforcement schedules) and complex treatment packages which may include many behavioral procedures in conjunction with other theoretical frameworks such as Social Cognitive Learning Theory and Behavioral Choice Theory as well as medical and nutritional models. A review of literature by Spear and colleagues (2007) indicates that while interventions based on a variety of models and theories can yield results, these interventions usually incorporate behavior modification techniques which seem to be the factor that is most effective in impacting childhood obesity.

Manipulating the environment in some capacity has proven to be a successful behavioral strategy for changing eating, physical activity, and exercise behavior. Sallis and colleagues (2003) implemented a program focused on changing the school environment and policies (e.g., requiring physical education daily, added supervision, equipment, and organized activities when physical activity was an option, and switching food vendors that provided low-fat food choices) to increase physical activity, exercise,
and health food consumption. These environmental manipulations resulted in an increase in physical activity for the children participating in the program.

Environmental manipulation is only one of the many behavioral strategies that are utilized in modifying eating, physical activity, and exercise behavior. Procedures that focus on providing consequences contingent on physical activity, exercise, and eating behavior can be very effective in producing initial short-term behavior change. DeLuca and Holborn (1992) used a variable ratio schedule of reinforcement within a changing criterion design to increase the rate of exercise on a stationary bike. The researchers utilized an elaborate token system in which a stimulus (light and bell) was activated and a point was delivered when the child pedaled at a specified level. The points accumulated during the sessions were later exchanged for preferred items. An increase in exercise was achieved and a notable positive effect on the verbal behavior of the participants was reported (e.g. asking if friends could join and asking for a bike at home). The limitation of this study and many studies within this area is the lack of follow-up data to assess generalization and maintenance. More recently, Epstein, Paluch, Kilanowski, and Raynor (2004) looked at stimulus control procedures (rule-setting and self monitoring) versus reinforcement procedures (contracting) and found that both resulted in a decrease in sedentary behavior and an increase in physical activity and fruit and vegetable consumption.

Environmental and consequence strategies often are combined to form a treatment package. Aragona and colleagues (1975) compared a treatment package which consisted of contracting, stimulus control techniques (not specified), daily exercise instructions, self monitoring, graphing, nutritional information, and response cost (in which a preferred item was lost if weight loss was not achieved) to the same package plus
reinforcement (a preferred item was given for losing weight). Both groups had greater weight loss than the control group. Nonetheless, a 31 week follow-up showed no treatment effect except for the response cost plus reinforcement group which showed a slower weight gain trend.

The use of peers in combination with other behavioral strategies can be effective in producing behavior change. Foster, Wadden, and Brownell (1984) implemented a program in which peers conducted weigh-ins, checked lunches, provided feedback on food selection, and provided stickers and praise for healthy food choice and weight loss. Results of this study showed that children lost weight; however, the weight loss was only partially maintained at the 18 week follow-up.

Even though behavioral strategies have proven to be effective in modifying health-related behavior, at least in the short term, the majority of the researched interventions are treatment packages that consist of other components in combination with behavioral procedures. These types of treatment packages have multiple components intended to increase the likelihood of behavior change and maintenance. Treatment packages designed to increase healthy food consumption, physical activity, and exercise typically are conducted in the school environment and incorporate some variation of the following: curriculum on nutrition, self monitoring, goal setting, contracting, stimulus control procedures (which are rarely defined), daily exercise instructions, family involvement (e.g. training, handouts, family nights, etc.), and rewards for goals met (Botvin et al.,1979; Brownell & Frederick, 1982; Gortmaker, Cheung et al., 1999; Gortmaker, Petterson et al., 1999; Sahota et al., 2001; Seltzer & Mayer, 1970; Simons-Morton et al., 1991). The articles evaluating treatment packages often describe their procedures in vague terms and report small effects with little to no assessment of
maintenance. The lack of detail in describing the procedures used in these studies makes replication and implementation of these procedures difficult for the research and practicing communities. In addition, due to the many treatment components, it is extremely difficult to determine which variable is responsible for the change in behavior and which variables are unnecessary. Interventions that are comprised of multiple components may be particularly difficult to implement and maintain. Therefore, it is imperative that researchers identify only the necessary procedures for effective health-related behavior change.

A researcher can have a seemingly well-constructed functional intervention, but if the environment does not support the intervention, it may fail. The school environment may be ideal for prevention and intervention strategies for obesity. Children spend the majority of their day at school and often spend additional time in this environment before and after school (U.S. Department of Health and Human Services, 2002). Interventions implemented in the school environment to increase physical activity are often focused at changing some aspect of the physical education class and usually are comprised of a treatment package. The treatment package implemented in the physical education class often centers on changing the class environment, including teacher behavior, through task analyzed curricula, instructions, behavioral skills training, and new equipment, in order to increase physical activity levels in children. McKenzie and colleagues (1993) implemented a health related curriculum through in-service training which incorporated task analyzed lessons, prompting, and instructional cues. Results showed an increase in effective instructional behaviors demonstrated by the teacher and active students. Data also indicated that students were more active in physical education classes that were taught by physical education specialists compared to those taught by teachers. This
finding may be due in part to the fact that specialists were handed picked and provided with bi-weekly training by the curriculum developer, which clearly does not allow for an accurate assessment of the curriculum implemented in a typical environment. Follow-up research on this study by McKenzie, Sallis, Kolody, and Faucette (1997) indicated that results maintained after 1.5 years for specialists and teachers who had previous training. In another study, Lupeker and colleagues (1996) implemented a treatment package with third graders called CATCH (The Child and Assessment for Cardiovascular Health) that modified lunch content; increased physical activity in the physical education classroom via a standardized curriculum, training, and booster training; and included families through a family fun night (information and activities associated with nutrition). Results of this study showed improved eating and physical activity for 3 years. Kelder and colleagues (2003) conducted a follow-up study and found no difference between schools that received treatment and control schools. They hypothesized that the CATCH program changed state practice in the states in which the program was implemented so that control schools improved as well as experimental schools. SPARK (Sport, Play, and Active Recreation for Kids) is another treatment package comprised of a physical education program, self management procedures (i.e. self reinforcement, self instruction, goal setting, self monitoring, and stimulus control procedures) designed to increase the likelihood of maintenance and generalization, homework and monthly newsletter to include the family, and rewards for meeting goals (Sallis et al., 1997). In an evaluation of SPARK with 4th graders, physical activity increased during physical education class but did not increase after school. The authors suggest that this limitation may be a result of poor design and/or poor implementation. Sallis and colleagues (1999) also assessed the effects of the SPARK program on academic performance. The authors found that
increasing physical education to three times a week had no harmful effect on academic behavior.

In addition to the school setting, after school sport programs have been used to increase physical activity and exercise. Weintraub and colleagues (2008) taught soccer skills to overweight children after school through positive feedback, social interaction, family involvement (participation in games), and the provision of equipment. Soccer was chosen because it included a wide range of muscles. Results demonstrated an increase in physical activity and exercise, which maintained for 6 months. In another study utilizing a sport team to increase physical activity, Jette, Barry, and Pearlman (1977) taught Lacrosse after school and demonstrated improved heart rates; however, maintenance was not assessed.

Researchers may add several components to an intervention to increase the likelihood of behavior change and maintenance, but these additional components may have no effect on behavior change and thereby, would be unnecessary. Complex interventions can be difficult to implement, requiring substantial time and effort. If unnecessary components are identified, effort and time may be reduced, ultimately increasing the acceptability of the intervention. Interventions targeting health-related behaviors may be more successful in long term behavior change if based on assessment results, strategies are simple to implement and require the least amount of time and effort as possible, interventions fit into current environment, and/or interventions include strategies that plan for generalization and maintenance.

Exergaming

Excessive video game play has been noted in the literature as a contributor to childhood obesity; however, newer gaming technology, called exergaming, has been
designed to capitalize on the reinforcing effects of video games to increase physical activity (Sanders & Hansen, 2008). Exergaming is a technology that utilizes interactive games to increase exercise behavior. Video games or various auditory or visual stimuli are paired with different types of exercise equipment and activities and, in order to play the game or produce the auditory or visual stimulation, the individual must engage in physical activity (Sanders & Hansen, 2008).

Exergaming may be an effective way to manipulate the PE environment to increase physical activity and reach large numbers of children. One of the critiques regarding treatments for childhood obesity is that behavioral interventions are not clearly laid out and often are very difficult for clinicians to implement (Spear et al., 2007). Exergaming holds promise as an intervention that is easy to implement, requires little effort from the PE teacher, and can be implemented with an entire class. Physical activity levels during PE may increase because class management time may decrease as children start engaging in physical activity right away during PE. In addition, opportunities for physical activity may increase by implementing an exergaming lab in the school system because these labs could also be available to students before and after school providing them with a safe location to engage in physical activity.

Research has just begun to investigate the effects of exergaming. Graves, Stratton, Ridgers, and Cable (2007) compared energy expended playing sedentary video games versus interactive video games and found that interactive video games resulted in more energy expenditure; however, the intensity of the energy expended was not high enough to contribute to the daily recommendations for exercise. The limitation of this study is that they used lean children who were already very active in sports. Results may vary with inactive children. In another study, Lanningham-Foster and colleagues (2006)
compared sedentary video games with interactive video games to assess energy expenditure and found that interactive video games doubled energy expenditure with children. In addition, the results showed that obese children had significantly greater increases in energy expenditure, suggesting that interactive video games may be a possible intervention for childhood obesity.

Exergaming in a school setting has yet to be scientifically evaluated. Although implementing an exergaming lab into an elementary school could have substantial start up costs, if exergaming increases physical activity in children and develops exercising as a reinforcing activity, it could dramatically decrease the amount of money spent on obesity related medical costs in the future (Hansen & Sanders, 2007). Due to the potential benefits of exergaming as an intervention for childhood obesity and the limited research in this area, it is clear that further research is needed to determine the effects of exergaming on physical activity in children. The purpose of this study was to evaluate the implementation of exergaming in a typical PE classroom with inactive children and answer the following questions. First, does an inactive child spend more time engaged in physical activity in an exergaming PE environment or in the traditional PE environment? Second, does an inactive child spend more of the time that is available for physical activity engaged in physical activity in the exergaming environment? Finally, which environment do inactive children prefer and does preference correspond with the environment that resulted in the highest level of physical activity?
Method

Participants and Setting

Four 5th grade physical education students from a southern public elementary school participated in this study. The participants met the criterion of being physically inactive in the PE classroom, which is defined as spending at least 30% of the time available to participate in physical activity either standing, sitting, and/or watching others. Inactive children were chosen for this study because inactivity is a variable correlated with childhood obesity. During pilot data collection, fitness test scores from the class were examined and children were selected based not only on being physically inactive in the PE classroom, but also on their fitness test scores being the lowest in the class, having good attendance, the teacher’s assessment of whether the child would engage in any property damage in the exergaming lab, being overweight (as defined by the PE teacher), and the PE teacher’s assessment that the child would benefit from an increase in daily physical activity.

Informed consent forms describing the study along with the researcher’s contact information were sent home to all students in this fifth grade physical education class. To ensure that caregivers understood the informed consent form, the option of either calling or meeting with the researcher to review the informed consent form was provided. After three weeks, four students were chosen from those students that had consent to participate in the study.

The study was conducted at the local public elementary school during the regularly scheduled PE class. Due to the PE teacher testing the exergaming equipment
with multiple classes, all 25 students in this 5th grade class engaged in both conditions of the study, but data were only collected on the four students participating in the study.

*Exergaming Equipment*

A classroom was converted into an exergaming lab, in which 9 stations utilizing seven types of exergaming equipment to promote physical activity were available to the participants during the exergaming conditions. Below is a description of each type of exergaming equipment that was utilized in this study (Hanson, 2008):

*Dance Dance Revolution (DDR).* A dance pad on which a player moves his or her feet to a set pattern that matches the general rhythm or beat of a song. Children stand on a “dance pad” in front of a monitor or television screen and step, stomp, or hop in the direction (i.e., up, back, right, and left) of the arrows that scroll up the screen to the rhythm of the music. DDR is designed to improve cardiovascular endurance and muscular endurance in the leg muscles.

*Gamercize.* A fitness machine with an interface to a video game’s console. When in motion the fitness machine provides a signal to the interface module. The interface allows interaction between the game controller and game’s console only when the signal is present. Gamercize therefore requires the player to remain in motion in order to play the game. Gamercize is intended to improve cardiovascular endurance, balance, and coordination.

*Game Cycle.* An upper body ergometer bike that requires children to control onscreen actions by pedaling and steering the bike with their arms instead of the legs. The Game Cycle is intended to improve muscular strength and endurance in the arm muscles and also to improve cardiovascular endurance.
Virtual Bikes. Virtual bikes resembling traditional bikes that allow children to control all on-screen actions, including steering, speed, turns, firing mechanisms and other strategies. The faster the player pedals, the faster the objects on the screen moves. The children also control the movement of the objects on the screen using the steering wheel. Virtual bikes are intended to improve muscular strength and endurance in leg muscles and also to improve cardiovascular endurance. Examples of virtual bikes include the Cateye GameBike, the Expresso Bike, and the Dog Fighter Bike.

Virtual Sports. Virtual sports allow children to play tennis, go bowling, practice boxing, or participate in a baseball game inside of a virtual world on a screen. Children may actually hold an implement that simulates a bat, racquet, or paddle as well as wear a pair of boxing gloves during game play. Virtual sporting games are intended to provide children with a variety of health benefits—including cardiovascular endurance, muscular endurance, balance, and flexibility—depending on the sport chosen. The Xavix console and Nintendo Wii are examples of virtual sport exergames.

XrBoard. A balance board simulator that allows children to experience the thrill of snowboarding down a mountain or practicing complicated skateboarding tricks. The XrBoard is intended to improve balance and coordination, muscular strength and endurance in leg muscles, as well as ankle flexibility and stability.

3 Kick. A martial arts simulator designed with resilient foam pads that can be punched, kicked, slapped, or tapped with shoes or bare feet, a fist, or an open palm. A light comes on in the pad and an audible tone sounds, when the pad is hit the light goes off and randomly another comes on. The score is based on speed as more points
are allocated the faster children are able to get to a light. 3 Kick is intended to develop cardiovascular strength and endurance, muscular strength and endurance, and flexibility.

**Dependent Variables**

The dependent variables in this study were the total minutes engaged in physical activity during each condition (PE and exergaming classes), the total minutes provided for physical activity, the percentage of opportunity engaged in physical activity during each condition, and a PE teacher scoring survey.

**Physical activity.** Physical activity for the purposes of this study was defined as moving a large muscle group (legs, arms, back, and/or abdominal) during an assigned task (designated by the PE teacher). Moving a large muscle group during any other time was not counted as physical activity. For example, movement during transition time, waiting time, or any other physical activity that was not part of the designated PE assignment was not counted. Total minutes engaged in physical activity for each participant was measured by utilizing a software program in which a button on the keypad of a PDA (personal digital assistant) was assigned to each participant. The researcher and/or research assistant started the keys at the beginning of class for all four participants once they engage in physical activity. When a participant stopped engaging in physical activity, his or her key was turned off and as soon as the participant started engaging in physical activity, the key was turned back on. This data collection process was repeated for the entire duration of the PE class, which was approximately 30 minutes.

**Opportunity to engage in physical activity.** The total number of minutes the student had an opportunity to engage in physical activity (OPA). For example, if the PE teacher
delivered instructions for two minutes, there was no opportunity for physical activity at that time; if all exergaming activities were occupied for 5 minutes, there was no opportunity for activity at that time; and if the teacher stopped the class to deal with problems behaviors, there was no opportunity for physical activity at that time.

**Percentage of opportunity engaged in physical activity.** The percentage of opportunity engaged in physical activity during the PE or exergaming conditions was calculated by dividing the number of minutes in which each participant was engaged in physical activity by OPA. In addition to the percentage of opportunity engaged in physical activity, the percentage of opportunity engaged in physical activity during the exergaming condition was also calculated by station towards the middle of the study to assess the differences across equipment and to identify exergaming activities that produced the highest and lowest percentage of opportunity engaged in physical activity (see Table 1).

**PE teacher scoring survey.** The PE teacher scoring survey was used to assess the teacher’s perceptions of how much time was spent dealing with behavior problems, providing instructions, and practicing PE skills, and how much time the class followed directions across conditions. The survey consisted of four statements and the PE teacher was asked to circle the percentage of time spent for each statement (see Appendix A). The survey was administered prior to (Pre) and at the completion of the study (Post).

**Social Validity**

Three surveys were utilized to assess the social acceptance of exergaming. The students’ preference ranking survey was used to evaluate the participants’ preferences among the different types of exergaming equipment and the PE teacher social validity
survey (see Appendix B) and the PE observer survey (see Appendix C) were used to assess the acceptability of exergaming to the PE teacher and a non biased observer.

**Students’ preference ranking survey.** The students’ preference ranking survey was administered at the end of the study during the PE class. Each participant met with the researcher individually in the back of the exergaming room. The students’ preference ranking survey consisted of eleven note cards with the name of one exergaming activity listed per card. Students were told to put the cards in order of their most favorite to least favorite activity (1 as most preferred and 11 as least preferred). To ensure the directions were clear, prior to ranking the exergaming activities, the researcher handed the participant five cards with one type of food listed on each card (e.g. pizza, beans, carrots, hotdogs, and ice cream). The researcher asked the participant to pick his/her favorite and least favorite food. The researcher then told the participant to put the cards in order of their most to least favorite food. Once the participant had done this correctly, he/she was told to rank the exergaming activities. Following the ranking survey, the researcher asked each participant three questions. The first question was, “Why did you put (most preferred) activity on top?” The second question was, “Why did you put (least preferred) activity on the bottom?” The last question was, “Would you rather do regular PE activities or exergaming activities during PE class?” After the participant answered these questions, he/she was thanked for speaking with the researcher.

**PE teacher social validity survey.** To measure the acceptability of exergaming as a form of PE, a survey consisting of eight statements utilizing a Likert scale (1-5) was administered to the PE teacher at the completion of the study.

**PE observer survey.** The PE observer survey was conducted in both the regular PE and exergaming conditions. The purpose of this survey was to have a non-biased
observer, whom was familiar with fitness standards, assess both conditions to provide an opinion about each environment. The observer was a fitness graduate assistant and held a personal trainer certification. A Likert type scale was used to assess nine statements about each environment. Two observations were conducted throughout the study. The observations were scheduled based on the observer’s availability.

*Interobserver agreement*

To assess interobserver agreement, physical activity and opportunity to engage in physical activity (OPA) data were collected by two additional independent observers across all conditions for 50% of the total data. Interobserver agreement was assessed on a second by second basis throughout the observation session. An agreement was defined when both observers indicated that exercise was or was not occurring during each second of the observation. Agreement was calculated by taking the total seconds of agreement divided by the total seconds of observation and then multiplying by 100. Agreements averaged 96% across all observations with a range of 92% to 98% for physical activity data and an average of 95% across all observations for OPA, with a range of 92% to 97%.

*Experimental Design and Procedures*

An alternating treatments design was used to assess the effectiveness of exergaming on physical activity. Two conditions were assessed in this study: Regular PE (PE), and exergaming (E).

*Regular PE.* During the regular PE condition, the fifth grade class participated in a traditional PE class. In the PE condition, the teacher conducted class as usual in the standard format consistent with her regular lesson plan. The standard format included providing instructions on a skill or activity; modeling the skill or activity; providing an
opportunity for the students to perform the skill or activity while providing prompts and encouragement; and repeating this cycle if teaching more than one skill or activity per class. The PE teacher was provided with outcomes that each student must meet by the end of the year; however, the PE teacher was not required to follow a specific protocol or curriculum in order to teach these skills in the PE classes.

*Exergaming.* During the exergaming condition, the fifth grade class participated in exergaming. The exergaming class was conducted by the PE teacher. During the first class, the PE teacher provided instructions and modeling on how to use each piece of equipment. A sign was posted on each piece of exergaming equipment indicating the station number as well as simple instructions to assist the students in starting up each activity. The PE teacher also provided instructions for station rotation and showed the class a schedule board indicating to each student to which group he/she belonged and at which station each group would start for that class (see Appendix D). She reviewed five rules for the exergaming room (see Appendix E) and had the class repeat back the rules. Schedule boards were changed at the end of each class so that each group would start on the station following the last one completed. For example, if a group ended at station 3, that group would start at station 4 the following exergaming class. Students rotated stations approximately every 10 minutes upon the PE teacher turning the lights off. For all subsequent exergaming sessions, at the start of class, students were told to check the schedule board when they came into the room and then to go to the assigned station. Stations continued to rotate approximately every 10 minutes.

This study evaluated exergaming under typical environmental conditions to ensure an accurate depiction of what would be observed in the natural environment by
utilizing the standard format that was currently in place for traditional PE and a station rotation format for implementing exergaming in the PE classroom.
Results

Dependent Variables

**Physical activity.** Based on the data collected across ten sessions, the exergaming condition resulted in higher levels of physical activity for all four participants (Drew, M=9.1 minutes; Hannah, M=9.2; Ryan, M= 9.6; Marley, M=9) than the PE condition (Drew, M=1.8 minutes; Hannah, M=1.4; Ryan, M=1.7; Marley, M=1.6) (see Figure 1). The exergaming condition resulted in an average of 9.2 minutes of physical activity per session across participants whereas the PE condition resulted in an average of 1.6 minutes of physical activity. Both the exergaming and PE conditions produced stable data patterns; however, the last two PE sessions showed a very slight increasing trend. Unfortunately, the school changed the time of the PE class after session ten and a decision was made to conclude data collection as the schedule change might have influenced the data. Due to student absences, Drew missed one session and Marley missed four sessions and therefore, Drew and Marley were not exposed to the same number of sessions for both conditions as were Hannah and Ryan. However, the patterns in the data are the same across participants regardless of number of sessions.
Figure 1. Minutes of physical activity per session by condition.
Opportunity to engage in physical activity. The exergaming condition resulted in higher levels of OPA for all four participants (Drew, M=12.4 minutes; Hannah, M=12; Ryan, M= 10.6; Marley, M=11.7) than the PE condition (Drew, M=3.1 minutes; Hannah, M=3.4; Ryan, M=3.6; Marley, M=4.4) (see Figure 2). The exergaming condition produced an average of 11.6 minutes of physical activity per session across participants whereas the PE condition produced an average of 3.8 minutes of physical activity. A clear separation between the exergaming and PE conditions is demonstrated for 3 out of 4 participants. The data for Ryan shows overlap between one data point in the PE condition and two data points in the exergaming condition. The data for the exergaming condition shows a decreasing trend for 3 out of 4 participants; however, as indicated previously data collection was stopped due to changes in the PE class schedule.
Percentage of opportunity engaged in physical activity. For the majority of the exergaming sessions across participants, the percentage of opportunity spent engaged in physical activity was greater than 80% (Drew, range was 46% to 90%, M= 79%; Hannah, 52% to 97%, M=80%; Ryan, 61% to 92%, M= 75%; Marley, 56% to 97%, M=79%). In the PE condition, percentage of opportunity spent engaged in physical activity was quite varied across sessions (Drew, range was 13% to 100%, M= 65%; Hannah, 23% to 81%, M=58%; Ryan, 16% to 88%, M= 63%; Marley, 21% to 90%, M=53%). Percentage of opportunity spent engaged in physical activity showed a decreasing trend in the first two PE sessions and an increasing trend in the last two PE sessions (see Table 1).

Data collected on the percentage of opportunity spent engaged in physical activity across exergaming activities showed that DDR and the 3 Kick produced the highest percentages across participants (range, 88% to 100%). The Wii tennis and baseball produced the lowest percentages across three participants (range, 12% to 20%) (Data on the Wii were not collected for Marley due to absences) (see Table 2).

Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Exergaming</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drew</td>
<td>85, 90, 46, 89, 86</td>
<td>63, 13, 100, 82</td>
</tr>
<tr>
<td>Hannah</td>
<td>66, 84, 96, 52, 83, 97</td>
<td>57, 23, 81, 70</td>
</tr>
<tr>
<td>Ryan</td>
<td>66, 83, 85, 61, 61, 92</td>
<td>68, 16, 100, 90</td>
</tr>
<tr>
<td>Marley</td>
<td>56, 85, 97</td>
<td>48, 21, 80</td>
</tr>
</tbody>
</table>

Note: All numbers are percentages
Table 2

Percentage of Opportunity Engaged in Physical Activity by Station

<table>
<thead>
<tr>
<th>Exergaming Activity</th>
<th>Drew</th>
<th>Hannah</th>
<th>Ryan</th>
<th>Marley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxing/Monster</td>
<td>83</td>
<td>83</td>
<td>99</td>
<td>-</td>
</tr>
<tr>
<td>DDR 2</td>
<td>100</td>
<td>100,95</td>
<td>98</td>
<td>93</td>
</tr>
<tr>
<td>3 Kick</td>
<td>97</td>
<td>96,100</td>
<td>88</td>
<td>100</td>
</tr>
<tr>
<td>Dog Fighter</td>
<td>-</td>
<td>90,95</td>
<td>85,89</td>
<td>92</td>
</tr>
<tr>
<td>Batman and Robin</td>
<td>70</td>
<td>68</td>
<td>82,95</td>
<td>-</td>
</tr>
<tr>
<td>DDR 6</td>
<td>95</td>
<td>100</td>
<td>93,96</td>
<td>-</td>
</tr>
<tr>
<td>Wii Tennis &amp; Baseball</td>
<td>12</td>
<td>15</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>XR Board</td>
<td>81</td>
<td>89</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Dirt Biking</td>
<td>47</td>
<td>72</td>
<td>51</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* Monster and Boxing and Wii Tennis and Baseball were separate exergaming activities but made up one station, therefore percentage of opportunity engaged in physical activity was combined for these activities. DDR is listed twice because there were two different types of DDR that made up two separate stations. The percentage of opportunity engaged in physical activity by station began midway through the study thereby data were only collected twice for a few activities for Hannah and Ryan and due to student absences; data were not collected on several stations for Marley and one station for Drew.
Teacher scoring survey. Results of the teacher scoring survey showed that the teacher reported a 30% reduction in time spent dealing with behavior problems, a 30% increase in students following directions, and a 50% increase in time spent having students practice a PE skill/activity per session across conditions (see Table 3).

Table 3

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average percentage of time spent dealing with behavior problems</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>The average percentage of time the class follows directions</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>The average percentage of time spent providing instruction on a PE skill/activity</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>The average percentage of time spent having students practice a PE skill/activity</td>
<td>30</td>
<td>80</td>
</tr>
</tbody>
</table>

*Note.* Due to a life situation experienced by the PE teacher, she was away from school for two weeks so the post survey was administered two weeks following the last session in which data were collected.
Social Validity

Students’ preference ranking survey. The students’ preference ranking surveys indicated that the most preferred exergaming activities were boxing (Drew and Marley), DDR (Hannah), and Wii baseball (Ryan). The preference for DDR and for boxing corresponded with a high percentage of opportunity engaged in physical activity. However, the Wii baseball did not correspond with a high percentage of opportunity engaged in physical activity. The least preferred exergaming activities were forms of gamercize; Batman and Robin (Drew, Ryan, and Marley), which was a stepper and the Monster 4X4 (Hannah), which was a hand bike. The Batman and Robin and the Monster 4X4 exergaming game did not correspond with the lowest percentage of opportunity engaged in physical activity; however, the Batman and Robin did produce lower percentages of opportunity engaged in physical activity across three participants (Drew, Hannah, and Ryan) (see Table 4). Drew and Ryan reported a preference for both PE activities and exergaming activities whereas Hannah and Marley reported a preference for exergaming (see Table 4).
## Table 4

### Students’ Preference Ranking Survey Results

<table>
<thead>
<tr>
<th>Exergaming Activity</th>
<th>Drew</th>
<th>Hannah</th>
<th>Ryan</th>
<th>Marley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxing</td>
<td>1</td>
<td>7</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Monster</td>
<td>8</td>
<td>11</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>DDR 2</td>
<td>6</td>
<td>1</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>3 Kick</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Dog Fighter</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Batman and Robin</td>
<td>11</td>
<td>5</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>DDR 6</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Wii Tennis</td>
<td>9</td>
<td>8</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Will Baseball</td>
<td>7</td>
<td>9</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>XR Board</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Dirt Biking</td>
<td>10</td>
<td>10</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

**Follow-up questions**

**Why did you put (most preferred activity on top)?**
- “Because it gives you arm strength, muscles, and coordination.”
- “You get to move your body more.”
- “Because I play baseball at home. It’s what I do.”
- “It has songs I listen to at home.”

**Why did you put (least preferred activity on bottom)?**
- “I don’t get much exercise. Not interesting.”
- “You just move your arms.”
- “I don’t know what to do.”
- “Difficult. I didn’t know how to play.”

**Would you rather do regular PE activities or exergaming activities during PE class?**
- “I like both.”
- “Exergaming because you get more exercise and it’s more fun.”
- “I like both.”
- “Exergaming because it is fun and it’s what kids are doing today.”

*Note.* DDR is listed twice because there were two types of DDR which had different choices of music. A rank of 1 indicates most preferred and 11 indicates least preferred.
PE teacher social validity survey. Based on the results of the PE teacher social validity survey, the PE teacher reported that she strongly agreed that exergaming was beneficial to the students, provided opportunities for students to work on skill development, and resulted in a reduction in behavior problems during class time (see Table 5).
Table 5

**PE Teacher Social Validity Survey Results**

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE time spent in the exergaming lab was beneficial to the students.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The PE exergaming lab provided opportunities for student to work on skill</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>development.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students followed directions in the PE exergaming lab.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE time spent in the exergaming lab resulted in a reduction in behavior problems.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE time spent in the exergaming lab provided an opportunity for me to assess</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>students’ individual needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE time spent in the exergaming lab resulted in an increase in the amount of</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE time allotted for student to be actively engaged.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE time spent in the exergaming lab increased skill acquisition for students.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE time spent in the exergaming and increased cardiovascular endurance for</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Due to a life situation experienced by the PE teacher, she was away from school for two weeks so the survey was administered two weeks following the last session in which data were collected.
*PE observer survey.* The outcome of the PE observer survey showed slight differences between the conditions. The observer reported a stronger agreement for exergaming with regards to students being on task, student and teacher enjoyment, and time engaged in physical activity. The greatest difference reported was for the statement regarding the teacher providing praise and encouragement for the students, which indicated a strongly agree for the exergaming condition and a neutral for the PE condition (see Table 6).
Table 6

*PE Observer Survey Results*

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>The students were usually on task.</em></td>
<td>P</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The students seemed to enjoy the activity.</em></td>
<td>P</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The students usually followed directions.</em></td>
<td>P</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The teacher spent a lot of time providing instruction.</em></td>
<td>P/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The teacher spent a lot of time dealing with behavior problems.</em></td>
<td>P/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The teacher seemed to enjoy the activity.</em></td>
<td>P</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The students spent the majority of class time engaging in physical activity.</em></td>
<td>P</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The students were usually engaged in moderate intensity activities.</em></td>
<td>P/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The teacher did a good job providing praise and encouragement to the students.</em></td>
<td>P</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* P stands for regular physical education class and E stands for exergaming physical education class.
Discussion

The current study evaluated the effects of exergaming on physical activity among four inactive 5th grade students in a physical education classroom. The results of this study showed the exergaming condition producing substantially more minutes of physical activity among the four participants than did the PE condition. In addition, this study revealed that, in the PE condition, fewer minutes were available for students to engage in physical activity than were available in study by Sallis and colleagues (1997), even though Sallis and colleagues only measured minutes of moderate to vigorous exercise. The PE class was scheduled for thirty minute, twice a week; however, after transition to PE, class management, instructions, waiting for a turn, and school announcements, very little time was left for actual physical activity in the PE environment (an average of 2 minutes were provided for physical activity per session with the exception of one session in which 7 minutes were provided). Based on the data, the PE environment, provided approximately 4-6 minutes of opportunity to engage in physical activity per week and the participants engaged in approximately 2-6 minutes of physical activity per week (see Figure 1 & 2 and Table 1).

In the exergaming condition, opportunity to engage in physical activity was substantially higher than in the PE condition (an average of 12 minutes were provided for physical activity per session). The exergaming environment provided approximately 24 minutes of opportunity to engage in physical activity per week and the participants engaged in approximately 18 minutes of physical activity per week (see Figure 1 & 2).
Based on the data collected in this study, the exergaming condition produced an average of three to four times more minutes of physical activity than the PE condition.

This study is important because data suggest that childhood obesity is on the rise and interventions that get children engaged in physical activity need to be identified. The purpose of this study was to evaluate exergaming as a potential intervention to increase physical activity among inactive children. This study was the first to assess the effects of exergaming on physical activity among school children in a natural environment. The data collected in this study showed that the implementation of exergaming did result in four students receiving more opportunity for physical activity and engaging in more physical activity than in the PE condition. Based on three social validity surveys, the PE teacher, the students, and the non-biased observer found exergaming to be a socially acceptable form of PE. The findings of this study support exergaming as an effective, socially valid intervention for producing more minutes of physical activity among inactive 5th graders.

A benefit of this study was that it was conducted in the natural environment under normal conditions. It is very difficult to determine whether results obtained in a controlled environment would be similar to results obtained in the natural environment, therefore, whenever possible, research should be conducted under normal conditions. Although a necessity, implementing this study in the natural environment proved to be extremely challenging. Several factors contributed to changes made in the original study’s protocol. First, the school had inservices days once a month, the PE teacher had two life situations resulting in her absence from school, and the school occasionally held a school event during the designated PE time. All of these factors resulted in lengthening the intervention data collection from six weeks to eight weeks. Second,
during school-wide testing, which lasted three weeks, the school banned PE class from outdoor activities (PE class is normally conducted outdoors), thereby resulting in a change in the pre-determined schedule of conditions. Lastly, the school changed the PE class’s designated PE time after session 10 and, as a result of this change, the data collection was cut short, thus ending with a minor increasing trend in the PE condition for three of the four participants.

Suggestions for future research in a school system, would be to 1) develop good rapport and communication which the PE teacher and administration so that notification of any modifications would be delivered in a timely manner; 2) get a school calendar of events prior to selecting a PE class (e.g. testing, holidays, inservice days, etc.); 3) before the study, speak with the PE teacher and principal regarding events that may effect the normal routine (e.g. Are there specific rules with regards to PE during test weeks?); 4) choose a time frame for the study that has the least amount of disruption (e.g. avoid time periods that have the most test weeks, inservice days, holidays, school events, etc.); 5) plan for delays by providing at least a month cushion; and 6) after the time frame has been set for the study, meet with the principal and teacher and stress the importance of keeping the same routine for the course of the study.

Another value of this study was the measurement of opportunity to engage in physical activity (OPA). This measurement provided information on how many minutes students were actually given to engage in physical activity per session (OPA) and the percentage of opportunity engaged in physical activity. In the PE condition, with regards to the last two PE sessions, when provided with opportunity to engage in physical activity, students engaged in physical activity on average of 84% of the time. However, the data showed that students were provided with very little time to engage in physical activity.
activity (an average of 2-3 minutes). Whereas, in the exergaming condition, students were provided with an average of 12 minutes of OPA and for the most part, engaged in physical activity on average 80% of the time.

In table 1, the percentage of opportunity engaged in physical activity in the PE condition is higher in the last two sessions. The high percentages of opportunity engaged in physical activity observed in the last two sessions could be a result of three possible variables. 1) When given only 2-3 minutes of opportunity to engage in physical activity, it is quite possible that students choose to engage in physical activity for a short duration over other activities such as waiting in line. However, this would not explain the lower levels in the earlier PE sessions. 2) The effects of exergaming on physical activity could have generalized to the PE environment thereby accounting for the increased trend in opportunity engaged in physical activity. However, this explanation is highly unlikely because of the third possible variable, fitness testing. 3) The last two PE sessions were not administered as usual. Fitness testing was conducted during these last two sessions and the sessions were more structured. In addition, physical activity may have been perceived as required (e.g. testing in which students are given specific instructions and monitored versus stations in which a student chooses an activity). It is the author’s belief that the difference in structure in the last two PE sessions (the testing format) resulted in the increase in percentage of opportunity engaged in physical activity relative to earlier sessions which consisted of stations and games (e.g. jump rope, football, hula hoop, around the world and bowling). The PE condition did not have a standard format, in the first session a game format, bowling, was conducted, in the second condition stations were conducted, and in the last two sessions a testing format was implemented. Physical activity levels across participants were the highest during the station format. In addition,
OPA was the highest in the station format. It is possible, that when given a choice of preferred activities, inactive children are more likely to engage in physical activity. Furthermore, the structure of stations may also provide more OPA. Future research should evaluate different PE formats to identify effective formats for producing more opportunities for physical activity and higher percentages of opportunity engaged in physical activity.

The U.S. Department of Health and Human Services (2005) recommends that children receive 60 minutes of moderate to vigorous physical activity per day. A limitation to this study is the absence of a measurement system to identify the intensity of physical activity engaged in during exergaming and PE classes. Heart rate monitors were considered, but due to the time that would have been subtracted from the PE class by putting on and taking off heart rate monitor, a decision was made to not assess the intensity of physical activity during this study. The use of heart rate monitors in future studies would add great value in determining if exergaming and/or PE conditions provide moderate to vigorous physical activity. Furthermore, the use of additional instruments that measure other potential benefits of physical activity (e.g. BMI, % of body fat, resting heart rate, recovery heart rate, blood pressure, muscular endurance, cardiovascular endurance) should also be incorporated into future studies.

This study showed that with exergaming, the students in this study met 15% of the recommended minutes for physical activity for 2 out of 7 days compared to the PE condition in which students only met 5% of the recommended minutes for physical activity for 2 out of 7 days. It is not feasible for PE class to be the sole opportunity for students to meet the recommended 60 minutes of physical activity per day. Students should have opportunity to engage in physical activity during recess (if provided;
however, some schools no longer provide recess), and before and after school. Of course, with the reported increase in sedentary behavior and rise in childhood obesity, it is unlikely that children are meeting this recommendation outside of PE class. Because children spend the majority of their day at school, it seems that 15% of the recommended physical activity for 2 out of 7 days is still too low. The focus of PE class may need to shift to establishing and maintaining an active lifestyle. This change will need to utilize methods that make engaging in physical activity reinforcing so that children will be more likely to maintain an active lifestyle into their adult years.

In this study, PE class occurred at the end of the day and was often cut short due to announcements made during the last 15 minutes of the class. Furthermore, several days of PE class were missed due to inservice days, holidays, and school events. Future research should evaluate environmental changes that might increase the likelihood of providing more opportunity for physical activity in the PE classroom. These changes might include scheduling PE on days other than inservice days; scheduling PE at an earlier time during inservices days; scheduling on days that are least commonly used for school events; and scheduling PE at times that are least likely to be interrupted such as the end of the day. For these changes to take place, school districts and school administrators would need to see PE as a valuable activity for children’s health and take steps to protect PE time.

Results of the students’ ranking survey showed that students reported that they liked exergaming and found it to be fun. It is possible that percentages of opportunity engaged in physical activity were consistently high in the exergaming condition due to the reinforcing effects of exergaming. Students’ ranking of stations revealed that the most preferred activities did correspond with high percentages of opportunity engaged in
physical activity for 3 out of the 4 participants. However, a limitation of these findings is the fact that data collection for this variable was started in the middle of this study, thus resulting in few assessments per activity and no assessments on several activities for two participants (Drew and Marley). A more thorough assessment of percentages of opportunity engaged in physical activity by station/exergaming activity is needed. In addition, an evaluation of the components that produce high percentages of opportunity engaged in physical activity that are most preferred would be beneficial in identifying the factors that could be added to increase physical activity in the regular PE environment. Furthermore, identifying the exergaming activities that were least preferred and produced the lowest percentages of opportunity engaged in physical activity would be valuable so that these stations could be modified or eliminated.

In the PE teacher social validity survey as well as the PE teacher scoring survey, the PE teacher reported a decrease in behavior problems as a result of exergaming. Data were not collected on problematic behavior, so these reports could not be verified. It is possible that exergaming might serve as an effective intervention for reducing problematic behaviors among children in a school setting. Therefore, it would be advantageous of researchers to evaluate the effects of exergaming on problematic behavior.

A final recommendation for future research is to assess teacher behavior across conditions. Based on antedoctal data, teacher behavior was observed to be different across conditions. For example, research assistants as well as the author noted that the PE teacher appeared to engage in more smiling, positive comments, and specific feedback in the exergaming condition than in the PE condition where positive comments appeared to be given less often. The PE observer also reported a score of a strongly agree for the
teacher providing praise and encouragement in the exergaming condition compared to a neutral score for the PE condition. Perhaps, because exergaming had children either actively engaged in physical activity or watching other children engage in physical activity during the entire class period this provided the opportunity for the teacher to give more specific feedback and praise. It is important to assess teacher behavior for two reasons; 1) to determine how teacher behavior effects physical activity levels in both an exergaming environment as well as the regular PE environment and 2) to identify what teacher behavior needs to occur in order to increase physical activity levels and OPA.

The present study demonstrated that the exergaming condition produced more minutes of physical activity across all four participants than did the PE condition. Furthermore, exergaming was socially acceptable to the PE teacher and students in this study. Based on the data collected during this study, exergaming could be a possible intervention choice for increasing physical activity among inactive 5th graders. Nonetheless, future research is needed to provide a further evaluation of the effects of exergaming on physical activity levels as well as health factors among inactive children.
References


Appendices
**On a scale of 0% to 100%, please score the following statements**

<table>
<thead>
<tr>
<th></th>
<th>0  10  20  30  40  50  60  70  80  90  100</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average percentage of time spent dealing with behavior problems</td>
<td>0  10  20  30  40  50  60  70  80  90  100</td>
</tr>
<tr>
<td>The average percentage of time the class follows directions</td>
<td>0  10  20  30  40  50  60  70  80  90  100</td>
</tr>
<tr>
<td>The average percentage of time spent providing instruction on a PE skill/activity</td>
<td>0  10  20  30  40  50  60  70  80  90  100</td>
</tr>
<tr>
<td>The average percentage of time spent having students practice a PE skill/activity</td>
<td>0  10  20  30  40  50  60  70  80  90  100</td>
</tr>
</tbody>
</table>
## Appendix B: PE Teacher Social Validity Survey

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE time spent in the exergaming lab was beneficial to the students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The PE exergaming lab provided opportunities for students to work on skill development.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Students followed directions in the PE exergaming lab.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PE time spent in the exergaming lab resulted in a reduction in behavior problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PE time spent in the exergaming lab provided an opportunity for me to assess students’ individual needs.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PE time spent in the exergaming lab resulted in an increase in the amount of PE time allotted for students to be actively engaged.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PE time spent in the exergaming lab increased skill acquisition for students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PE time spent in the exergaming lab increased cardiovascular endurance for students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
## Appendix C: PE Observer Survey

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The students were usually on task</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The students seemed to enjoy the activity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The students usually followed directions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The teacher spent a lot of time providing instruction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The teacher spent a lot of time dealing with behavior problems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The teacher seemed to enjoy the activity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The students spent the majority of class time engaging in physical activity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The students were usually engaged in moderate intensity activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The teacher did a good job providing praise and encouragement to the students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix D: Exergaming Schedule Board
SIX EXERGAMING RULES

1. Get into your group and check station board
2. Wait for instruction
3. Stay with group
4. Take turns in group
5. Lights off means rotate (by station signs 1-9)
6. Help: raise hand and wait for Coach XXX