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Effect of Exergaming on Physical Activity of Adults with Intellectual Disabilities

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Effect of Exergaming on Physical Activity of Adults with Intellectual Disabilities

By

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts
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DEDICATION

“Lay aside every encumbrance which so easily entangles us, and let us run with endurance the race that is set before us- fixing our eyes on Jesus, the author and perfecter of faith” (Heb 12:1). The completion of this manuscript was one of the most challenging goals set before me, and is dedicated, first, to God who created me to run this race. Next, I dedicate this to my parents, sisters and friends. I will always be grateful for your endless support and encouragement.
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# TABLE OF CONTENTS

List of Figures ............................................................................................................... iii

Abstract ......................................................................................................................... iv

Introduction ................................................................................................................... 1

Method .......................................................................................................................... 7
  Participants .................................................................................................................. 7
  Setting ......................................................................................................................... 8
  Materials ..................................................................................................................... 8
  Target Behavior ......................................................................................................... 8
  Data Collection ......................................................................................................... 9
  Interobserver Agreement and Treatment Integrity .................................................. 10
  Social Validity .......................................................................................................... 11
  Design ....................................................................................................................... 11
  Procedures ................................................................................................................. 12
    Participant training .................................................................................................. 12
      Traditional training ............................................................................................... 12
      Exergaming training .............................................................................................. 12
    Scheduled phase ..................................................................................................... 13
      Scheduled traditional ............................................................................................ 13
      Scheduled exergaming ........................................................................................... 13
    Choice phase ............................................................................................................ 14

Results .......................................................................................................................... 15
  Physical Activity ...................................................................................................... 15
    Scheduled Phase .................................................................................................... 15
    Choice Phase ......................................................................................................... 16
  Intensity ..................................................................................................................... 16

Discussion .................................................................................................................... 21

References ................................................................................................................... 26

Appendices ................................................................................................................... 31
  Appendix A, Par-Q Questionnaire ............................................................................. 32
  Appendix B, Participant Training Data Sheet ........................................................... 33
  Appendix C, Traditional Condition Data Sheet ....................................................... 34
  Appendix D, Exergame Condition Data Sheet ......................................................... 35
Appendix E, Treatment Integrity.................................................................36
Appendix F, Social Validity........................................................................37
Appendix G, Institutional Review Board Letter........................................38

About the Author..........................................................................................40
LIST OF FIGURES

Figure 1: Percent occurrence of physical activity for 4 participants…………………………17

Figure 2: Percent occurrence of physical activity for each level of intensity for 4 participants…………………………………………………………………………………………..19
ABSTRACT

Physical inactivity is the fourth leading risk factor related to death (World Health Organization, 2016a). Thus, the World Health Organization (2016a) suggests engaging in at least 150 min of physical activity (PA) throughout the week. Many individuals with intellectual disabilities (ID) engage in sedentary lifestyles that raise concern about their long-term health.

The purpose of this study was to evaluate the effects of exergaming on PA and intensity when implemented with adults with ID. Four adult males diagnosed with ID were recruited. During the scheduled phase, percent occurrence of PA was variable across both conditions for each participant. During the choice phase, all participants chose the exergaming condition. All ratings of intensity were attainable across both conditions for all participants. Results varied across participants. Participants reported high acceptability for exergaming.
CHAPTER ONE:
INTRODUCTION

One out of five adults in the United States do not engage in any leisure activity involving physical movement (Center for Disease Control, 2015). Researchers have found that adults between 20 and 49 years of age mostly engage in physical activity (PA) as part of their daily commute but report 60 to 65% of their day inactive (Dixon-Ibarra, Lee, and Dugala 2013). Physical inactivity poses health risks such as frailty, which is weakness in movement, strength and balance abilities (Jing et al. 2015). In addition, there is a higher risk of being diagnosed with noncommunicable diseases (e.g., cardiovascular disease, diabetes and cancer) (World Health Organization, 2016a). Physical inactivity is the fourth leading risk factor related to death and is responsible for 3.2 million deaths worldwide (World Health Organization, 2016a; World Health Organization, 2016b). Because sedentary behavior poses health risks, there is growing concern about the infrequent, low levels of PA individuals with intellectual disabilities (ID) engage in throughout their day (Barnes, Howie, McDermott, & Mann, 2013). The sedentary lifestyles adopted by many individuals with ID raises concern about their long-term health (Emerson, 2005).

To combat sedentary behavior, the World Health Organization (2016a) suggests engaging in at least 150 min of PA throughout the week. PA is important because it can decrease health risks for adults with ID (Jing et al., 2015). An hour of PA a day can decrease the risk of frailty onset and the risk of knee osteoarthritis (Jing et al., 2015). Some long-term effects of PA include
low likelihood of developing coronary heart disease, Type II diabetes, Alzheimers, and dementia (Reiner, Niermann, Jekauc & Woll, 2013). PA does not necessarily refer to exercise activities, but rather any bodily movement that requires energy expenditure (World Health Organization, 2016c). The magnitude of energy expenditure involved in various activities can be grouped as moderate-intensity and vigorous-intensity physical activity (MVPA) (World Health Organization, 2016c). An activity that stimulates moderate intensity is identified by a noticeable increase in heart rate as opposed to vigorous-intensity which is displayed by rapid breathing and a considerable increase in heart rate (World Health Organization, 2016d).

Research has evaluated the effectiveness of implementing programs to increase PA of individuals with ID (Krentz, Miltenberger, & Valbuena, 2016; Matthews et al., 2016; McDermott et al., 2012; Melville, Mitchell, Stalker, Matthews, and McConnachie, 2015; Schijndel-Speet, Evenhuis, Wijck, Montfort, & Echteld, 2016; Taylor, Baranowski, and Young, 1998). Unfortunately, these programs have not demonstrated significant change. Another challenging issue in this field of research is that there is an observed high level of participant attrition (Melville et al., 2015; Schijndel-Speet, et al., 2016). Ultimately, the literature concludes inconsistent findings and very little research demonstrates successful interventions to increase PA for adults with ID (Spanos, Melville, & Hankey, 2013; Taylor, Baranowski, and Young, 1998).

Given the increase in the use of technology for improving fitness, another approach to promote PA for adults with ID is exergaming (Taylor, Taylor, Gamboa, Vlaev, & Darzi, 2016). Exergaming incorporates the use of technology gaming systems with motion sensors where users play by engaging in PA. Research has found that levels of PA for individuals with and without a diagnosis of diabetes were higher when participating in an exergame than when engaged in a
sedentary activity (Okorodudu, Bosworth, & Corsino, 2015; Scanlan et al., 2013). The required movements of some exergames fundamentally stimulate substantial levels of MVPA (Douris, McDonald, Vespi, Kelley, & Herman, 2012; Garn, Baker, Beasley, & Solmon, 2012; Howe, Barr, Winner, Kimble & White, 2015; Sween et al., 2014). In addition to increasing levels of PA, exergaming has other benefits for adults. One benefit is that some exergames provide the opportunity to participate in mental challenges which, in effect, enhances cognitive functioning (Barcelos, et al. 2015; Lange et al., 2010; O’Leary, Pontifex, Scudder, Brown, & Hillman, 2011). Other games require balancing skills and are capable of improving balance and decreasing the risk of falls (Fu, Gao, Tung, Tsaing, & Kwan, 2015; Franco, Jacobs, Inzerillo, & Kluzik, 2012; Harris, Rantalainen, Muthalib, Johnson, & Teo, 2015; Pietrzak, Cotea, & Pullman, 2014; Smith, Lord, & Delbaere, 2012). In addition, exergaming is an easily accessible activity (Kerrigan, Chen, Wiederhold, Gamberini, & Wiederhold, 2009; Konstantindis et al., 2016; Plow & Finlayson, 2014). Exergame consoles can be bought and installed within homes or school settings. Further, exergaming provides more opportunities for social interaction (Keogh, Power, Lucas, Woller, & Whatman, 2014; Strand, Francis, Margrett, Franke, & Peterson, 2014). When placed in a residential-aged care center, elderly-adults reported that exergames promoted interactions with peers and staff (Keogh et al., 2014). Moreover, adults rate this activity to be very enjoyable overall (Graves et al., 2010; Griffin, Shawis, Impson, Shanks, & Taylor, 2013; Hochsmann, Schupbach, & Schmidt-Trucksass, 2015; Taylor, et al., 2016). Participants of studies evaluating exergaming reported that they were more likely to participate in exergaming in the future as opposed to traditional sports activities (Garn, Baker, Beasley & Solmon, 2012). Thus, exergaming appears to possibly be a socially valid intervention to increase PA.
Research has compared exergaming and traditional exercise (Douris, et al., 2012; Fogel, Miltenberger & Koehler, 2010; Fu, et al., 2015; Shayne, Fogel, Miltenberger, Koehler, 2012). Fu, et al. (2015) compared traditional balance training with an exergaming balance game for patients who underwent a stroke or were diagnosed with multiple sclerosis. They found that exergaming actually had a significant impact on increasing balancing skills and decreasing the risk of falls. Conversely, Douris et al. (2012) conducted an experiment with sedentary college students. The maximum heart rate when engaging in 30 min of exergaming is compared with the maximum heart rate during 20 min of brisk walking. Results showed that heart rate reached a higher or equal maximum during exergaming than brisk walking for all participants.

Fogel et al. (2010) conducted an experiment with inactive children to evaluate the effects of exergaming and regular physical education (PE) classes on PA for elementary aged students. The duration that the participant is engaged in PA and the duration time the participant had the opportunity to engage in PA were recorded. In the regular PE class condition, students were given instructions on skills or activities they would participate in for the class period. In the exergaming condition, stations were set up with a variety of exergames and the students were scheduled to rotate every 10 min. Some exergame equipment included gaming consoles, stair-stepper machines with virtual reality screens, balance board simulators and stationary cycling equipment with virtual reality screens that have game objectives. Results showed that the duration of PA is at higher levels during the exergaming condition than in the traditional exercise condition. The teacher who implemented the exergaming intervention also reported feedback in favor of exergaming. Shayne et al. (2012) replicated this study with active children who were exposed to exergames prior to the study. Their results were consistent with Fogel et al. (2010) suggesting levels of PA were higher in the exergaming condition than in the regular PE
condition. In addition, the novelty of exergaming did not appear to affect levels of PA. Exergaming appears to be a promising intervention to implement with children who are both active and inactive regardless of previous exposure. While exergaming has valuable effects for increasing PA with children, research comparing exergaming and traditional exercise has yet to be conducted focusing on the population of adults with ID. Further, a limitation presented in both studies is that there are no data that capture the intensity of PA (Fogel et al., 2010; Shayne et al., 2012).

There are different methods to capture intensity which include questionnaires, technology, and direct observation systems (Ainsworth, Cahalin, Buman, & Ross, 2015; Ferguson, Rowlands, Olds, & Maher, 2015; Graser, Pangrazi, & Vincent, 2009; Larson, Normand, & Hustyi, 2011; McIver, Brown, Pfeiffer, Dowda & Pate, 2009; Surapiboonchai, Furney, Reardon, Eldridge, & Murray, 2012). While there are advantages and disadvantages to each method, The Observational System for Recording Physical Activity in Children- Home (OSRAC-H) has been validated as a reliable measurement system because of the correlation between the OSRAC scores with MVPA and heartrate (Larson, et al. 2011; McIver, et al., 2009). This data collection method is beneficial because data collectors can record information regarding intensity and the context in which the PA is observed.

Considering the benefits of PA and exergaming specifically, exergaming could be a beneficial approach to increasing levels of PA for adults with ID. The purpose of this study was to evaluate the effects of exergaming when implemented in a group home residential setting with adults with ID. PA during exergaming and traditional exercise was examined. This study aimed to answer two research questions:
1. To what degree do exergaming activities affect levels of PA compared to traditional exercise activities?

2. To what degree of intensity does an individual engage in during exergaming compared to traditional exercise activities?
CHAPTER TWO:

METHODS

Participants

Four adult males diagnosed with mild to moderate intellectual disability were recruited to participate in this study. Their participation was completely voluntary and participants were offered a $25 gift card to receive at the end of the study as compensation for their participation. All participants lived in a local group home that provided residential habilitation services to male adults with ID and who engaged in challenging behaviors.

Brian was a 27-year-old male with an intelligence quotient (IQ) of 71. He weighed 165 lbs and was 5.75 ft tall. Han was a 21-year-old male with an IQ of 65. He weighed 425 lbs and was 6.1 ft tall. Tej was a 20-year-old male with an IQ of 44. He weighed 155 lbs and was 5.5 ft tall. Roman was a 51-year-old male with an IQ of 61. He weighed 200 lbs and was 6.1 ft tall.

As a health precaution, each participant completed the Physical Activity Readiness Questionnaire (PAR-Q) (Thomas, Reading, & Shepard, 1992) (Appendix A). Participants who answered “no” to all questions were eligible to participate in the study. Participants who answered “yes” to one or more questions were instructed to obtain written documentation from their medical doctor approving his participation in the study. All participants answered “no” to all the questions.
Setting

The study was conducted at the participants’ group home. Exergaming training and sessions were conducted in the living room area inside the residents’ home. The living room area measured about 4 m by 4 m. Traditional exercise training and sessions took place outdoors on the residential site behind the group home where there was a basketball court that measured 20 m by 15 m.

Materials

For the traditional exercise condition, items were placed next to the basketball court. These items included a football, 4 cones, an SKLZ® solo football-trainer, a soccer ball, street hockey/ soccer net, 2 hockey sticks, a street hockey ball, basketball hoop and a basketball. For the exergaming condition, an Xbox Kinect gaming system (including the remote and necessary cable cords) and a television with an HDMI output were placed inside the participants’ home and connected to the television in the living room. Games that were available for use on the gaming system included football, soccer, bowling, boxing, track/ field beach volleyball, and table tennis.

During all sessions, a smartphone with a circuit timer application, data collection sheet, and writing utensil were used for data collection. To set the circuit timer, the “Seconds” application was opened. The circuit timer was selected. The number of sets was set to 61, exercises were set for 25 s, 5 s rest between intervals, and a one vibration alert was selected. A Nexus tablet was also used for video-recording sessions.

Target behavior

Physical Activity (PA) was defined by levels of intensity. Intensity was measured during a 5 s time-sample with 25 s in between each interval during a 30 min session. Each level of intensity was defined by the 5-point Likert-type scale on the OSRAC-P. A score of 1 indicated
sedentary behavior (no PA was taking place). A score of 2 indicated that the participant was stationary, but was engaging in PA (e.g. slight movement of limbs, holding a heaving object, twisting torso). A score of 3 indicated slow and easy movement (e.g. walking 3 continuous steps, marching in place, an instance of jumping, throwing, and kicking, etc.). A score of 4 indicated moderate movement (e.g. brisk walking, two repetitions of jumping, kicking, throwing, and punching, etc.). A score of 5 indicated fast movement (e.g. running, three repetitions of jumping, kicking, throwing, and punching, etc.). Although designed for children in the home setting, this scale for intensity was appropriate for the participants because the definitions for each level of intensity corresponded with the responses that the participants had the opportunity to engage across both conditions. Similar to the OSRAC-P, context categories were used to include information on the activity in which the participant was engaged. So that the contexts were directly relevant to the activities across both conditions, the context categories typically featured were modified to identify the activities available (Appendix B). These data were not measured as dependent variables, but they provided information related to the dependent variable.

**Data Collection**

During participant training, the data collector collected data on prompted and independent demonstrations of PA with relevant stimuli (Appendix B). During baseline and intervention, the data collector pressed start on a stopwatch after he or she delivered a prompt to begin the activity. Time sample data were collected to capture intensity. Every 25 s, the data collector observed the participant for 5 s. Then, the data collector rated the highest level of activity observed during the 5 s to capture intensity. Data were collected on a data sheet that contained space to write the participants’ initials, identify the activity, and record the intensity of
PA (Appendix C). At the top of the data sheet, brief definitions of each level of intensity were also included. Some sessions were scored through video recording.

**Interobserver Agreement and Treatment Integrity**

The researcher recruited research assistants. The researcher and research assistants were responsible for data collection. The researcher trained assistants in a meeting room. The researcher explained how to collect interval data and how to score intervals using the OSRAC-P. Then, research assistants watched 3 30-min videos of actual sessions. During the first 10 min, the researcher told the research assistant the score and a rationale for each interval. The research assistant scored the remainder of the video and feedback was given for correct and incorrect responses. More videos of sessions were given to the research assistant to score. After 3 consecutive scores of 80% agreement on intensity and 90% on PA, the research assistant was considered trained to collect IOA.

The researcher and research assistants calculated inter-observer agreement (IOA) and treatment integrity data for 35% of scheduled exergaming sessions, 36% of scheduled baseline sessions, 33% of choice exergaming sessions and 33% of choice baseline sessions. IOA for PA were calculated by percent agreement for each interval (agreement divided by total number of intervals multiplied by 100; e.g., $59/60 \times 100 = 98\%$). IOA for intensity were calculated by percent agreement for each interval (agreement divided by total number of intervals multiplied by 100; e.g., $55/60 \times 100 = 92\%$). During the scheduled exergaming sessions, the mean agreement was 97% and 91% for PA and intensity respectively (range 90% to 100% for percent agreement for PA; range 85% to 100% for percent agreement for intensity). During the scheduled traditional sessions, the mean agreement was 95.2% and 89.2% for PA and intensity respectively (range 81.7% to 100% for percent agreement for PA; range 80% to 100% for percent agreement for
intensity). During the choice exergaming sessions, the mean agreement was 97% and 92% for PA and intensity respectively (range 95% to 98.3% for percent agreement for PA; range 90% to 95% for percent agreement for intensity).

The researcher measured treatment integrity using a competency-based checklist (Appendix C). The researcher calculated the number of correct steps, divided that number by the number of steps total, and multiplied by 100 (e.g., 6/7x100=86%). The researcher collected data on treatment integrity for 32% of sessions of the scheduled traditional phase, 30% of sessions of the scheduled exergaming phase, and 33% of sessions of the choice exergame phase. The mean percentage of steps correctly implemented were 100%, 98% and 100% for the scheduled exergame, scheduled traditional and choice exergaming phases respectively.

### Social Validity

The researcher administered a questionnaire to the participants upon the completion of data collection for three sessions in the second phase (Appendix D). The questionnaire involved a 5-point Likert-type scale from strongly disagree (1) to strongly agree (5). Participants were asked to rate how enjoyable the exergaming and traditional exercise activities were and their view on their level of PA. All participants reported a score of 5 that stated they enjoyed exergaming more than traditional exercise, would like to continue exergaming after the study, and would like to suggest exergaming as part of their weekly activities. Further, all participants reported a score of 5 that they felt more physically active because of engaging in exergaming. Their responses show high acceptability for exergaming.

### Design

This study was conducted using a multielement design with two phases (Kazdin, 2011). In the first phase the researcher scheduled which condition would be implemented for the
session. The choice phase was implemented when stability in the separation of data paths was demonstrated, or if there was stability in undifferentiated data paths. In the choice phase, the participant decided which condition would be implemented. In the traditional condition, traditional exercise activities were available. In the exergame condition, exergaming activities were available.

**Procedures**

**Participant training**

Participants received training from the researcher or research assistants to ensure participants could perform the pre-requisite skills required in the traditional exercise condition and exergaming tradition. Training was conducted before the first session across both conditions.

**Traditional activities training.** At the basketball court, the researcher demonstrated how to exercise using the materials provided. The researcher and participant spent 2 min at each activity together. During that time, the participant was asked to show the researcher how to exercise with the materials provided for that activity with the researcher. After 2 min, the researcher instructed the participant to engage in that activity for 1 min independently. If the participant engaged in a response that met the operational definition of PA with that item, then the activity related to the item was considered trained (e.g., bounces the basketball, shoots the basketball, kicks soccer ball, etc.). If the participant did not engage in a response that met the definition of exercise within 10 s, the researcher modeled the use of the item for the participant to imitate. The activity was presented again to the participant until the participant independently engaged in a response that met the operational definition of PA with two of the activities.

**Exergaming training.** The researcher or research assistant set up an exergame console and one of the exergames (i.e. bowling, soccer, track and field, boxing, beach volleyball or table
tennis) in the living room. The researcher and participant spent 5 min playing one activity featured in the exergame. During that time, the researcher modeled the use of the activity and prompted the participant how to use the activity. After 5 minutes, the participant was instructed to play the game independently for 1 minute. If the participant engaged in a response that met the operational definition of PA with respect to that game, then the activity related to the game was considered trained (e.g., runs in place, moves arm in throwing motion, moves leg in a kicking motion, etc.). If the participant did not engage in a response that met the definition of exercise within 10 s of the start of the game, the researcher modeled physical motions that met the definition of exercise with respect to the game. The game was prepared and presented again to the participant until the participant independently engaged in a response that met the operational definition of PA for two of the games.

Scheduled phase

In the scheduled phase, the researcher chose which condition would be implemented each session.

Scheduled traditional. Traditional exercise materials were made available. The researcher prompted the participant using the following script: “Today you will have 30 min to play with hockey equipment, a football, a soccer ball, and/or basketball. I will sit nearby to observe, but I will not be available to join your activity. The session will end after 30 min has passed. Enjoy!” Participants had 30 min to engage in PA. The session ended when 30 min had passed.

Scheduled exergame. The exergame console was connected to the television with the game disc already prepared in the living room. Games that were available for use on the Xbox included soccer, track/field, boxing, beach volleyball, bowling and table tennis. The researcher
prompted the participant using the following script: “Today you will have 30 min to play with this exergame equipment. Games that will be available for use on the gaming system include bowling, soccer, track/field, boxing, beach volleyball and table tennis. I will sit nearby to observe, but I will not be available to join your activity. The session will end when 30 min has passed. Enjoy!” Participants had 30 min to engage in PA. The session ended after 30 min.

Choice phase

In the second phase, the participant chose which condition would be implemented each session. The researcher told the participant that he would have the choice to have a half-hour to play with the exergaming console or outside with traditional activities. Once the participant made a choice, the chosen condition was set up by the research assistant similar to the first phase. The research assistant would prompt the participant using the following script: “Today you will have a half-hour to play with this activity you have chosen. I will sit nearby to observe, but I will not be available to join your activity. The session will end when 30 min has passed. Enjoy!” Participants had 30 min to engage in PA. The session ended after 30 min.
CHAPTER THREE:
RESULTS

Physical Activity

Scheduled Phase

During the scheduled phase, percent occurrence of PA was variable across both conditions for each participant. Figure 1 depicts the percent occurrence of PA for each of the three participants.

For Brian, sessions 3 through 8 show a separation in the data paths during the scheduled phase. While there is an increasing trend across both conditions, the percentage of PA appears to be higher in the exergaming condition than the traditional exercise condition. Han’s data show levels of PA were higher in the scheduled exergame condition than in the scheduled traditional condition for the first 7 sessions. Onward from session 8, percentage of PA was higher in the traditional condition than in the exergame condition. Data were not continued to be collected because the participant withdrew from the study. For Roman’s first 2 sessions, percentage of PA were both 100%. The rest of the data show a clear separation in data paths. Percentage of PA was slightly higher in the traditional condition than in the exergame condition. For Tej, the level of percent occurrence of PA was higher in the exergame condition compared to the traditional condition.
**Choice Phase**

During the choice phase, all participants chose the exergaming condition. There was an increasing trend seen in Brian and Roman’s data. Brian’s data show a steep increasing trend while Roman’s data show a slight increasing trend. Tej’s data show a decreasing trend in PA.

**Intensity**

Figure 2 illustrates the percent occurrence of intensity during all conditions. Based on the OSRAC-P scale, all ratings of intensity were attainable across both conditions for all participants. Results varied across participants. Brian and Han both had the highest levels of intensity at rating 1 during the traditional condition while Roman and Tej had highest levels of intensity at rating 1 during the choice exergaming condition. Without considering rating 1, the highest percent occurrence of intensity occurred at rating 2 during the choice-exergame condition for Brian and Tej; rating 2 during the scheduled exergame condition for Han; and rating 5 during traditional condition for Roman. Brian’s intensity ratings of 2, 3, and 5 were higher in the scheduled and choice exergaming condition than the traditional condition. For Han, intensity was higher in ratings 2 and 4 during the scheduled exergaming conditions. Intensity was higher in rating 5 and slightly lower in rating 3 during the exergame condition. Roman’s data show intensity was higher in ratings 1-3 and lower in ratings 4 and 5 during the scheduled and choice exergaming conditions.

On average, at intensity level 3 and above, Brian and Tej had higher levels of physical activity during the exergaming condition in the scheduled phase while Han and Roman had higher levels of physical activity at these levels during the traditional condition in the scheduled phase. For Brian, an average of 37.5%, 38.3%, and 33.4% of intervals were spent engaged in an intensity level of 3 or above during scheduled traditional, scheduled exergaming, and choice
exergaming conditions respectively. Tej’s data show an average of 32.8%, 46.2%, and 28.4% of intervals were spent engaged in an intensity level of 3 or above during scheduled traditional, scheduled exergaming, and choice exergaming conditions respectively. On the other hand, Han’s data show an average of 29.4% and 28.6% of intervals were spent engaged in an intensity level of 3 or above during scheduled traditional and scheduled exergaming conditions respectively. Roman’s data show an average of 94.3%, 37.6%, and 33.4% of intervals were spent engaged in an intensity level of 3 or above during scheduled traditional, scheduled exergaming, and choice exergaming conditions respectively.
Figure 1 continued

**Physical Activity- Tej**

*Exergame*  
*Scheduled*  
*Traditional*

**Physical Activity- Roman**

*Exergame*  
*Scheduled*  
*Traditional*

**Figure 1.** Percent occurrence of PA for 4 participants.
Figure 2. Percent occurrence of PA for each level of intensity for 4 participants.
CHAPTER FOUR:

DISCUSSION

This study aimed to evaluate the effects of exergaming on PA and intensity measures of exergames compared to traditional exercise activities for adults with intellectual disabilities. While the data for PA show undifferentiated levels, if given the choice, we found that participants were more likely to choose exergaming as an activity compared to traditional activities. All ratings of intensity were attainable across both conditions indicating that exergaming can reach high levels of intensity. These results are consistent with research that claims exergaming can stimulate substantial levels of MVPA (Douris, McDonald, Vespi, Kelley, & Herman, 2012; Garn, Baker, Beasley, & Solmon, 2012; Howe, Barr, Winner, Kimble & White, 2015; Sween et al., 2014). Choice led to a variety of effects on PA across participants. Results overall were not consistent although the literature supports choice increases on-task behavior (Dunlap et al., 1994; Parsons, Reid, Reynolds, & Bumgarner, 1990).

Brian’s data show an increasing trend for PA across all conditions of the study in both phases over time. There was a lapse in meeting times between session 8 and 9 which may contribute to the increasing trend in the second phase. It is possible that the percentage of PA from session 9 was lower than previous sessions because the percentage of responding had reset to what it was in the first phase.

While Han’s data show higher levels of PA in the exergaming condition during the first 7 sessions, Han spent more time playing basketball instead of sitting during sessions 9 and 10. Because he withdrew from the study, social validity information was not collected in regards to his preference for which condition he may have preferred. Also, he was unable to participate in
the choice phase which could have also given this information. When Han withdrew from the study, he expressed that he did not want to engage in the activities alone. He said he would only like to continue if he could have a peer participate with him, but this request was not possible for this study due to the design of the procedures and confound that peer engagement might pose.

Tej consistently engaged in high levels of PA the exergaming condition during the scheduled phase. His data show that on the days where he had the highest levels of physical activity (Session 8 and 15), he played boxing and track/field exergames. These games also showed to evoke higher intensity of physical activity as well. He engaged in repetitions of punching, jumping, running in place, and throwing during these sessions.

Roman engaged in high levels of PA across both conditions overall. He had the highest percent of PA out of the four participants. During the scheduled phase, he had higher levels of PA in the traditional condition than in the exergame condition. During the exergame condition, Roman enjoyed playing bowling. During bowling, there is an uncontrollable opportunity for the player to rest while the ball is rolling towards the pins, or the pins are being reset similar to regular bowling. At that time, Roman would stand and wait which would result in an intensity score of 1. This poses a limitation to the study because there was an uncontrolled decrease in the motivating operation to engage in PA during certain parts of the 30 min session. Future research should look into what PA levels would look like if the timer was paused during these situations.

During the choice phase, Brian’s data show an increasing trend although there was a decrease in level during the first data point in the second phase. Tej engaged in less PA during exergaming activities over time. It might be possible that when given the choice, participants are less likely to participate at the same levels of PA as opposed to when they are given a scheduled activity. During this time, however, it is relevant to note that Tej had begun actively seeking
medical treatment for psychiatric reasons which may have impacted his performance during his sessions. When given the choice, Roman was less likely to engage in higher levels of PA compared to levels during the scheduled traditional condition; however, it is clear that he would prefer the exergaming condition because he consistently chose that condition when given the choice. Choice in this study revealed social acceptability as opposed to an impact on engagement.

This study adds to the literature that examines levels of PA during exergaming activities. Although it was observed for the participants in this study that they engaged in similar levels of PA across both conditions, when given the choice, participants would choose the exergaming activity as opposed to the traditional activities. It is not clear if there were particular factors related to why exergaming was preferred such as novelty, different games, or that it could be completed indoors. Future studies may want to evaluate some of the reasons why exergaming may be more preferred than traditional exercise. This study also provided information on the levels of intensity during traditional activities and exergame activities which had not yet been examined in studies that compared exergaming and traditional activities (Fogel et al., 2010; Shayne et al., 2012). This study found that exergaming evokes almost equal if not higher amounts of physical activity at the intensity rating level of 3 and above compared to traditional activities. Only one participant had an incomparably high percentage of physical activity at the rating of 3 and above for the scheduled traditional condition. Lastly, we found that it was possible to use the Likert-type scale defined in the OSRAC-P to capture levels of intensity for adults.

Some strengths of the study were cost-effectiveness, easy scheduling with participants, access to a suitable setting, and social validity. The cost of exergaming materials were actually
slightly less expensive than the combined total for the traditional equipment. The exergaming materials were bought at a local videogame store for a discounted price because it was a previously-owned, older model. Participants had ample leisure time scheduled during the week for the researcher to schedule when meetings would occur. Further, because the study was conducted at a group home which had a communal basketball court, the location was kept consistent and always available. The exergaming session was cost-effective and simple to implement which could be a beneficial means for group homes to encourage adults with intellectual disabilities to engage in more PA regularly. Also, social validity scores showed high acceptability among participants.

There are several limitations to be discussed. Similar to other PA research, one limitation was retention of participants (Melville et al., 2015; Schijndel-Speet, et al., 2016). When Han dropped out of the study, he reported that engaging in PA without the company of another person was boring. Future research could examine the possibility of grouping participants into dyads which might help with participant retention and increasing PA. Tej was also unable to complete the study due to being discharged from his group home and being involuntarily admitted to a psychiatric hospital.

Another limitation was the free access participants had to attention received from staff during the study. During traditional and exergaming sessions, sometimes staff or peers would comment on the ongoing session or make a comment towards one of the participants. Future research should attempt to conduct this study at a recreation center or during a life-skills development day program where there is more control over the setting and less opportunities for leisure activities. Due to these specific variables, we are uncertain as to if or how much attention may have functioned as reinforcement for PA.
Lastly, this study has the potential to influence future research. Exergaming showed high acceptability for participants, but not always high levels of intensity. Exergames like boxing and soccer evoked higher intensity levels during sessions. Future research should look into a variety of exergaming activities to see how the design of the game might be able to increase levels of intensity during the exergame. Future research could also evaluate if token reinforcement for exergaming could also increase levels of PA (Krentz, Miltenberger, & Valbuena, 2016). In addition, studies could evaluate how attention might function as a reinforcer for PA. A functional analysis or reinforcer assessment to compare which conditions might evoke more PA could be conducted. In the same regard, future research could examine if grouping participants into dyads may not only help with participant retention, but also increase PA during sessions.
REFERENCES


Appendix A: Par-Q Questionnaire

A PAR-Q should be completed by all nonmilitary participants (civilians, beneficiaries, retirees, and auxiliaries). It is highly encouraged for all military participants.

**READINESS ASSESSMENT**

1. Has your doctor said you have heart trouble?
   - [ ] Yes
   - [ ] No
   - [ ] I do not know or I do not remember

2. Do you frequently suffer from pain in your chest?
   - [ ] Yes
   - [ ] No
   - [ ] I do not know or I do not remember

3. Do you often feel faint or have spells of dizziness?
   - [ ] Yes
   - [ ] No
   - [ ] I do not know or I do not remember

4. Has a doctor ever said your blood pressure was too high?
   - [ ] Yes
   - [ ] No
   - [ ] I do not know or I do not remember

5. Has a doctor ever told you that you have a bone or joint problem, such as arthritis, that has been aggravated by exercise or might be made worse with exercise?
   - [ ] Yes
   - [ ] No
   - [ ] I do not know or I do not remember

6. Is there a good physical reason not mentioned here why you should not follow an activity program even if you wanted to?
   - [ ] Yes
   - [ ] No
   - [ ] I do not know or I do not remember

7. Are you over age 65 and not accustomed to vigorous exercise?
   - [ ] Yes
   - [ ] No
   - [ ] I do not know or I do not remember

If a participant answers yes to any question, vigorous exercise, or exercise testing should be postponed until medical clearance is obtained. "I do not know" answers should be researched further to determine testing suitability.

I have read, understood, and completed this questionnaire. Any questions I had were answered to my full satisfaction.

Name: ____________________________ Date: ____________________________

Signature: ____________________________ Witness: ____________________________


**PRIVACY ACT STATEMENT**

Authority: 5, 10, and 14 United States Code and Executive order

Principle Purpose: To complete a Physical Activity Readiness Questionnaire (PAR-Q) prior to beginning an exercise program or test.

Routine Uses: Used to determine health & fitness readiness according to military standards. Information will be released to authorized personnel involved in health assessment.

Disclosure: Voluntary; however, failure to furnish the requested information will impede on determining the health and fitness process.

U.S. DEPT. OF HOMELAND SECURITY, USCG, CG-6200 (Rev. 04-07)
Appendix B: Participant Training Data Sheet

Instructions: mark – for prompted, and + for independent

Participant Initials:

Baseline

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Appendix C: Traditional Condition Data Sheet

Participant initials: ___________________________ Date: ____________
Condition: Traditional ________________________ Data Collector: ______________________________

**ACTIVITY CODES:**

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<thead>
<tr>
<th>bball</th>
<th>Soccer</th>
<th>Hock</th>
<th>Football</th>
<th>Other</th>
<th>?</th>
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</tr>
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**PHYSICAL ACTIVITY LEVEL INTENSITY CODE:**

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<th>?</th>
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<td>Stationary w/</td>
<td>Slow/ easy</td>
<td>Moderate</td>
<td>Fast</td>
<td>Cannot</td>
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<tr>
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<td>movement</td>
<td>movement</td>
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<td></td>
<td>limbs or trunk</td>
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Notes on weather, temperature outside: ________
Appendix D: Exergame Condition Data Sheet

Participant initials:  
Condition: Exergame  
Date:  
Data Collector:  

ACTIVITY CODES:

<table>
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<th>Socc</th>
<th>Box</th>
<th>track</th>
<th>bowl</th>
<th>voll</th>
<th>tenn</th>
<th>O-</th>
<th>?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer</td>
<td>boxing</td>
<td>Track and field</td>
<td>bowling</td>
<td>Beach volleyball</td>
<td>Table tennis</td>
<td>Other</td>
<td>Cannot determine</td>
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PHYSICAL ACTIVITY LEVEL INTENSITY CODE:

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<td>Moderate movement</td>
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DATA COLLECTION:

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Notes on weather, temperature outside: _______
Appendix E: Treatment Integrity

Participant training

1. The participant and instructor are at the appropriate setting
2. Required materials are present (game console and game or punching bag, football, basketball, and soccer ball)
3. The instructor engages the participant at an activity for a minimum of 2 min and a maximum of 5 min.
4. The instructor asks the participant how to exercise using that item for 1 minute
5. The instructor provides praise for correct responses and a model prompt at the end of the minute for incorrect responses

Baseline and Intervention

1. The participant and instructor are at the appropriate setting
2. Required materials are prepared (game console and game or punching bag, football, basketball, and soccer ball)
3. The instructor prompts the participant with the appropriate script
4. The instructor is sitting at an appropriate location
5. The instructor remains neutral and does not provide attention for physical activity
6. The instructor responds to any requests from the participant using the prompt provided on the script (e.g. The session will end after 30 min has passed)
7. The instructor ends the session after 30 min has passed
Appendix F: Social Validity

1. I enjoy participating in exergaming activities scheduled on the activity calendar
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*

2. I would engage in more physical activity if I had free access to an exergaming console
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*

3. I would like to suggest exergaming to be scheduled on the activity calendar in the future
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*

4. I enjoy exergaming more than traditional exercise
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*

5. I would rather suggest exergaming to be scheduled on the activity calendar as opposed to physical activity in the future
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*

6. I would like to continue exergaming after this study
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*

7. I feel like I am more physically active because of engaging in exergames
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*

8. Exergaming has increased positive social interactions with my peers and/or staff
   1 2 3 4 5
   *Strongly Disagree Disagree Neutral Agree Strongly Agree*
Appendix G: Institutional Review Board Approval Letter

5/11/2017

Jennifer Dawn Vergara
Psychology
10811 N McKinley dr #14310
Tampa, FL  33612

RE:  Expedited Approval for Initial Review
IRB#:  Pro00029114
Title:  Effect of Exergaming on Physical Activity of Adults with Intellectual Disabilities

Study Approval Period: 5/9/2017 to 5/9/2018

Dear Ms. Vergara:

On 5/9/2017, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
IRB Protocol #1 05-03-17.docx

Consent/Assent Document(s)*:
consent form 4-8-17 clean.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:
(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson
USF Institutional Review Board
ABOUT THE AUTHOR

Jennifer Vergara began her career in behavior analysis while studying at the University of Florida. During her time as a research assistant, she assisted with projects related to functional communication training, functional analysis, and time-out procedures. She graduated with a Bachelor’s of Science degree in Psychology in May 2015. Jennifer is currently a graduate student at the University of South Florida in the Applied Behavior Analysis Master’s Degree program. Her research interests involve the application of behavior analytic principles in the group-home setting.