A Randomized Controlled Trial Exploring the Feasibility of Multimedia-Based Exercise Programs on Older Adult Adherence and Physical Activity

by

Christopher Yao
BA, Western University, 2011

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Supervisory Committee

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Dr. Ryan E. Rhodes, School of Exercise Science, Physical and Health Education
Supervisor

Dr. Sandra Hundza, School of Exercise Science, Physical and Health Education
Departmental Member

Abstract

Supervisory Committee
Dr. Ryan E. Rhodes, School of Exercise Science, Physical and Health Education
Supervisor
Dr. Sandra Hundza, School of Exercise Science, Physical and Health Education
Departmental Member

Purpose: Transitioning into retirement may be a suitable period to help adults establish an active lifestyle. One innovative approach to promote PA may be through multimedia-based programs. This experiment aimed to explore the feasibility DVD and videogame-based exercise programs in promoting physical activity (PA) in adults transitioning into retirement. Underlying motivations, functional fitness, quality of life, and elicited beliefs from participating in the exercise programs were also explored. **Methods:** Twenty-seven adults were randomized into either a nine-week exercise DVD (n = 9), exergame (n = 9), or waitlisted control group (n = 9). Main outcomes include adherence was based on attendance during the in-lab component and participant logs during the in-home component. PA levels were measured through accelerometery and assessed at baseline, four-, nine- and 12-weeks. Secondary outcomes related to motivation were assessed at baseline, three- and nine-weeks. Tertiary outcomes such as physiological/functional fitness and quality of life outcomes were assessed at pre- and post-intervention. **Results:** During the in-lab portion, t-tests showed that adherence was slightly higher in the exergame group than the DVD group (t_{16} = -0.06, p = .96; d = .31). Repeated measures of analysis showed that the group x time interaction for moderate-to-vigorous physical activity (MVPA) ($F_{2,24}$ = 0.87, p = .52; η^2 = .05), while overall PA saw negligible changes ($F_{2,24}$ = 0.16, p = .85; η^2 = .01). At the end of the intervention, overall adherence was similar between both exercise groups (t_{16} = -0.06, p = .96; d = .03). The group by time interaction effect yielded a moderate effect size for MVPA ($F_{2,24}$ = 1.07, p = .36; η^2 = .08) and overall PA ($F_{2,24}$ = 1.11, p = .35; η^2 = .08). Overall PA only increased in the exergame group (d = .74). The exergame group saw major decreases in instrumental attitude (d = .64), injunctive norm (d = .79), perceived behavioural control (d = .40) and intention (d = .90). Both exercise groups enhanced strength, mobility, and aerobic endurance outcomes (d = .33-.98), as well as several quality of life domains (d = .32-.89). At the post-intervention follow-up, both exercise groups were more active

than the control group (*d* = .49-1.03). Two-thirds of the DVD group adopted DVD-based exercise, while a third of exergame group adopted videogame-based exercise. **Conclusions:** With a high adoption rate, DVD-based exercise programs may be a feasible and acceptable approach to promote PA levels. Participants in both groups were generally satisfied, indicating that the exercise program was enjoyable, comprehensive, and a simple and convenient way to exercise at home. Improvements to important functional and quality of life domains were also identified. Further research will be required to fully test the effectiveness of exercise DVDs and exergames on adherence and PA behaviour in adults transitioning into retirement.

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Acknowledgements

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Dedication

I would like to dedicate this thesis to my parents. To my mother, who has always been my biggest fan and cheered me on all the way. To my father, who has taught me the true meaning of hard work and dedication – I know that you would have been proud of me.

Chapter 1: Introduction

As the aging population rapidly increases, managing direct and indirect healthcare costs associated with chronic diseases that are either worsened by or derived from physical inactivity will be an impending challenge (Janssen, 2012; Pratt, Norris, Lobelo, Roux, & Wang, 2014). Undoubtedly, an abundance of research support the fact that regular physical activity (PA) participation can profoundly impact health and well-being in older adults by curtailing the risk of chronic diseases and morbidity (e.g., cardiovascular disease, type 2 diabetes, osteoporosis), disability and loss of independence, dementia, and premature all-cause mortality (Paterson & Warburton, 2010; Warburton, Charlesworth, Ivey, Nettlefold, & Bredin, 2010). Despite this evidence, approximately 85% of adults over the age of 60 do not obtain the recommended minimum 150 minutes of moderate-to-vigorous physical activity (MVPA) per week to obtain health benefits – making this the most inactive segment of the population (Colley et al., 2011; Troiano et al., 2008). Based on these staggering figures, it is evident that intervention efforts aimed at increasing PA in this population are needed.

One 'window of opportunity' to change older adult PA behaviour may be during the retirement phase (Barnett, van Sluijs, & Ogilvie, 2012; Engberg et al., 2012; Rhodes et al., 1999; Zantinge, van den Berg, Smit, & Picavet, 2013). Without a doubt, retirement is a major life transition were changes may be occurring to one's social networks, income, and availability of time; which can drastically impact PA behaviour (Barnett, van Sluijs, et al., 2012; Zantinge et al., 2013). It has been suggested that older adults are more able to increase their exercise and leisure-time PA during this time because of greater time availability (Barnett, van Sluijs, et al., 2012; Engberg et al., 2012; Rhodes et al., 1999; Zantinge et al., 2013). With this in mind, it may

be an opportune time and advantageous to intervene and promote PA and healthy aging during the retirement transition.

At this present time, cognitive and behavioural interventions targeting PA behaviour have demonstrated modest results in increasing activity levels. For instance, systematic reviews examining the effectiveness of interventions promoting PA among middle-aged to older adults have shown small changes to self-reported PA in the short-term (standard mean difference (*SMD*) = 0.18-0.28) (Conn, Hafdahl, & Mehr, 2011; Foster, Hillsdon, Thorogood, Kaur, & Wedatilake, 2005). Moreover, a recent review that synthesized the evidence from randomized controlled trials (RCT) on the effectiveness of interventions promoting long-term (i.e., greater than 12 months) PA in the retirement population has illustrated similar results (*SMD* = 0.19) (Hobbs et al., 2013). At this point in time, RCTs interventions that target PA behaviour in the retirement population have been typically conducted in a healthcare-, lab- or community-based setting; and to a lesser extent, in the home setting (Hobbs et al., 2013).

Home-based interventions may be a more advantageous approach to promote PA among retirees compared to healthcare-, lab-, and community-based interventions as there is an element of ease and convenience that is characteristic of the home environment. (Atienza, 2001; Brawley, Rejeski, & King, 2003; Burke et al., 2013; Martin & Sinden, 2001; Opdenacker, Boen, Coorevits, & Delecluse, 2008; van der Bij, Laurant, & Wensing, 2002; van Stralen, De Vries, Mudde, Bolman, & Lechner, 2009). This ease and convenience is often defined by the motivational construct known as perceived behavioural control (PBC) according to the theory of planned behaviour (TPB), which specifically refers as one's perception of ease or difficulty in engaging in a particular behaviour (Ajzen, 1991). The importance of this particular construct lies in the fact that it is an antecedent that possesses a moderate effect on both intention and

subsequent PA behaviour (McEachan, Conner, Taylor, & Lawton, 2011). Moreover, constructs like PBC and intention have been consistently identified as key correlates of the levels of older adult PA (Koeneman, Verheijden, Chinapaw, & Hopman-Rock, 2011; Martin & Sinden, 2001; Rhodes et al., 1999; Trost, Owen, Bauman, Sallis, & Brown, 2002; van Stralen et al., 2009), particularly in the early adoption phase (van Stralen et al., 2009). Incorporating an in-home PA program can also reduce substantial barriers, such as transportation or cost. As well, these home-based programs can provide convenience and flexibility in scheduling, which can lead to higher levels of overall adherence (Brawley et al., 2003; Martin & Sinden, 2001; van Stralen et al., 2009). Consequently, these types of programs ultimately allow people to integrate PA into their daily routine, and in turn, increase the likelihood of maintaining PA once the intervention has ended.

Exercise DVDs or exergames (exercise videogames or active videogames) have been shown as relatively cost-effective and simple way exercise in the home and increase overall levels PA (Kaushal & Rhodes, 2014; Wendel-Vos, Droomers, Kremers, Brug, & Van Lenthe, 2007). Both DVDs and exergames have can potentially increase PA levels and functional outcomes, such as balance, mobility, and joint range of motion, in the adult population (Kingston, Gray, & Williams, 2010; Laufer, Dar, & Kodesh, 2014; Miller et al., 2014; Peng, Crouse, & Lin, 2013; Primack et al., 2012; Taylor, McCormick, Shawis, Impson, & Griffin, 2011; van Diest, Lamoth, Stegenga, Verkerke, & Postema, 2013). Despite these encouraging results, experiments with the focus of improving older adult PA have not moved beyond laboratory- and community-based settings to explore the efficacy within a home environment (Gothe et al., 2015; Keogh, Power, Wooller, Lucas, & Whatman, 2014; Kirk, Macmillan, Rice, & Carmichael, 2013; Strand, Francis, Margrett, Franke, & Peterson, 2014; Studenski et al., 2010;

Wollersheim et al., 2010). Moreover, inquiries to whether these types of programs are able to increase overall PA in older adults have not been explored, particularly individuals entering the retirement phase.

For these reasons, it will be expedient to conduct a three-armed RCT to examine the feasibility and acceptability of these multimedia-based exercise programs on adherence and PA behaviour in adults between the ages of 60-70 years, and evaluate whether a full trial is warranted. Secondary aims of this study were to test the utility of the TPB and investigate the motivational beliefs regarding DVD and videogame-based exercise, and the ability for these programs to improve functional fitness and quality of life. A final objective was to perform a belief elicitation study based on the participants' experiences using the DVD and exergame programs.

Research Questions

The study aimed to addressing the following questions:

Primary research questions

1) Will the laboratory, home and overall adherence rate differ between the two exercise groups?
2) Are the there any group differences between the exercise and control groups over the course of the 12-week study for MVPA and overall PA?
3) Over the course of the 12-week study, do levels of MVPA and overall PA change from baseline in the three experimental groups?
4) What are the rates of program adoption and exercise maintenance after the nine-week intervention?

Secondary research questions

1) Are the TPB constructs different between the two exercise groups over the course of the intervention? How do these constructs change over the course of the study relative to baseline?
2) With the utility of the TPB, what constructs will predict adherence during the lab and home phases of the study?

Tertiary research questions

1) Do functional fitness and physiological health outcomes and quality of life change across time for each experimental group?
2) What are the elicited beliefs about exercise derived from using the DVD and exergame programs?

Hypotheses

It is postulated that:

Primary hypotheses

1) In-home, in-lab and overall levels of adherence will be higher in the exergame group compared to the DVD group.
2) Both exercise groups will engage in higher levels of MVPA and overall PA than the control group at the end of the in-lab and in-home phases. However, relative to the DVD group, participants assigned to the exergame group will engage in higher levels of MVPA at the end of the study due to the games progressive exercise programming, but overall PA level will be similar in both exercise groups. At the 12-week post-intervention follow-up, the exergame group will see similar levels of MVPA and overall PA as the control group, while participants in the DVD group will have higher levels of MVPA and overall PA.

3) Both exercise groups will see higher levels of MVPA and overall PA than baseline levels over the nine-week intervention. The level of activity will decrease to baseline levels at the 12-week post-intervention follow-up in the exergame group, while the DVD group will see higher levels of activity than baseline. For the control group, activity levels will be relatively stable across the 12 weeks.
4) Participants in the DVD group will more inclined to adopt and engage in DVD-based exercise once the intervention is over, whereas participants in the exergame group will less inclined to adopt and engage in videogame-based exercise.

Secondary hypotheses

1) Participants in the exergaming group will have higher affective attitude scores than the DVD group and this attitudinal construct will decrease in both groups over time. PBC will be similar at baseline for both exercise groups. The PBC scores will decrease over time in the exergame group, while PBC will be increase over time in the DVD group. Intention scores will be higher in the exergame group than the DVD group and will decrease in both exercise groups over time. For all other constructs, there will be no difference between the two groups and scores will remain stable over time.
2) Based on the TPB framework, affective attitude and PBC will be major predictors of intention. Adherence will be predicted by intention and PBC.

Tertiary hypotheses

1) Both exercise groups will see more improvements to functional fitness and physiological health outcomes, while participants in the control group will see very little change from baseline scores. For quality of life, participants assigned to the exercise groups will see

improvements in physical functioning, vitality, bodily pain, and general health perception domains.

2) Many of the elicited beliefs from using the equipment will be consistent with previous research in the PA and exergaming domain. However, due to the fact that there has not been an elicitation study conducted in the area of DVD-based exercise, unique beliefs will be elicited.

Assumptions

1) Participants will answer all questionnaires in a truthful manner and to the best of their ability.
2) Participants will accurately log their exercise sessions during the in-home portion of the study.

Delimitations

1) Healthy adults between the ages of 60 to 70 years old.
2) Residents in the Greater Victoria Region, British Columbia
3) Individuals not meeting the national recommendations for PA (i.e., 150 minutes moderate to vigorous aerobic physical activity per week).
4) Ability to score a minimum of 28 points on the Telephone Interview for Cognitive Status (TICS).

Limitations

1) Due the voluntary nature of the study, the degree to which the results can be generalized will be limited.
2) Results will be specific to adults between the ages of 60-70 years.

3) Questions pertaining to the beliefs of physical activity might not encompass all beliefs of the individuals participating in the study.
4) Measures regarding in-home adherence, motivation, self-regulation, and quality of life were self-reported.

Operational Definitions

1) Adherence
    a. For the in-lab phase of the study: The number of exercise sessions a participant attends each week.
    b. For the in-home phase of the study: The number of times a participant exercises with the DVD or exergame per week.
2) Exergame: Also known as exercise or active videogames, exergames are an interactive media approach usually on a gaming platform (e.g., Sony Playstation, Nintendo Wii, Microsoft Xbox) that integrates videogames and bodily movement. Through the incorporation of sensors and/or peripheral equipment that respond to the user's movement, these games are focused on fitness and functional outcomes.
3) Moderate to vigorous physical activity: The intensity of the physical activity performed and can be measured in numerous ways. Has been traditionally defined as energy expenditures equal to three METs or more. In this study, it will be defined on the objective measurement of counts per minute during a 60 second epoch recorded by an accelerometer. Counts of 1952 per minute or more will refer to a moderate to vigorous intensity (Freedson, Melanson, & Sirard, 1998).
4) Physical activity: Conceptually defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985). It

will also refer to accelerometer counts of 101 counts per minute or more (Freedson et al., 1998).

5) Theory of planned behaviour constructs
    a. Affective attitude: Attitudinal beliefs pertinent to one's feelings or emotions of performing the behaviour.
    b. Instrumental attitude: Attitudinal beliefs focused on the outcomes of the behaviour.
    c. Descriptive norm: Normative beliefs that refer to perceptions about what others in one's social or personal networks are doing.
    d. Injunctive norm: Normative beliefs based on what others think one should do and motivation to comply.
    e. Perceived behavioural control: The extent of a person ability (i.e., ease or difficulty) to enact the behaviour.
    f. Intention: An individual's readiness to perform the behaviour.

Chapter 2: Literature Review

The literature review will be divided into five sections: the aging population and PA, determinants of older adult PA, DVD- and videotape-based interventions, exergaming interventions, older adults and technology adoption, and a summary.

The Aging Population and Physical Activity

The aging population in the 21st century. In 2014, approximately one in six Canadians were over the age of 65, and for the first time, the proportion of retiring individuals surpassed the number of adolescents and young adults (Statistics Canada, 2014). With this being indicative of

the rapid growth of this particular segment of the populace, recent population projections estimate that seniors will make up at least a quarter of the population in 50 years (Statistics Canada, 2014). Among this population, the major concern is the prevalence of low PA levels. The most recent objectively measured national surveillance data found that only 13% of seniors met the national PA recommendations, making them the least active segment in the population (Colley et al., 2011).

Presently, there has been an extensive amount of evidence that supports the positive association between PA and health. Research has shown that the lack of PA has been associated with the risk of developing cardiovascular disease, high blood pressure, certain types of cancers, osteoporosis, type 2 diabetes, and obesity in older adults (Chodzko-Zajko et al., 2009; Kokkinos, Sheriff, & Kheirbek, 2011; Warburton et al., 2010). Moreover, regular PA can attenuate the risk for premature mortality and morbidity, dementia, disability, and loss of independence, which are all significant concerns in this population (Chodzko-Zajko et al., 2009; Paterson & Warburton, 2010). Despite the evidence for the protective benefits from regular PA participation, many older adults remain physically inactive and the prevalence of chronic conditions remains high.

The impending concern with the emergent aging population over the next couple of decades is the significant and proportional rise of chronic conditions and the subsequent economical burden on the healthcare system. In 2009, the estimated direct, indirect, and total healthcare costs of chronic conditions associated with physical inactivity (i.e., coronary artery disease, stroke, hypertension, colon and breast cancer, type 2 diabetes, and osteoporosis) were $2.4 billion, $4.3 billion, and $6.3 billion, respectively in Canada (Janssen, 2012). In a recent survey, 75% of adults over the age of 65 years reported having at least one chronic condition (Terner, Reason, McKeag, Tipper, & Webster, 2011). Moreover, a quarter of seniors experienced

multiple chronic conditions (Terner et al., 2011). Indeed, a mounting prevalence of morbidity has been shown to be directly associated with healthcare usage. Older adults with a high number of morbidities have shown to contribute to 40% of healthcare use, which is equivalent to 13.3 million visits over 12 months (Terner et al., 2011). As a result, it will be crucial to enact preventative measures against chronic conditions by promoting PA in the older adult population and attenuate the burden on healthcare resources.

Physical activity and transitioning into retirement. Retirement is known as a major life transition that involves the restructuring of social networks, income, time flexibility, which are often associated with changes in PA levels (Barnett, van Sluijs, et al., 2012; Zantinge et al., 2013). Adults in this life transition have been found to increase leisure-time PA during this time (Barnett, van Sluijs, et al., 2012; Engberg et al., 2012; Rhodes et al., 1999; Zantinge et al., 2013). However, it is unclear whether changes to overall PA levels occur (Barnett, van Sluijs, et al., 2012). Despite the increase in leisure-time, regular PA participation among older adults is among the lowest relative to other age groups (Colley et al., 2011). In fact, PA levels decrease further within this age group as people become older (Koeneman et al., 2011; Rhodes et al., 1999; Sun, Norman, & While, 2013; van Stralen et al., 2009). With these findings, it truly highlights the pre-retirement and early retirement phases as pivotal points to target PA adoption in hopes that active lifestyles are maintained into later life.

Physical activity adoption during retirement. There are many determinants of PA during the transition into retirement. One area to examine is the motives that individuals have for increasing their leisure-time PA during this time. With the help of qualitative research, the underlying motivations for PA change during the transition into retirement could be described and understood in detail (Markula, Grant, & Denison, 2001). A recent systematic review

explored the various motives for the reasons to why older adults might increase their overall leisure-time PA (Barnett, Guell, & Ogilvie, 2012). Based the evidence from five studies, several motives for the adoption of PA after the transition to retirement was identified. For instance, one of the reasons for older adults to adopt leisure-time PA during this time was to work towards achieving potential health benefits and gain a sense of well-being (Barnett, Guell, et al., 2012). As well, the transition into retirement was found to increase overall awareness about the imminent physiological changes associated with aging (Barnett, Guell, et al., 2012). In addition, older adults felt that the uptake of PA could attenuate physical and mental decline related to aging and maintain functional independence (Barnett, Guell, et al., 2012).

Another motive indicated by retirees was the restructuring of time and re-establishing routine. For some, leisure-time PA was taken up as an attempt to replace their previous occupational routine with structured recreational activities. Gender-specific motives were identified in this review. For men, PA adoption was seen as a new personal challenge (e.g., fitness goals, new skills) and an opportunity to increase self-worth and achievement, whereas women adopted leisure-time PA as an opportunity socialize with others (Barnett, Guell, et al., 2012). Overall, these findings provide some insight to the motivations and the expected outcomes characteristic of adults transitioning into retirement.

Determinants of Older Adult Physical Activity

Theory of planned behaviour and physical activity. Adopting a theoretical framework may aid the overall understanding of the underlying mechanisms of PA behaviour change. One theoretical framework that is often used to explain behaviour is the theory of planned behaviour (TPB) (Ajzen, 1991). Rooted and extending from the theory of reason action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), the TPB maintains that one's behavioural intention and PBC are

impetuses in a subsequent behaviour (Ajzen, 1991). While antecedents to one's intention are based on the attitudes, subjective norms, and PBC (Ajzen, 1991). With these various constructs, the TPB has been able to adequately explain PA behaviour.

A recent meta-analysis of prospective studies has identified intention as a strong predictor of PA behaviour (r = .48), while PBC was found to be a moderate predictor of PA (r = .34) (McEachan et al., 2011). When examining the predictors of intention, attitude (r = .60) and PBC (r = .55) were found to be strong predictors, while subjective norm was found to be a weaker predictor of intention (r = .38) (McEachan et al., 2011). With these medium to large effect sizes, the TPB model can be seen as an adequate framework to understand PA behaviour.

Expanded multi-component model of the TPB have further differentiated principal constructs like attitude, subjective norm, and PBC into distinct components (Rhodes, Blanchard, & Matheson, 2006). In this extended model, attitude can be separated into affective (i.e., emotional-laden judgments related to the consequences of the behaviour) and instrumental domains (i.e., appraisal of the benefits and costs associated with the behaviour); while subjective norm could be divided into descriptive (i.e., whether one's social network performs a behaviour) and injunctive norms (i.e., whether one believes it is important that others want them to perform the behaviour). For the PBC construct, it could be further categorized into perceived skills, opportunities and resources in performing the behaviour (Rhodes et al., 2006). Research has shown that of these various components, only affective attitude and perceived opportunity were significant predictors of exercise intention (β = .47 and .25; respectively) (Rhodes et al., 2006). As a result, affect and perceived opportunity may be focal points to target in PA interventions.

One important constituent when using the TPB, as suggested by Ajzen and Fishbein (1980), is to conduct an elicitation study. In has been noted that the creation of a new set of

beliefs may be easier than altering long withstanding belief systems (Ajzen, 2006). Since interventions can bring forth the possibility of behaviour change accompanied by a different set of beliefs, researchers should provide the population of interest an opportunity to unveil the prospects of new behavioural, normative and control beliefs that they have in relation to the specific behaviour (Ajzen & Fishbein, 1980). As a consequence, these elicited beliefs may then inform the development of future questionnaires.

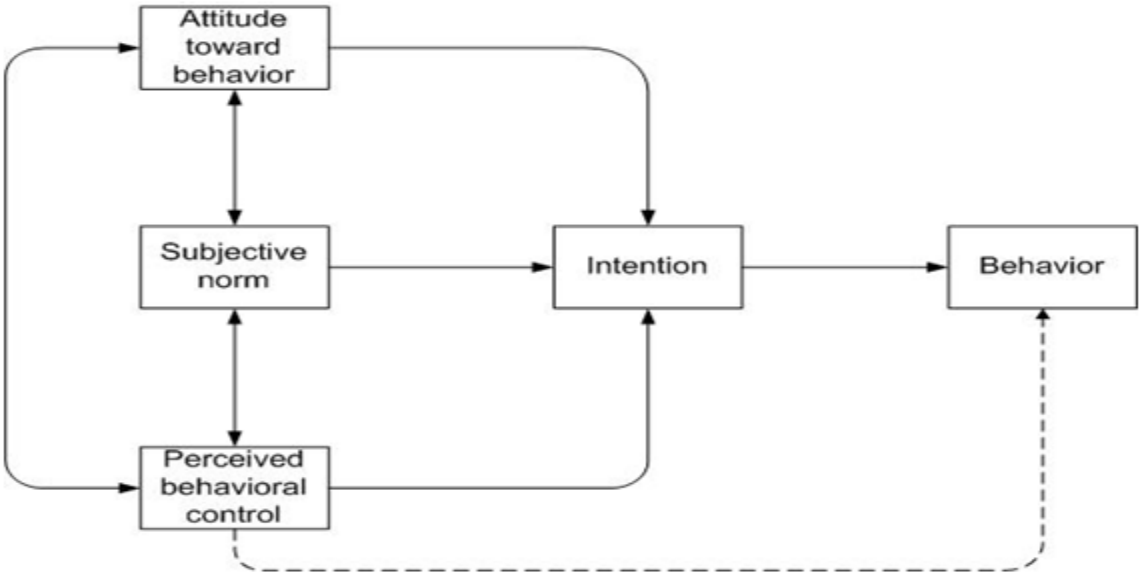

Figure 1. Theory of planned behaviour.

Affective attitude and physical activity. Affective attitude may be an important construct to target according the TPB framework, as it was found to significantly predict exercise intention (Rhodes et al., 2006). Further illustrating the importance of affective attitude in PA, a meta-analysis has identified a direct moderate association between affect and PA among adults (r = .42) (Rhodes, Fiala, & Conner, 2009). In the PA domain, physical exertion from traditional forms of exercise may be perceived as not enjoyable and unpleasant by some individuals (Plante,

Aldridge, Bogden, & Hanelin, 2003). Thus, affective judgments like enjoyment may be an important correlate in older adult PA, which has been associated with the adoption and maintenance phases of PA (Rhodes et al., 1999; van Stralen et al., 2009). Consequently, it may be important to target affect with novel and innovative approaches to increase older adult PA.

Exergames have been found to enhance enjoyment and effort, and reduce a person's perceived exertion during exercise (Plante et al., 2003), and improve the person's overall affective attitude towards PA. One of the possible explanations to how exergames improve a person's affective attitude towards PA may be the result of a phenomenon called flow state. Often applied to sports and games, the flow state can be defined as a successful engagement where one is optimally aroused, intrinsically motivated and entirely immersed in an activity (Csikszentmihalyi, 1990). Videogames have garnered great success and recognition for the ability to create an interactive gaming experience that is conducive to the flow state (Sherry, 2004). In order to create a flow state, a number of underlying factors must be considered and incorporated into the videogame.

One of the main tenets to achieving a flow state is ensuring a balance between the person's skill sets and the challenges that are presented and that success can be achieved (Csikszentmihalyi, 1990). Other factors that influences flow include: 1) clear goal expectations and rules that are attainable that meet the persons skill set or abilities, 2) limited field of attention and a high degree of concentration and focus, 3) the fusion of one's action and awareness, 4) the altering of the perception of time, 5) direct and immediate feedback, 6) a sense of personal control over the activity, and 7) the availability of intrinsic reward (Csikszentmihalyi, 1990). Thus, with the success videogames to incorporate these elements to gaming and evoke a user's

flow experience, it is possible that exergames can capitalize on the flow state and provide a positive affective experience to exercise.

Perceived behaviour control and physical activity. PBC and self-efficacy have been consistently identified as a correlate of older adult PA in a number of systematic reviews (Koeneman et al., 2011; Martin & Sinden, 2001; Trost et al., 2002; van Stralen et al., 2009; Wendel-Vos et al., 2007). Among adults, control beliefs such as inconvenience and time have been often perceived as PA barriers (Symons Downs & Hausenblas, 2005). While among the older adult population, distance, unavailability of PA opportunities, fear of injury and lack of time are likely barriers (Barnett, Guell, & Ogilvie, 2012; Smith et al., 2012), which have been found to be negatively associated with PA (Brawley et al., 2003; Trost et al., 2002). Additionally, within this population, distinct barriers have been identified for men and women. Among elderly men, cost was found to be associated with nonparticipation (Smith et al., 2012). While lack of time and location not being physically accessible were associated with nonparticipation among women (Smith et al., 2012). Home-based programs may address these specific barriers, which would consequently enhance one's availability of resources and opportunities to be active.

Relatively low-cost, simple and convenient, home-based PA programs have an advantage over lab- and community-based interventions due to its high degree of generalizability and can be readily implemented once the intervention is over. As well, home-based PA has been associated with PA initiation and maintenance phases in this population (van Stralen et al., 2009). Several reviews have found that these types of interventions can enhance overall adherence in the older adult population (Atienza, 2001; Brawley et al., 2003; Martin & Sinden, 2001; van der Bij et al., 2002; van Stralen et al., 2009). Research has shown high levels of

adherence in short-term interventions (~90%) (van der Bij et al., 2002). However, adherence rates in interventions lasting over a year saw lower adherence levels (36 to 68%) (van der Bij et al., 2002). Considering many older adults transitioning into retirement are intending to increase leisure-time PA and adopt an active lifestyle, in-home programs may be beneficial in the early adoption phase by helping these individuals implement a regular PA routine.

Thus far, home-based interventions have been limited to prescriptive programs (e.g., walking and/or resistance programs) and have had a small effect on changing PA behaviour (d = .24) (Conn et al., 2002). Despite the limited effectiveness, home interventions are fairly cost-effective and possess a high ecological validity. To increase the overall effectiveness home-based PA programs, innovative approaches many enhance PA behaviour. In terms fitness outcomes, interventions based out of the home has shown improvements to strength and physical functioning, as well as cardiorespiratory fitness (Atienza, 2001). Thus, innovative home-based PA interventions may be able to eliminate many barriers experienced by older adults and improve PA and functional outcomes.

Physical activity interventions and older adults. To date, two meta-analytic reviews have synthesized the effectiveness of PA interventions among adults of all ages (Conn et al., 2011; Foster et al., 2005). PA interventions aimed at the general adult population have shown to be modestly effective in the short- to mid-term with an effect size of d = .19-.28 (Conn et al., 2011; Foster et al., 2005). Of the various types of intervention approaches, behaviour-based interventions that offered professional guidance and ongoing support were more effective at improving PA compared to cognitive-based interventions (Conn et al., 2011; Foster et al., 2005). A 2002 meta-analysis that examined the effects of PA interventions among healthy older adults showed that interventions had a small effect on PA behaviour change (d = .26) (Conn et al.,

2002). Despite these findings, many of the studies found in these meta-analyses were limited to 12-month follow-ups and only reflected short-term behaviour change.

More recently, a quantitative review examined the effectiveness of long-term (i.e., 12 to 36 months) RCT PA interventions on older adults aged of 55-70 years (Hobbs et al., 2013). A total of 21 studies were included in the review. Many of the interventions took place in a healthcare setting and facilitated by health professionals. Moreover, all of the interventions, except one, were individually tailored to some degree. Ten studies indicated a least one theoretical framework and included theories like the social cognitive theory, transtheoretical model, relapse prevention theory, health protection motivation theory, and health action process approach, while the remaining studies did not indicate the use of a theoretical model. About two-thirds of the studies employed self-regulatory strategies such as goal setting, planning, self-monitoring, and providing feedback. Overall, the results from the meta-analysis showed that at 12 months, PA interventions were able to modestly increase PA by d = .19 based on self-reported PA; though, no changes to behaviour were seen at 24 (Hobbs et al., 2013). Similarly, accelerometer measured PA showed a similar trend with a small increase in PA (d = .18) and no change at 24 months; however, these results were limited to one study. With these overall findings, more theoretical-based RCTs are needed that objectively measured PA and move beyond the confines a formal lab or community setting are needed in order to advance PA interventions in this older adult population.

DVD- and Videotape-Based Exercise Interventions

Multimedia platforms can provide a low-cost and -barrier approach to deliver and disseminate health behaviour programs. Despite the fact that DVDs and videotapes exercise programs have been available for the past several decades, limited research has been done to

explore the effects of these screen-based exercise programs on PA behaviour (Kaushal & Rhodes, 2014). Recent research has shown some implications that DVD-based exercise can improve psychosocial outcomes, promote and educate individuals about health behaviours, enhance functional outcomes, and improve PA levels in healthy and clinical adult populations (Gothe et al., 2015; Kingston et al., 2010; McAuley et al., 2012, 2013).

In clinical populations, DVD- and videotape-based interventions have been applied to patient compliance to post-operative care, breast cancer screening, and education on healthy behaviours and coping strategies (Kingston et al., 2010). A narrative review of 11 DVD and videotape-based interventions in promoting adherence with home exercise and health programs have shown that these platforms to be quite cost-effective, convenient to the patient, and equally efficacious to an in-person clinical setting. For instance, their results have shown that DVD interventions have comparable levels of exercise compliance to face-to-face sessions (Kingston et al., 2010). Post-operative heart surgery patients who received a videotape-based intervention saw significant increases in moderate and vigorous exercise at 1- and 3-months post-discharge (Kingston et al., 2010). With regard to functional outcomes, patients who have undergone shoulder surgery reported similar physical outcomes to those who receive face-to-face instruction (Kingston et al., 2010). These findings highlight the potential of in-home DVD and videotape-based programs in the domain of PA and functional outcomes among clinical populations. However, based on the limited number of studies and a short duration of follow-up, these findings and can be only seen as preliminary evidence.

The availability of evidence for DVD-based interventions in healthy populations is even less than what is found in the clinical population. Presently, one intervention has explored the use of DVD-based programs to increase PA and enhance physical functioning in healthy older

adults (Gothe et al., 2015; McAuley et al., 2012, 2013; Wójcicki et al., 2014). This six-month RCT assigned 307 older adults into one of two groups: a DVD-delivered exercise intervention group or a DVD-based attention control group (Gothe et al., 2015; McAuley et al., 2013). Overall participant adherence to the program (i.e., three times per week) was approximately 75% (McAuley et al., 2013). Along with these adherence rates, participants in the exercise group saw modest improvements in levels of MVPA (self-reported PA: $\eta = .03$, $p < .05$; objective PA: $\eta = .02$, $p = .05$) (Gothe et al., 2015). Moreover, between-group comparisons resulted in significant improvements favouring the experimental group in the areas of functional performance (i.e., balance, gait speed, and lower extremity strength) ($\eta = .03$), arm strength ($\eta = .04$), and hamstring flexibility ($\eta = .02$). A follow-up assessment six months after the intervention ended showed that participants in the experimental group maintained improvements in functional performance and arm strength (Wójcicki et al., 2014). More interestingly, about 40% of the participants that were assigned to the experimental group maintained the original prescription of exercising with the DVD three times per week (Wójcicki et al., 2014).

With the limited number of studies found in both healthy and clinical populations, DVD-based exercise programs may have the potential to elicit high program adherence, increase in MVPA levels, and enhance functional outcomes in older adults. Moreover, with the generalizability of this approach and the availability of exercise DVDs to the public, it is possible that behaviour change can be sustained long after the intervention has ended.

Exergaming Interventions

Serious games and health. Most recently, the term "serious games" has been used to refer to interactive digital platforms with the outcome of teaching or training individuals that is intertwined with a gaming element (Wiemeyer & Kliem, 2012). Applications of these serious

games have been applied to areas like health education and promotion, exercise, prevention, and rehabilitation; which have consistently demonstrated benefits in multiple health domains (Miller et al., 2014; Papastergiou, 2009; Primack et al., 2012; Taylor et al., 2011; Wiemeyer & Kliem, 2012).

Serious games that integrate exercise, otherwise known as exergames or active videogames, has been facilitated through various gaming platforms, such as Konami's Dance Dance Revolution, Sony's EyeToy Kinetics, Nintendo's Wii, and Microsoft's Xbox Kinect. These gaming systems incorporate RGB cameras, infrared motion sensors, and accelerometers that detect player's movements and integrate this information to create an interactive gaming experience, and are generally aimed at improving overall fitness and health. As well, these exergames can potentially provide individuals with additional PA opportunities. With novel approach, it may offer a practical, low-barrier, relatively inexpensive, and entertaining way to promote PA.

Exergames and physical activity. A number of reviews have examined the applications of exergames in promoting PA; however, research in this area has been conducted with the main focus on children and adolescents (Mark, Rhodes, Warburton, & Bredin, 2008; Peng et al., 2013; Primack et al., 2012; Sween et al., 2014). In children and youth, videogames have been traditionally associated with sedentary behaviour. By changing child sedentary behaviour by augmenting videogames to incorporate an active component to the added "fun" element, it may likely increase overall PA levels and decrease sedentary behaviour (Best, 2013; Gao & Chen, 2014; LeBlanc et al., 2013; Mark et al., 2008; Papastergiou, 2009).

In the area of exergames and PA behaviour, it is unclear whether exergames can ultimately increase overall PA behavior in child and adult populations (Barnett, Cerin, &

Baranowski, 2011; Best, 2013; Biddiss & Irwin, 2012; Gao & Chen, 2014; LeBlanc et al., 2013; Peng et al., 2013; Primack et al., 2012). At this point in time, the consensus among many reviews is that investigative efforts to improve PA levels have been compromised by poor methodological design (e.g., lack of controlled trials, convenience samples) and small sample sizes (Barnett et al., 2011; Best, 2013; Biddiss & Irwin, 2012; LeBlanc et al., 2013; Peng et al., 2013; Primack et al., 2012). Despite these outcomes, the overall findings with regards to the adherence and motivational outcomes from exergaming interventions have been fairly consistent.

Several reviews have identified the ability of exergames to elicit higher levels of adherence over traditional modes of exercise in the short-term in both children and younger adults (Biddiss & Irwin, 2012; Gao & Chen, 2014; LeBlanc et al., 2013; Mark et al., 2008; Peng et al., 2013). One of the explanations for the enhanced adherence in these groups may be attributed to the affective experience that exergames provide. As the importance of affective experiences in child and adult PA behaviour has been established in several meta-analyses, (Nasuti & Rhodes, 2013; Rhodes, Fiala, et al., 2009), the use of exergames can potentially target this affective component, and increase intention and subsequent exergaming behaviour (Keats, Jakob, & Rhodes, 2011; Mark & Rhodes, 2013; Rhodes, Warburton, & Bredin, 2009).

The support for the associations between levels of affective attitude, intentions, and adherence in exergaming can be consistently found in a number of experimental studies. The results from these studies have found higher levels of affective attitude and intention in the exergaming groups compared to standard exercise groups (Garn, Baker, Beasley, & Solmon, 2012; Keats et al., 2011; Mark & Rhodes, 2013; Rhodes, Warburton, et al., 2009). As a result, the gaming component to exergames may have the ability to target enhance affective attitude and intention and bolster exercise adherence (Keats et al., 2011; Mark & Rhodes, 2013; Rhodes,

Warburton, et al., 2009). Despite these motivational and adherence outcomes, the applications of exergames in older adult PA remain fairly uncharted.

Currently, three studies have examined the effects of exergames on older adult PA behaviour in a community-based setting (Keogh et al., 2014; Strand et al., 2014; Wollersheim & Merkes, 2010). Of these studies, two interventions saw significant increases in PA from baseline levels (Keogh et al., 2014; Strand et al., 2014); however, only one of these studies employed a control group (Keogh et al., 2014). Along with the improvements in PA, older adults reported significant improvements in self-reported physical health and decrease in pain (Strand et al., 2014), as well as improvements to the psychological component of quality of life (Keogh et al., 2014). In terms of functional outcomes, a significant difference for upper body strength was found for the intervention group when compared to the control (Keogh et al., 2014). Based on the limited evidence to date, exergames may have the potential to improve PA levels and health outcomes; however, the state of this research remains quite exploratory and requires further rigorous investigation.

In brief, studies examining the effects of exergames in the adult population have lacked in methodological rigor (e.g., convenience samples, no comparison group). Furthermore, research in to older adult PA behaviour and exergames have been limited to considerably older adults in community- and laboratory-based settings, and therefore it would be inappropriate generalize the results to a younger older adult population within a home setting. In fact, no formal RCT has been conducted in this population. As a result, it will be beneficial to test the efficacy and ecological validity of exergames on adherence and PA behaviour with a RCT design.

Energy Expenditure. One of the contentious issues raised with exergames has been the intensity that the games elicit and whether they commensurate with the recommended moderate-to-vigorous levels. Opponents of exergames have often taken a broad and simplistic evaluation when evaluating the physiological effects of gaming, often grouping videogames that require minimal body movement for the interactive component and produce only light-to-moderate intensities. Substantial evidence has shown that exercise intensities elicited from exergames are largely moderated by type of movement required by the user (i.e., upper, lower, or whole body movements) and age (i.e., child or adult) (Peng, Lin, & Crouse, 2011). In particular, exergames that involve whole or lower body movement have been found to elicit higher energy expenditure than those that utilize upper body movements (Peng et al., 2013). Furthermore, exergaming among children and adults can result in moderate-to-vigorous intensities, with children exhibiting slightly higher intensities than adults (Biddiss & Irwin, 2012; Peng et al., 2011; Sween et al., 2014; Warburton, 2013). As a result, it will be important to consider exergames that incorporates whole body or lower body movement in PA interventions.

With the gained popularity of exergames in the last decade, there has been a plethora of exergames available to the public. Games like Wii Fit Plus or EA Sports Active 2 have been games that provide a comprehensive exercise program that targets flexibility, balance, strength, and aerobic fitness with the sole purpose of increasing PA and overall fitness. Currently, several experiments have investigated the energy expenditure elicited by Wii Fit (Graves, Ridgers, & Stratton, 2008; Lanningham-Foster et al., 2009; Miyachi, Yamamoto, Ohkawara, & Tanaka, 2010; Zhang, Pi-Sunyer, & Boozer, 2004). However, measurements of energy expenditure during gameplay have been generally underestimated due to the indirect measurements employed or equipment limitations (i.e., equipment unable to account for arm and trunk

movements) (Graves et al., 2008; Lanningham-Foster et al., 2009; Zhang et al., 2004). Only one investigation has examined the energy expenditure of healthy adults in a metabolic chamber (Miyachi et al., 2010). Researchers from this study were able to determine Metabolic Equivalent of Task (MET) values within each fitness domain. Computed MET values for all the resistance exercises ranged from 1.7 to 5.6 (e.g., lunges, push-ups, planks), while aerobic exercises ranged from 2.7 to 5.1 (e.g., basic run, boxing, hula hoop). Overall, mean MET values calculated for resistance and aerobic exercises were found to be 3.2 and 3.4, respectively – which correspond to a moderate intensity. Mean MET values calculated for flexibility and balance exercises were found to be lower than strength and aerobic exercises, which were approximately 2.0 METs. With these findings, exergames such as Wii Fit Plus may be an appropriate exercise prescription based the intensities induced by the aerobic and strength-based exercises, which commensurate with national guidelines and can lead to subsequent health and fitness benefits.

Older Adults and Technology Adoption

Usability, or the ease of use, is an important consideration in health-related technology adoption, particularly in the older adult population (Heinz et al., 2013; Hwang, Hong, Hao, & Jong, 2011). Focus groups conducted with older adults have identified that approximately half of the issues when using technology was related to usability, and that proper training was cited as the most common solution (Fisk, Rogers, Charness, Czaja, & Sharit, 2009). Moreover, these authors outlined five characteristics related usability: 1) learnability (the degree of effort needed to comprehend and integrate instructions), 2) efficiency (the extent to which technological applications meet users' needs, avoiding loss of time, frustration, and dissatisfaction), 3) memorability (the ability to retain information related to the program which can reduce frustration and loss of time), 4) possibility of errors (how easily a device can induce errors for

older adults uses and how easily it can recover from them) , and 5) satisfaction (the user's attitude and adoption of the devices' applications) (Fisk et al., 2009). With this in mind, ensuring that the usability of technical devices is present in the early stages of the intervention is a critical consideration.

With regards to the adoption, self-efficacy has been identified as an important construct when adopting technology (Marquié, Huet, & Jourdan-Boddaert, 2002). By incorporating a training period where older adults can receive support, become more familiarized, and gain confidence with their use of the technology, it can lessen some of the cognitive demands during the exercise sessions (Hwang et al., 2011). This may more important in the exergaming domain, where the mitigating the demands on the person may increase the potential for the user to experience flow (Hwang et al., 2011). Overall, by providing training and support during the initial stages of a technology-based PA intervention, it can help participants become more familiar with the equipment and build up the confidence with using the technology, which ultimately maximizes the usability of the device.

Summary

Transitioning into retirement can be seen as a window of opportunity to promote PA in the older adult population. At this point, efforts to increase PA in this population have had very modest results. In order to advance intervention research in this area, innovative approaches that target important psychological correlates are needed. Home-based multimedia exercise programs, such as exercise DVDs or exergames may be an innovative and suitable approach to target key correlates such as affective attitude and PBC. Contemporary interventions have achieved modest impact on PA levels suggesting a need for innovative exercise interventions. DVDs and exergames have shown the potential to improve functional outcomes and increase PA

levels in older adults. However, the research in this area is scant and hampered by poor methodology and restricted generalizability.

A caveat of conducting a technology-based intervention with the older adults is the varying levels of comfort and proficiency, which can affect the usability of the device and overall user experience. To maximize the usability of the devices, a training period may be necessary to provide individuals with the support necessary to establish the confidence to access what the DVD or exergame have to offer and help them adopt the technology in the long-term.

Based on the literature review, several gaps in the literature exist. First, exergaming and DVD-based interventions have been predominantly conducted in the laboratory or a community setting, and have limited ecological validity. Second, there has been a limited number of RCTs conducted in the exergaming domain and the available literature has methodological constraints such as the lack of comparison groups and the use of convenience samples. Finally, there has been no exergaming or exercise DVD intervention that has examined individuals in the pre-retirement or early retirement phases.

With the use of a RCT design, the study will aim to test the feasibility and acceptability of exercise DVDs and exergames in promoting PA behaviour and exercise adherence in individuals transitioning into retirement in the home environment, and determine whether a full experimental trial is warranted. The study will provide estimates of key aspects of trial design needed to conduct a full experimental trial based on the following indicators: 1) overall program adherence, 2) post-intervention program adoption and maintenance of exercise behaviours, 3) changes to levels of MVPA, 4) program retention, and 5) program satisfaction. Secondary aims of the study will be to investigate the utility of the TPB in DVD- and videogame-based exercise, and changes in functional fitness and physiological and quality of life outcomes. As well, the

experiment will explore the beliefs elicited from engaging in DVD- and videogame-based exercise programs.

Chapter 3: Methods

Study Design

The CONSORT statement for reporting randomized trials was used as guide for this study (Altman et al., 2001). See Appendix A for the CONSORT Statement Checklist. The study employed a nine-week randomized, three-arm parallel, randomized waitlist-controlled trial (RCT) whereby participants were randomly assigned either to a 1) exercise DVD, 2) exergame, or 3) waitlisted group. Randomization was completed via a computer-generated randomized numbers table by the principal investigator. Adherence, MVPA and overall PA were considered the main primary outcomes, while TPB measures were considered secondary. In addition to these primary and secondary outcomes, physiological fitness-related and quality of life measures were regarded as tertiary outcomes. The initial follow-up assessment was conducted at the end of the nine-week intervention, while a secondary follow-up was performed at 12-weeks. Table 1 provides an overview of the various measurements taken over the course of the study and when the variables were measured.

Due to the potential novelty of the exercise programs, it was important to expose the participants to the assigned exercise program first prior to measuring the secondary motivational outcomes. Thus, baseline TPB measurements for the affective attitude, instrumental attitude, descriptive norm, injunctive norm, PBC, and intention constructs were completed after the participants' orientation session. By doing this, it provided participants with a consistent impression regarding the assigned exercise program and allowed for a better assessment of

motivation. These procedures have been established in previous exergaming studies (Mark & Rhodes, 2013; Rhodes, Warburton, et al., 2009).

Based on the TPB framework and the recommendations outlined by Ajzen & Fishbein (1980), structured interviews were conducted at the end of the 9-week intervention to investigate the beliefs derived from the regular use of the DVD or exergame. Participants were able to discuss their overall experience and anything that could not be noted from the questionnaires.

Table 1

Outcomes and Measurement Times

Variable	Baseline (T1)	Week 4 (T2)	Week 9 Follow-Up (T3)	Week 12 Follow-Up (T4)
Adherence	√	√	√	
MVPA/PA	√	√	√	√
TPB	√	√	√	
Fitness	√		√	
Quality of Life	√		√	

Participants

The intervention was aimed at increasing PA in healthy adults in transitioning into retirement. Therefore, in order to be eligible for the study, individuals had to be: 1) between the ages of 60 and 70 years, 2) not meeting the national recommendations of 150 minutes of moderate to vigorous PA (Tremblay et al., 2011), 3) exhibiting no contraindications to exercise according to the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+), 4) exhibiting no signs of cognitive impairment by scoring a minimum of 28 points on the Telephone Interview for Cognitive Status Questionnaire (TICS-M) (Brandt, Spencer, & Folstein, 1988; Wolfson et al., 2009), 5) residing in the Greater Victoria Area, and 6) able to comprehend and speak English.

Recruitment and Sampling

A rolling recruitment was employed and participants were enrolled from January 2013 to January 2014. Printed advertisements were posted at local recreation centres, healthcare clinics, shopping malls, and senior centres in the Capital Region District of British Columbia. In addition, various retirement associations were contacted and electronic versions of the recruitment poster were sent via email or printed in the organization's newsletter.

Based on an overall sample size of 27 participants and a moderate effect size of $\eta^2 = .05$ for the main effect of time on MVPA, the study powered at .50. With the study being underpowered, it will only investigate feasibility of the DVD and exergame programs and serve as a pilot intervention. Thus, the study will primarily focus on trends in the data rather than on statistical significance.

Procedures

Prior to the initial baseline assessment, pretesting instructions were sent via email. Pretesting instructions were based on the Canadian Physical Activity, Fitness and Lifestyle Approach (CPAFLA) protocols and informed the participant to 1) avoid strenuous exercise two days prior to testing day, 2) refrain from excess alcohol use 24 hours prior to the assessment, 3) have a light meal one hour before testing, and 4) wear proper exercise attire. Participants travelled to the university for their 1.5-hour initial appointment. At the university, the researcher reviewed the details of the study and addressed any potential questions or concerns. Ethical approval from the Human Research Ethics Board at the University of Victoria was granted before commencing and all participants provided informed consent before any measurements were taken. Once written consent was obtained, a formalized copy of the PAR-Q+ and a questionnaire regarding the participant demographic information and health-related quality of life were administered. For the second half of the assessment, a Canadian Society for Exercise Physiology (CSEP) certified personal trainer facilitated the fitness assessments. At the end of the session, the participant wore an accelerometer for a week prior to starting the program to obtain baseline activity levels.

Once the seven days of accelerometry was completed, the group assignment was revealed and an orientation session was booked with the participant. Individuals assigned to the control group were instructed to continue with their current PA. For those assigned to an exercise condition, a 60-minute orientation session was scheduled to familiarize participants to the program and address any technical issues. The initial 45-minutes was dedicated to help participants become familiarized with the technology, exercises performed, the 10-point Borg rating for perceived exertion (RPE), and heart rate intensities. For the final 15 minutes of the

session, a TPB questionnaire (Ajzen, 1991) was administered. As well, a copy of Canada's PA Guideline for older adults reviewed and provided to the participant. Participants were encouraged to adhere to the exercise prescription of four 45-minute exercise sessions per week, and engage in other activities to meet or exceed the guideline's recommendations of 150 minutes of MVPA per week. Finally, exercise sessions for the rest of the week were scheduled.

Participants took part in supervised exercise sessions at the university for the first three weeks. All sessions were monitored by a CSEP certified personal trainer to ensure proper exercise technique and safety and to address any potential technology-related issues. In the case that exercises were too difficult to perform or contraindicated, the exercises were modified. Participants were required to schedule their exercise sessions for the following week at the end of each week.

Once the supervised sessions were completed at the end of week 3, a questionnaire regarding motivation to continue with the program was administered. Participants were provided with all the necessary equipment to continue exercising at home and encouraged to adhere to the prescribed four exercise sessions per week. Participants in the DVD group took home the exercise DVD, 3 resistance bands with varying tensions (low, medium, high), heart rate monitor, RPE and heart rate chart, and logbook. Whereas, participants in the exergaming group brought home the exergame and accessories (sensor/heart rate armband, leg sensor, resistance band), Wii console, RPE and heart rate chart, and logbook. Seven days of accelerometry was obtained from the participant for the first week of the in-home component of the study (i.e., week 4).

At the beginning of week eight, an accelerometer was given to the participant to wear and an end-of-intervention assessment was scheduled. At nine-week assessment, all baseline measures were reassessed. Questionnaires for the TPB items were framed based on the

hypothetical situation that the participant would be able to continue with the assigned condition. At the end of the follow-up assessment, a qualitative interview was conducted.

A post-intervention follow-up assessment was performed at 12 weeks. At this point, the researcher obtained a final measurement of PA and provided the participant with a questionnaire inquiring about whether the participant purchased and continued utilizing the prescribed equipment, any potential reasons for not purchasing the equipment, and any other PA adopted since the study ended.

Intervention

Exergame condition. Participants assigned to the exergaming condition utilized the Nintendo Wii™ (Nintendo of America Inc., Redmond, Washington) console along with the Electronic Arts (EA) Sports Active 2™ game. Exercises found in EA Sports Active 2 were comparable to those found in Wii Fit, which has shown to elicit light to moderate intensities in older adults (Graves et al., 2010; Mullins, Tessmer, McCarroll, & Peppel, 2012) and commensurate with the American College of Sports Medicine guidelines for improving and maintaining aerobic fitness (Guderian et al., 2010).

Participants assigned to this group used a pre-existing program designed for adults of all ages. Over the course of 9 weeks, the participant exercised with a virtual personal trainer that provided guidance and encouragement during the exercise sessions. A wireless motion tracking system, located in leg and arm straps, relayed information regarding the user's movement to the console. The integration of a heart rate monitor in the armband provided the participant with real-time heart rate information and allowed the user to monitor exercise intensity for each exercise session.

Each session had a distinctive focus on developing cardiovascular fitness or strengthening the whole body, upper extremities, or lower extremities via traditional exercises, games, and sporting/recreational activities. A warm-up component consisting of a series of dynamic stretches; strengthening, cardiovascular, and/or dynamic balance exercises; and a stretch/cool-down segment was included in each workout. At the onset of each novel exercise, the game offered instructional videos on how to execute the movement correctly and safely prior before the participant performed the exercise.

Strengthening exercises incorporated resistance bands and body-weight exercises and were performed in single sets of 8-20 repetitions. While cardiovascular exercises required the participant to move bouts of 30 seconds or more. Exercises focused on developing dynamic balance utilized single sets of 8-10 repetitions where the participant was required to shift their centre of gravity in different directions. Exercises became progressively challenging over the 9-weeks. To increase difficulty, participants were required to use more complex movements (e.g., single-joint exercises to multi-joint exercises). Other methods of progression included increasing the duration of individual exercises performed (e.g., increased time or repetitions) or the total number of exercises each session.

The exergame featured self-regulatory features and allowed the participant to schedule the required number of sessions every week; set goals driven by the calories expenditure, overall exercise time, and number of sessions per week; provide real-time information and feedback about the completed session (e.g., duration of the session, average heart rate, calories burned, percentage of exercises completed); and monitor their progress.

Supervised 45-min sessions during the first three weeks were aimed at providing support for proper exercise technique and safety and any technical issues related to the game. In cases

where participants had previous injuries and could not perform a particular exercise, modifications were given or the exercise was avoided completely.

DVD condition. Participants assigned to the DVD group received the Older and Much Wiser DVD, which was specifically marketed to individuals over 65 years. The 68-minute DVD-program was separated into six sections: 1) warm-up, 2) low impact aerobics, 3) aerobic cool-down, 4) resistance band and body-weight strengthening exercises, 5) balance training, and 6) cool-down and stretch. The DVD was divided into two separate 45-minute exercise components. Participants alternated between an aerobic, and a strength and balance program. For the aerobic component, participants performed a warm-up, moderate-to-vigorous intensity low-impact aerobic exercises, and aerobic cool-down sections. While strength and balance component consisted of a warm-up, strengthening and balance and stretching exercises.

During the supervised in-lab sessions, research staff provided modifications to exercises and support for any technical issues. Exercises were modified based on physical limitations indicated by the participant. As well, participants had the option of choosing a low-, medium-, high-tension resistance bands as a progression for the strengthening exercises. Heart rate monitors (Polar FS1, Polar Electro Oy, Finland) and a 10-point RPE scale were provided to participants to monitor their exercise intensity during the sessions.

Control condition. Individuals randomized into this group were put on a waitlist and instructed to continue with current PA. At the end of the 12 weeks, participants were given the option of enrolling into one of the two exercise programs.

Ethical Considerations

Ethical approval from the University of Victoria's Human Research Ethics Board was obtained prior to the start of the study. The consent form provided to the participant and any

questions or concerns were addressed prior to obtaining written consent. Once consent was obtained, the right to withdraw from the study at any time without any explanation or consequence was communicated to the participant. In the case that a participant requested to withdraw from the study, a withdrawal form was completed and signed to grant the researcher permission to use the existing data.

Questionnaires

Demographic and health status. Participants reported age, gender, ethnicity, marital and employment status, education level, household income, present and past health status (i.e., smoking, chronic disease), and previous video and computer gaming use. These questions have been used in previous exergaming research (Mark & Rhodes, 2013; Rhodes, Warburton, et al., 2009).

Primary Measures

Adherence. The participant's attendance and reported usage were used to assess program adherence. For the initial three weeks of the intervention where the participant exercised in the lab, the researcher recorded the participant's attendance. Adherence data for the in-home portion of the intervention was obtained by asking the participant to track their usage in a logbook provided by the researcher. This logbook has been adapted from a prior research (Mark & Rhodes, 2013). Participants were instructed to record the date and time of usage, the duration of usage, and brief comments or notes after each exercise session.

Objectively measured physical activity. The ActiGraph GT1M (LLC, Pensacola, FL) was used to assess overall PA and moderate to vigorous physical activity (MVPA). This lightweight (27 g) and compact (3.8 x 3.7 x 1.8 cm) device was able to detect vertical and

anterior-posterior accelerations. This particular model has been validated against doubly labeled water and indirect calorimetry (Colbert, Matthews, Havighurst, Kim, & Schoeller, 2011), found to be a reliable way to measure both sedentary and PA behaviours in the older adult population (Colbert et al., 2011; Hart, Swartz, Cashin, & Strath, 2011; Miller, Strath, Swartz, & Cashin, 2010), and used in epidemiological research (Evenson, Buchner, & Morland, 2012).

The accelerometers were initialized to record 60-second epochs using the ActiLife software (ActiGraph, LLC, Pensacola, FL). Participants were instructed to wear the accelerometer for a minimum of 10 hours each day during waking hours for a total of seven consecutive days. The device was worn on a waist belt and sat anterior to the right iliac crest and participants were told to remove the device prior to sleeping and participating in water-based activities (e.g., bathing, swimming). A log was provided to the participant for the purpose of recording the daily wear times and PA during the week.

A number of reviews have shown a variety of cut-points for the classifying the various levels of PA intensities and appropriate thresholds have yet to be established (Bento, Cortinhas, Leitão, & Mota, 2012; Gorman et al., 2014; Kowalski, Rhodes, Naylor, Tuokko, & MacDonald, 2012; Strath, Pfeiffer, & Whitt-Glover, 2012; Taraldsen, Chastin, Riphagen, Vereijken, & Helbostad, 2012). Cut-offs for this study were delineated as: 1) less than 100 counts per minute for sedentary time, 2) 101 to 1951 counts per minutes for light intensity PA, and 3) 1952 counts per minute or more for MVPA (Freedson et al., 1998). Despite the contention of various cutoffs for this population, a significant proportion of studies have utilized these particular cut-offs; thus, using these recommendations would allow for the comparability of our results (Gorman et al., 2014). Moreover, applying thresholds previously used for a younger adult population may be appropriate, since the participants enrolled in this study were quite healthy and did not report any

major functional limitations. While lower cut-points for older adult MVPA exist in the literature, using thresholds less than 1952 counts per minute may be appropriate when dealing with individuals with age-related decline in fitness (Gorman et al., 2014). As a result, using a lower threshold may overestimate MVPA in our sample.

In order for the accelerometer data to be included in the subsequent analyses, the data had to meet the minimum criteria of five full days (i.e., 1 weekend and 4 weekdays) and 600-minutes of wear time. Non-wear time was defined as 120-minutes of consecutive zeroes (Hutto et al., 2013). Research has shown that five days were sufficient enough to reliably predict total and MVPA in older adults (r = .85-.90) (Hart et al., 2011). Data cleaning and reduction rules for incomplete activity monitoring data was based on the procedures outlined from prior research (Esliger, Copeland, Barnes, & Tremblay, 2005). In instances where the participant indicated a specific reason for the removal of the device (e.g., 60 minute aquatic class), MET values from the Compendium for PA was identified and corrected for age, height and weight prior to having the data modeled (Ainsworth et al., 2011; Kozey, Lyden, Staudenmayer, & Freedson, 2010). To account for the missing times on weekdays, the data was modeled in from the available data from the other weekdays. While missing data for weekend days, the data was modeled from the existing weekend day.

Secondary Measures

Beliefs regarding DVD and exergame use. To assess the beliefs about exergame and exercise DVD use was based on the TPB constructs (Ajzen, 1991). The development of behavioural, normative, and control beliefs measures were based on the recommendations of previous work (Ajzen, 2006). These measures have been further adapted to the context and duration of this particular study. Each item was based on a seven-point Likert scale framed in the

context of using the exercise DVD or exergame "at a moderate to vigorous intensity for at least 30 minutes for at least four times per week."

The TPB's attitudinal construct was broken down to instrumental and affective attitudes. For instrumental attitude, participants rated three items based on their perception of the equipment as being useful-useless, wise-unwise, and beneficial-harmful. The internal consistency for this construct is α = .30 (baseline), α = .89 (week 3), and α = .80 (week 9). While three items measured affective attitude by asking whether the participant felt that using the equipment was enjoyable-unenjoyable, pleasant-unpleasant, and exciting-boring. The aggregated variables for this construct had an internal consistency of α = .61 (baseline), α = .87 (week 3), and α = .94 (week 9). Due to the low internal consistencies found at baseline for instrumental and affective attitudes, item two and item five were removed. With these items removed, the internal consistency for instrumental attitude were α = .75 (baseline), α = .68 (week 3), and α = .76 (week 9). For revised affective attitude consistencies, α was .74 (baseline), .86 (week 3), and .98 (week 9).

Subjective norm measures required participants to rate from 1 (strongly disagree) to 7 (strongly agree) to several statements. For the sub-construct of injunctive norm, individuals responded to two items: "most people who are important to me would want me to engage in regular exercise with the exergame or exercise DVD over the next three weeks" and "most people whose opinions I value would expect me to engage in regular exercise with the exergame or DVD program over the next three weeks". The internal consistency for this construct at each measurement point was α = .95 (baseline), α = .42 (week 3), and α = .93 (week 9). Descriptive norm was assessed through the items, "most people who are important to me will exercise with the exergame or DVD over the next three weeks themselves" and "I feel pressure to exercise

with the exergame or DVD the next three weeks from the people who are important to me." The internal consistencies for this construct was $\alpha = .27$ at baseline, $\alpha = .47$ at week 3, and $\alpha = .43$ at week 9. With the poor consistencies for descriptive items two and four were removed.

For PBC, participants rated three items on a seven-point Likert scale (1 = strongly disagree to 7 = strongly agree. The items required participants to respond to statements such as, "exercising with the exergame or exercise DVD over the next three weeks is under my control if I really wanted to" and "how confident do you feel that you could engage in regular exercise on the exergame or exercise DVD over the next three weeks if you really wanted to." Internal consistencies for this construct was baseline $\alpha = .28$, week 3 $\alpha = .37$, week 9 $\alpha = .53$. To improve the internal consistency for this measure, items two and three were eliminated from the analysis.

Intention to exercise with the equipment was assessed by two items. Participants responded to a seven-point Likert scale (1 = strongly disagree to 7 = strongly agree) to statements like, "I plan to engage in regular exercise with the exergame or DVD over the next 3 weeks" and "I intend to engage in regular exercise with the exergame or DVD over the next 3 weeks. The aggregated variables had an internal consistency of $\alpha = .65$ (baseline), $\alpha = -.13$ (week 3) and $\alpha = 1.00$ (week 9). Based on the poor consistency seen at week 3, item one was removed.

Tertiary Measures

Health-related quality of life. The Short-Form Health Survey-36 (SF36) was used to measure the participant's perceived health-related quality of life (Ware & Sherbourne, 1992). The items from the SF36 measure were clustered into the following scales: physical functioning (10 items), roles limited by physical health (four items), bodily pain (two items), general health

perceptions (five items), vitality (four items), social functioning (two items), roles limited by emotional problems (three items), and mental health (five items). An algorithm was then used to transform responses to a 0-100 scale and then averaged for each domain, such that higher scores indicated higher functioning (Ware, Kosinski, Turner-Bowker, & Gandek, 2002). The SF36 has been previously validated for the Canadian adult population (Ware & Gandek, 1998).

The internal consistency for each of the eight domains ranged acceptable to excellent. The internal consistency for each domain were: physical functioning baseline $\alpha = .81$, week 9 $\alpha = .89$; roles limited by physical health baseline $\alpha = .88$, week 9 $\alpha = .93$; bodily pain baseline $\alpha = .82$, week 9 $\alpha = .93$; general health perceptions baseline $\alpha = .81$, week 9 $\alpha = .80$; vitality baseline $\alpha = .79$, week 9 $\alpha = .85$; social functioning baseline $\alpha = .77$, week 9 $\alpha = .92$; roles limited by emotional problems baseline $\alpha = .83$, week 9 $\alpha = .92$; mental health baseline $\alpha = .81$, week 9 $\alpha = .79$.

Blood pressure and resting heart rate. An automatic blood pressure monitor (LifeSource UA-787EJ, A & D Medical, Milpitas, CA) was used to assess the participant's blood pressure and heart rate. For the initial five minutes, the participant sat quietly and motionless. The cuff was applied to the participant's left arm at the level of the heart. Once the device was activated the cuff inflated and took the participant's blood pressure and heart rate. The information was present on the screen and recorded by the fitness assessor.

In the case that the participant had a resting heart rate of 100 beats per minute or more, systolic blood pressure of 144 mmHg or more, or diastolic pressure of 94 or more, the participant remained seated quietly for an additional five minutes and the heart rate was taken again. If the reading remained the same, the participant was advised to obtain a medical clearance by their physician. If the participant indicated that they did not adhere to the pre-test protocols (e.g.,

caffeine within the last two hours), the participant was rescheduled a week later for the fitness assessment.

Height, weight and body mass index. Participant's height and weight were assessed using a calibrated scale and stadiometer (Heath o meter 402KL; Jarden Consumer Solutions, Boca Raton, FL). The standard procedures outlined by the CPAFLA manual were used (Gledhill & Jamnik, 2003). The participant removed footwear and was asked to stand and remain still as they stood on the scale and the weight was recorded to the nearest 0.1 kg. For height, the participant stood tall, with the feet together, and arms hanging by their sides while looking straight ahead. Height was recorded to the nearest 0.1 cm. Body-mass index (BMI) was calculated by dividing the participant's weight by height in meters squared (kg/m^2).

Waist circumference. Protocols set by the National Institutes of Health and adopted by the CSEP were used to assess abdominal obesity (Gledhill & Jamnik, 2003). The participant was instructed to stand with their feet shoulder width apart and arms crossed over the chest in a relaxed manner. The assessor ensured that the abdomen was clear of any clothing or accessories. The superior aspect of the iliac crest was located through palpation. Once located, the landmark was marked at the midline of the body. The measuring tape was then applied tautly around the participant's waist, such that the bottom aspect of the tape was at the level of the landmarked point and parallel to the floor. Upon a normal expiration, the waist circumference was recorded to the nearest 0.5 cm.

Balance. The Fullerton Advanced Balance (FAB) Scale (Rose, Lucchese, & Wiersma, 2006) was used to assess both static and dynamic balance under various sensory conditions. The performance battery consisted of 10 different tests and items were scored on a 5-point ordinal scale from 0 to 4 points. Participants were able to obtain a score out of 40 points. The

development of FAB battery was based on empirical evidence and has shown high test-retest reliability (r = .96) in functionally independent OA (Rose et al., 2006).

Grip strength. Grip strength was assessed in both hands using a handgrip dynamometer (T.K.K. 5001 Grip A; Takei Scientific Instruments Corporation, Niigata City, Japan). Handgrip performance has been associated with functional limitations, premature mortality, and disability for aging adults (Bohannon, 2008; T Rantanen et al., 1998; Taina Rantanen et al., 1999). According the CPAFLA protocols, the dynamometer was adjusted so that the second joint of the fingers fit snugly under the handle (Gledhill & Jamnik, 2003). Participants were instructed to stand with their feet shoulder width apart and hold the dynamometer in line with the forearm at the level with the thigh slightly away from the body. As well, participants were encouraged to exert a maximal isometric contraction for three to five seconds, while exhaling simultaneously to prevent increased intrathoracic pressure. Grip strength for each hand was measured alternately allowing for a total of two trials per hand. Participants were allowed two practice attempts for each hand for the purpose of familiarization. Scores were recorded to the nearest kilogram. The combined maximum of the best scores for each hand was used in the analysis.

Functional Fitness Measures. The assessor followed the standard protocols outlined in the Senior Fitness Test to assess functional fitness (Rikli & Jones, 2012). These tests assessed the participant's ability to perform activities of daily living. Only tests pertaining to the lower extremities were examined, thus a total of three subtests were from the whole battery. The tests used were the: sit-and-reach test, chair-stand test, and the six-minute walking test. All recorded trials were preceded by a demonstration and practice trial. Previous research has shown that the fitness battery has acceptable test-retest reliability (r = .81-.98), construct validity, and criterion validity (r = .71-.82) (Rikli & Jones, 2012).

Chair stand test. To assess the strength of the lower extremities, participants performed as many sit-to-stand repetitions within a 30-second time frame. Participant began in a seated position with their arms held across their chest. When the signal was given, the participant rose to standing position, and then returned to a fully seated position. The score was based on the total number of stands completed. Repetitions where the participant did not fully extend their legs were not considered.

Chair sit-and-reach test. Flexibility of the hamstrings was evaluated through a chair sit-and-reach test. The participant sat on the edge of the chair with their leg extended and foot flexed at 90 degrees. With arms outstretched and hands overlapping, the participant slowly reached as far forward toward or past the toes. Participants were given the opportunity to practice on both legs to determine the preferred leg. The scoring was based on the distance in centimeters between the midpoint at the toe of the shoe and the tips of the middle fingers. If the reach was short, a minus score was given; while individuals who were able to reach past the toes were awarded a positive score. In the case that the individual was only able to touch his or her toes, a score of zero was recorded. The best score was used in the analysis.

Six-minute walking test. Aerobic endurance was assessed by the six-minute walking test (6MWT). Participants were instructed to cover as much distance as possible by completing laps around a marked rectangular track within a six-minute timeframe without running. The tester tracked the number of laps completed and indicated the time remaining to the participant every two minutes. The number of laps completed was converted to an overall distance covered in metres.

Timed-up and go. Functional mobility was assessed through the timed up and go test (Podsiadlo & Richardson, 1991). A cone was placed three metres from a chair. Participants were

instructed to start the test in a seated position with their back against the chair with their arms in their lap. When given the cue to go, the participant stood up and walked at a normal pace towards the cone. Once at the cone, the participant walked around the cone and back towards the chair, returning to their original seated position. Each participant was given a demonstration on how to perform the assessment and then allowed one practice trial. Once the practice trial was completed, the participant completed two recorded trials. The average time of both trials was used in the analysis.

Manipulation check for exercise sessions and six-minute walking test

Heart rate and rating of perceived exertion. To ensure that the aerobic assessments and exercise components were performed at a moderate-to-vigorous intensity, individuals reported their heart rate and perceived exertion while exercising. All participants were familiarized with a 10-point rating of perceived exertion (RPE) scale (Foster et al., 2001), and a heart rate monitor (Polar FT1; Polar Electro Oy, Kempele, Finland) and the associated intensities prior to exercise.

For the six-minute walking test, participant heart rates and RPE were recorded at 1-minute intervals. For the exercise component, participants reported their heart rate and RPE while performing the strength and aerobic exercises for the first 3 (exergame condition) or 6 (DVD condition) sessions. The reported heart rates and RPEs were subsequently averaged over the six minutes or based on the type of exercise performed (i.e., resistance or aerobic). For heart rate intensity, the calculated average heart rate was divided by the maximum heart rate (i.e., 208 – 0.7 X age) to obtain a percentage of heart rate max (Tanaka, Monahan, & Seals, 2001). While for intensities derived from average RPEs, the average RPE was reference to the corresponding number on the 10-point RPE scale (Foster et al., 2001).

Qualitative interview. Beliefs regarding the participant's experience using the equipment were elicited by asking participants about their perspectives on the usage and sense of enjoyment while using the equipment, barriers or challenges to using the equipment, and whether the exergame or exercise DVD was a valuable piece of equipment to have at home. The aim of this interview was to act as an elicitation study to understand the beliefs held by the individual about their subjective experience with using the exercise DVD or exergame (Ajzen & Fishbein, 1980). Due to the novelty of these types of screen-based exercise programs, questions regarding social norm were not relevant or useful and omitted.

Questions were framed to ask the participant to reflect on his or her own regular use of the exercise DVD or exergame (i.e., four times per week for at least 30 minutes at a moderate to vigorous intensity). Participants responded to questions such as "what do you feel are the benefits of using the exercise DVD or exergame, did you use the exercise DVD or exergame as recommended over the past five weeks, what do you perceive as barriers to using the DVD or exergame or what prevented you from using the exercise DVD or exergame," and "do you think that the exercise DVD or exergame is a valuable program to have within the home." Older adults had an opportunity to express any additional concerns that they had regarding the intervention at the end of the interview. These questions have been used in previous exergaming research (Mark & Rhodes, 2013).

Analysis

All statistical analyses were conducted using SPSS version 20.0 software (SPSS Inc, Evanston, Ill). Based on the exploratory nature of this pilot study will focus on exploring the trends in the data rather than significance. For the various analyses employed, a total of five effect sizes were used. Correlation-based analyses used Pearson's r. For these effect sizes, a

magnitude of .10 was deemed small, .30 as medium, and .50 as large (Cohen, 1992). While mixed ANOVA analyses used eta squared (η^2) effect sizes. Here, effect sizes of .02 were quantified as small, .06 as medium, and .14 as large. For t-tests, Cohen's *d* effect sizes were computed. For these coefficients, effects of .20 were small, .50 were medium, and .80 were large effects. The final effect size in the regression analyses employed a standardized β, where the magnitudes were interpreted in the same manner as *r*. Effect sizes denoted by *h* were also interpreted the same way as Cohen's *d* effect sizes. As a secondary consideration given to the pilot-level of the intervention, the probability alpha was set at $p < .05$.

Data cleaning. Prior to the analyses, the data set was carefully examined for errors by inspecting data entry and using frequency plots. Subsequent analyses were conducted to examine the internal consistencies for the TPB variables. Once completed, the distribution of all the variables included in the analysis was assessed for normality. Skewedness was based on the z-score distribution where skewedness greater than 2.58 and outliers greater than 3.29 were considered to be problematic (Field, 2009). To resolve this, the outlier was converted to a value that was equal to two standard deviations from the mean.

Missingness and multiple imputation. Prior to the imputation of missing data, it was important to identify the mechanisms of missing data in the data according to Rubin's classification system: missing completely at random, missing at random, and missing not at random (Allison, 2001; Graham, 2012a; McKnight, McKnight, Sidani, & Figueredo, 2008; Schafer, 1997). To do this, relationships between health and demographic variables and missing data were examined. Through SPSS's multiple imputation function, patterns of missing data was examined based previously established procedures (Graham, 2012b). To examine the

relationship between health and demographic and missing data, missing data was dummy coded as 0 (i.e., missing) or 1 (i.e., completed).

Descriptive statistics. Descriptive statistics were used to describe the study population. A correlation matrix was constructed for each group to examine the associations between the descriptive, TPB, and adherence variables. Bivariate correlations between descriptive, TPB, and adherence variables were performed and presented in a matrix format

Adherence. Independent t-tests were performed to compare the average number of exercise sessions per week during the in-lab, in-home, and 9-week intervention between the DVD and exergame groups.

Physical activity. To compare the total weekly count for PA behaviour across four separate measurement points, separate mixed ANOVA analyses were conducted for MVPA and overall PA counts. Separate analyses were performed for each measurement point relative to baseline measures (i.e., week 4, 8 and 12). The analyses focused on the intervention group by measurement time interaction and the time main effects. The dependent variable that was examined was the average minutes of MVPA and overall PA minutes per week, while the independent variables will be the intervention group and measurement time.

Theory of planned behaviour variables. Prior to analysis, the scores for the TPB constructs were averaged. Separate mixed ANOVA analyses were conducted between the two exercise groups at each measurement point relative to baseline measures (i.e., week 3 and 9). In this analysis, the intervention group by time interaction and the time main effect were investigated. The independent variable for this analysis was time and group assignment, and the dependent variable was the score for each construct of the theory.

Multiple regression analyses were performed to predict intention and overall adherence for the in-lab and in-home phases of the study. Demographic and medical/health variables, affective attitude, instrumental attitude, injunctive norm, descriptive norm, and PBC were used as predictor variables for intention. A multiple regression analysis was used to predict adherence. For this particular analysis, PBC and intention were used.

Functional fitness and quality of life measures. Pre- and post-intervention scores for each the fitness assessments and different domains from the SF-36 were tallied. To evaluate the differences between the groups, a mixed ANOVA was used to compare the group means across two time points. Here, the dependent variable was the overall score for the specific fitness test or the SF-36 domain. The independent variable in this analysis was the intervention group and measurement time.

Equipment adoption. The number of individuals that adopted the equipment after the intervention was expressed as a percentage based on the number of people that purchased and exercised with the equipment and the total number of people assigned to each exercise condition. A chi-square analysis was used to determine whether the proportions of adoptees in both groups differed from each other.

Qualitative data analysis. Recorded interviews were voided of any identifying characteristics and transcribed verbatim. Once transcribed, the data was imported and coded. The initial step was to perform a content analysis by reducing and interpreting the data (Patton, 2002). The main purpose of this step was to assign labels and organize the responses to later develop categories or themes within the data (Morse, 1994).

In the preliminary step, the transcripts were carefully reviewed and coded based on common words or phrases (Patton, 2002). A second round of coding was performed and

categories were redefined to elicit substantial themes (Morse, 1994). Once this process was completed, the results from the analyses were framed according to the TPB constructs (i.e., attitude, perceived behavioural control) used in the interview.

Chapter 4: Results

Participant Flow

A total of 59 people expressed their interest in participating in the study. Thirty-two of these individuals did not ultimately enroll in the study based on the following reasons: 1) declined to participate prior to enrollment (n = 18), 2) exceeded 150 minutes of MVPA per week (n = 8), 3) had contraindications to exercise (n = 5), and 4) did not meeting the minimum score required for the cognitive screen (n = 1). Overall, 27 individuals were randomized in to the control (n = 9), DVD (n = 9), and exergame groups (n = 9). Two individuals were lost at follow-up in the control group, but provided consent to have their data incorporated into the final analysis. Figure 1 details an overview of the participant flow.

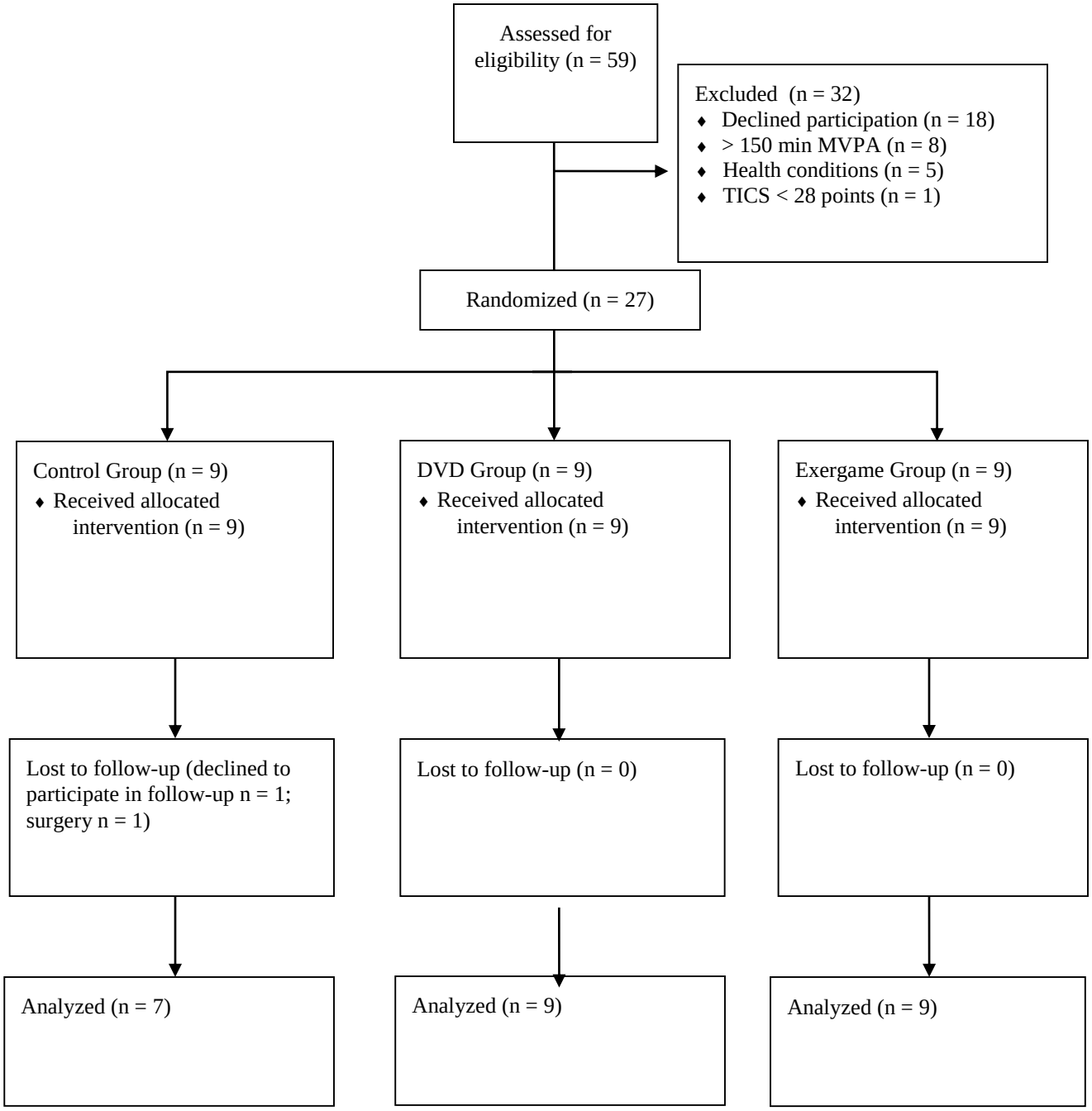

Figure 2. CONSORT participant flow diagram.

Missingness and Multiple Imputation

Based on the outputs derived from SPSS, there were no problematic patterns of missing data (i.e., cases where no data was present). Reasons for missing data were due to dropout, equipment malfunction (e.g., accelerometer did not record any PA data), and follow-up measurement could not be obtained (e.g., illness, scheduling conflict). The subsequent examination of bivariate correlations revealed a significant association for TICS score ($r = -.46$, $p = .02$) and T1 accelerometer missingness. However, associations between all other demographic and health variables and missingness were not significant ($p > .05$).

Based on the missing data analysis and overall association among missing data, it was concluded that data was not missing at random. Based on this assumption, 40 imputations were applied to variables that were missing 10% or more (procedures outlined in Graham, 2012b). Imputations were specifically applied to PA variables. Variables included as predictors in the imputation model were age at baseline, TICS Score, gender, ethnicity, education, employment, income, and self-reported health.

Baseline Characteristics of Participants

Baseline characteristics of the participants are illustrated below in Table 2. Overall, participants were mostly female, Caucasian, university educated, and a household income of greater than $50,000. The mean age was 64.59 ($SD = 2.89$). All groups at baseline had similar characteristics except for mean age. One-way ANOVA analyses found that there was a significant difference among groups with regard to mean age ($p < .05$). Post hoc analyses showed that the average of the participants assigned to the DVD group were significantly younger than those in the control group ($d = .23$, $p < .05$). There were no meaningful differences between groups at baseline for primary and tertiary outcome variables. However, among secondary

variables, meaningful differences were found for injunctive norm (d = .87) and intention constructs (d = .64). Bivariate correlations between demographic variables, TPB variables and adherence are presented in Table 3.

Table 2

Participant Demographics and Baseline Characteristics

Characteristics	Overall (n = 27)		Control (n = 9)		DVD (n = 9)		Exergame (n = 9)		Effect size[a]	p-value
	M	SD	M	SD	M	SD	M	SD		
Age (years)	64.59	2.89	66.44	1.77	63.11	3.19	64.2	2.25	.23	.04*
% female	74%		78%		67%		67%		.01	.84
% visible minority	11%		22%		0%		11%		.10	.30
% completed university	81%		78%		89%		78%		.01	.88
% household income > $50,000[b]	85%		86%[a]		100%		89%		.03	.73
% retired	56%		67%		67%		33%		.18	.10
% smokers	0%		11%		0%		0%		.08	.38
Hours of leisure-time/day	5.25	2.90	6.11	3.33	4.56	2.65	5.06	2.78	.05	.53
BMI (m/kg^2)	27.10	4.35	26.32	3.54	28.93	4.74	26.04	4.11	.09	.33
Self-reported health (range 1-5)	3.19	0.85	3.13	1.25	3.11	0.78	3.33	0.17	.02	.84
TICS score (range 1-50)	38.15	4.18	37.56	5.00	36.78	2.66	40.11	3.79	.12	.23
TPB (range 1-7)										
IA	-		-		6.89	.17	6.83	.27	.27	.69
AA	-		-		5.48	.97	5.62	.45	.19	.56
IN	-		-		6.83	.35	5.61	1.95	.87	.10
DN	-		-		2.89	1.65	3.06	1.33	.11	.82
PBC	-		-		6.89	.17	6.87	.21	.10	.80
Intention	-		-		6.82	.28	7.00	.00	.64	.08
Total PA (min/wk)	-		698.78	207.17	690.33	333.67	695.61	346.79	.09	.99
MVPA (min/wk)	-		69.67	51.24	63.22	58.45	52.99	40.07	.00	.78
Resting HR (bpm)	-		73.00	8.38	69.44	5.96	69.33	10.49	.04	.59
SBP (mmHg)	-		132.22	18.10	131.89	12.81	131.44	13.17	.00	.99
DBP (mmHg)	-		79.78	9.54	77.00	12.76	78.78	8.38	.01	.85
WC (cm)	-		92.06	11.18	97.72	9.38	86.72	13.93	.14	.16
Weight (kg)	-		72.08	14.33	82.64	10.97	71.42	12.02	.16	.13
Grip Strength (kg)	-		61.76	16.18	68.48	16.26	55.50	11.25	.13	.20
Sit to Stand (reps)	-		12.00	2.29	12.11	2.32	13.91	4.07	.09	.34
Sit and Reach (cm)	-		4.5	11.07	-6.72	9.43	.22	13.53	.15	.13
Up and Go (sec)	-		7.62	1.31	7.17	.71	7.00	1.45	.05	.53

6MWT (m)	-	538.89	63.51	572.56	58.04	528.54	49.44	.11	.25
FAB Scale (range 1-40)	-	33.24	3.70	36.11	2.89	36.00	2.40	.18	.10

Note. [a]Effect sizes are expressed as η^2; except TPB variables, which is expressed as Cohen's *d*. [b]Two participants did not report household income. 6MWT = Six-minute walking test; ADL-EP = activities of daily living affected by emotional problems; ADL-PH = activities of daily living affected by physical health; DBP = diastolic blood pressure; EF = energy/fatigue; EWB = emotional well-being; FAB Scale = Fullerton Advanced Balance Scale; GH = general health; HR = heart rate; PBC = perceived behavioural control; PF = physical functioning; SBP = systolic blood pressure; SF = social functioning; STS = sit to stand; WC = waist circumference. *$p < .05$.

Table 3

Bivariate Correlations between Baseline Demographic, TPB, and Adherence

	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Age	.20	.05	.19	.11	-.03	.33	.05	-.23	.30	-.17	-.13	.01	-.10	.36	.37	.29	.35
2. Gender		-.19	.12	.03	-.12	-.13	-.12	-.04	.37	.31	-.03	-.22	.22	.28	-.02	.15	.13
3. Ethnicity			.05	.23	.29	-.28	-.47	-.17	.09	.12	**-.86****	.47	.09	.11	.17	.21	.23
4. Education				-.07	.38	.40	-.28	-.42	.17	-.03	-.07	-.20	.27	.06	-.06	.31	.29
5. Employ.					-.27	-.11	.18	-.21	.28	-.09	-.13	-.06	-.11	.39	.07	.12	.13
6. Income						.48	.08	.08	.18	.17	**-.61****	-.03	.16	-.19	-.20	.19	.15
7. Health							.15	.15	**.70****	-.22	-.13	-.05	.41	-.08	.14	-.02	.02
8. TICS								.00	.09	.22	-.19	-.36	-.20	.38	-.22	.16	.11
9. BMI									-.27	.09	.07	-.02	-.46	-.48	.01	-.10	-.09
10. AA										.11	-.28	-.10	**.60****	.10	-.02	-.11	-.11
11. IA											-.24	-.27	.35	.00	-.01	.33	.31
12. DN												-.26	-.17	-.22	-.18	-.41	-.43
13. IN													.14	-.17	.24	-.07	-.02
14. PBC														-.16	-.12	-.03	-.05
15. Intent.															.30	.14	.19
16. Lab																.04	.23
17. Home																	**.98****
18. Overall																	

Note. AA = affective attitude; BMI = body mass index; DN = descriptive norm; IA = instrumental attitude; IN = injunctive norm; PBC = perceived behavioural control. **p* < .05; ***p* < .01

Exercise Intensity – Manipulation Check

Manipulation checks were conducted to ensure that the intensity of the exercises performed were comparable and within the parameters of moderate-to-vigorous intensity. Table 4 presents the average heart rate and rating of perceived exertion across the initial three exercise sessions.

For the resistance exercises, participants were exercising at approximately 70% of their maximum heart rate and reported this as a "moderate" to "somewhat hard" intensity based on the CR-10 Borg scale (Foster et al., 2001). Independent t-tests revealed that there was a significant difference between the exercise groups for heart rate (t_{16} = -1.07, p = .30; d = .51). As well, the reported RPE was significantly different between the two exercise groups. Individuals assigned to the exergame group reported higher RPEs than the DVD group (t_{16} = -2.57, p = .02; d = 1.24).

The intensities for the aerobic exercises performed were comparable in both exercise conditions. Exercises performed were about 80% of the maximum heart rate and reported as "somewhat hard" (Foster et al., 2001). Based on the results from the t-tests, no significant differences were found between the two groups for heart rate (t_{16} = -.89, p = .39; d = .41) and RPE (t_{16} = .02, p = .98; d = .01).

Table 4

Average RPE and Heart Rates During Exercise Sessions

	HR (bpm)		*d*	*p*	RPE		*d*	*p*
	DVD *M* (*SD*)	Exergame *M* (*SD*)			DVD *M* (*SD*)	Exergame *M* (*SD*)		
Resistance	104.56 (9.52)	112.25 (19.01)	.51	.30	2.73 (.73)	3.58 (0.64)	1.24	.02*
Aerobic	120.15 (9.39)	125.5 (16.09)	.41	.39	3.72 (.91)	3.71 (0.57)	.01	.98

Note. RPE = rating of perceived exertion. *p < .05.

Laboratory Phase

Primary Outcomes

Adherence. Over the course of the nine-week intervention, participants were able to complete a total of 36 exercise sessions (12 in-lab sessions, 24 in-home sessions). For sessions conducted in the lab, the adherence rate was 90% for the DVD group (M = 10.74, SD = 1.78) and 94% for the exergame group (M = 11.22, SD = 1.30). The average number of sessions attended each week were similar in both exercise groups (DVD: 3.58 sessions/week, SD = .59; exergame: 3.74 sessions/week, SD = .43). The between-group difference of the average number of sessions attended during the in-lab portion of the intervention was represented by a small effect size of d = .31 (t_{16} = -0.65, p = .52).

Moderate-to-vigorous physical activity. Figure 3 depicts the average minutes of MVPA for each group at the beginning and end of the laboratory phase of the intervention. Results from the mixed ANOVA analyses revealed that the group by time interaction effect approached a moderate effect size of η^2 = .05 ($F_{2,24}$ = 0.77, p = .46). The time main effect yielded a moderate effect size of η^2 = .10 ($F_{1,24}$ = 2.78, p = .11)

Post-hoc between-group comparisons showed that MVPA was similar between the DVD and control groups at the end of the in-lab phase. At the four-week measurement point, the difference between the exergame and control groups was small (d = .33). Comparisons of MVPA levels between the DVD and exergame groups showed that groups were relatively the similar during the laboratory phase of the study (baseline d = .20; week 4 d = -.13).

Post-hoc within-group comparisons saw small increases in MVPA in the DVD group from baseline levels at the end of the laboratory phase. This difference was represented by an effect size of d = .26. In the exergame group, MVPA increased substantially from baseline. The

effect size for this change was d = .65, which was representative of a moderate effect size. In the control group, levels of MVPA did not change from baseline levels (d = .05).

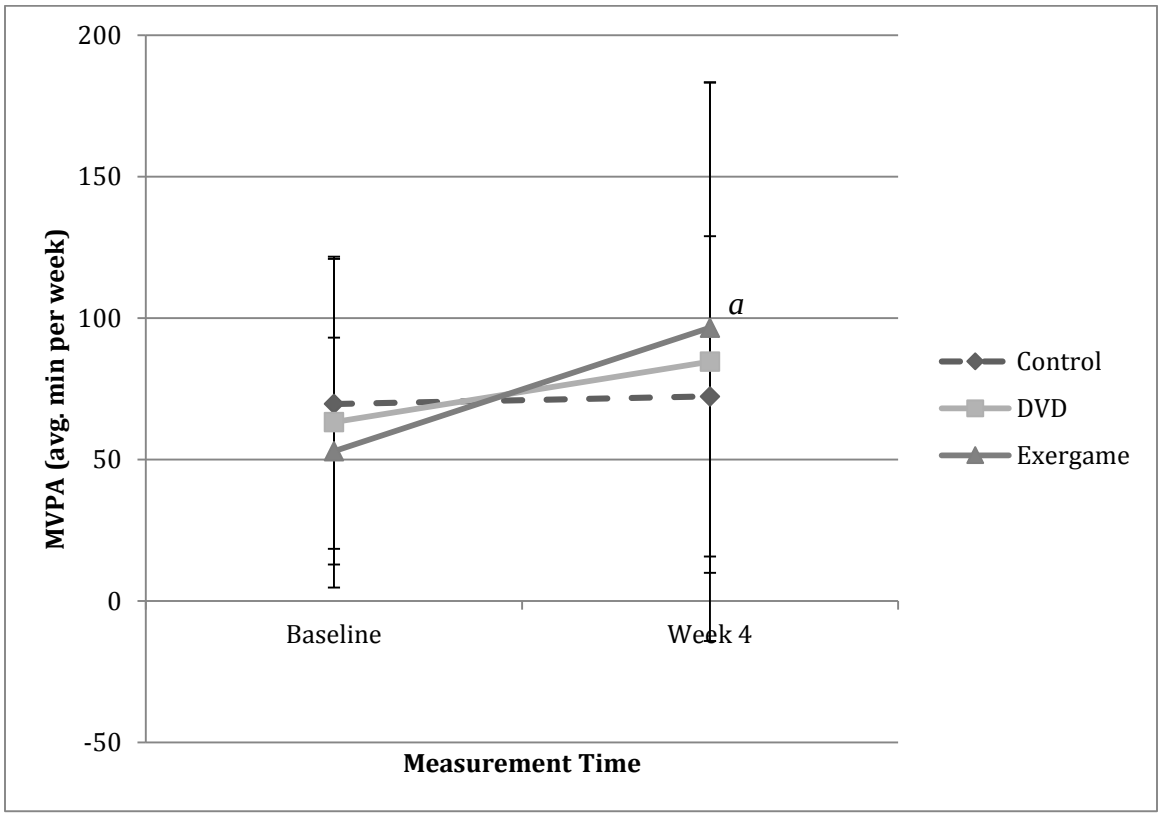

Figure 3. Average minutes of MVPA per week during the laboratory phase.

Note: * = meaningful difference, where d > .50 between at least one exercise group and control group; *a* = meaningful difference, where d > .50 between baseline and week 8 measurement.

Total physical activity. Figure 4 illustrates the average minutes of PA for the initial laboratory phase of the intervention. Effect sizes from the mixed ANOVA analyses yielded small effect sizes for the group by time interaction effect and was not statistically significant ($F_{2,24}$ = 0.16, p = .85; η^2 = .01). Similarly, the main effect of time was small and not statistically significant ($F_{2,24}$ = 0.83, p = .37; η^2 = .03).

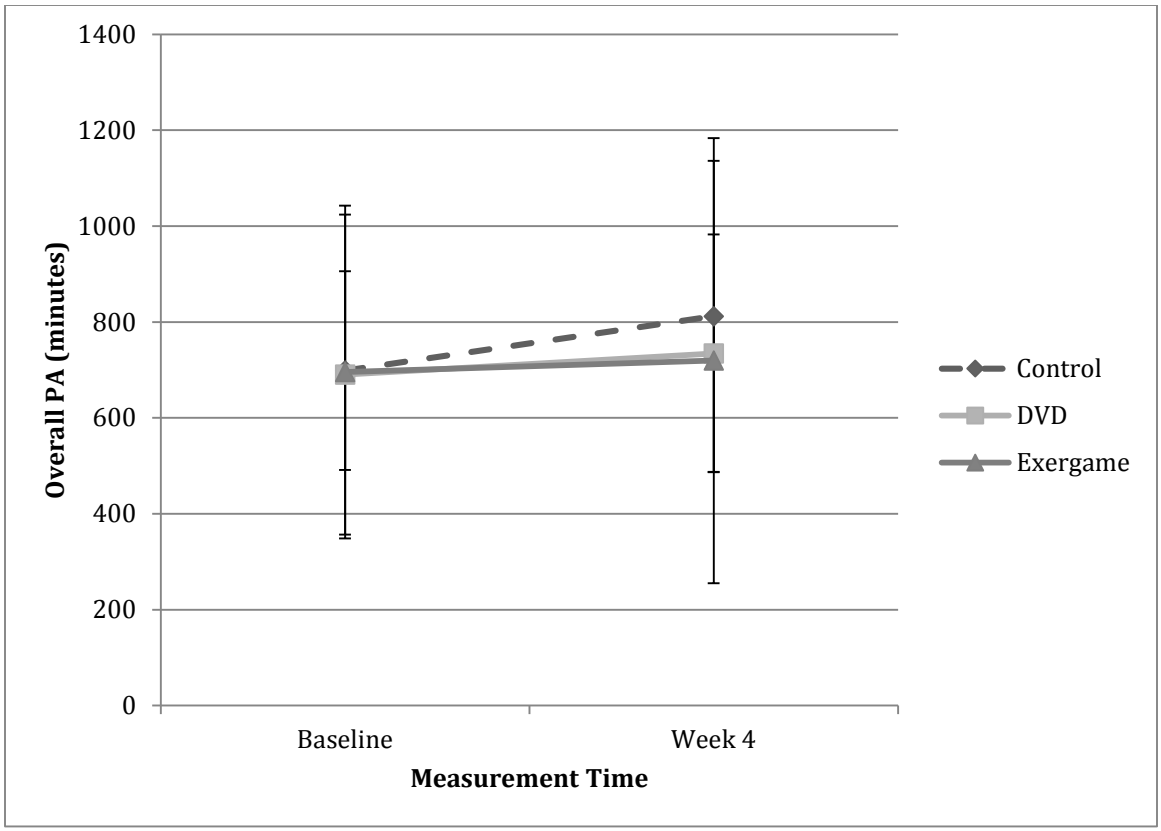

Figure 4. Average minutes of PA per week during the laboratory phase.

Note: * = meaningful difference, where *d* > .50 between at least one exercise group and control group; *a* = meaningful difference, where *d* > .50 between baseline and week 8 measurement.

Secondary Outcomes

Theory of Planned Behaviour Variables

Means and standard deviations for the TPB constructs during the in-lab portion of the intervention are presented on Table 5.

Affective attitude. Results from the RM ANOVA revealed small effect sizes for both the time by group interaction ($F_{1,16} = 0.63$, $p = .61$; $\eta^2 = .02$) and time main effects ($F_{1, 16} = 0.06$, $p = .61$; $\eta^2 = .02$).

Instrumental attitude. ANOVA results indicated that there was no time by group interaction effect and main time effect ($F_{1,16}$ = 0.13, p = .13; η^2 = .01).

Injunctive norm. Mixed ANOVA analyses resulted in statistically significant moderate-to-large effect sizes for both the time by group interaction ($F_{1,16}$ = 5.36, p = .03; η^2 = .19).

Post-hoc analyses showed that the scores in the DVD group were higher than the exergame group at week four. The magnitude of this difference approached a medium effect (d = .44).

Injunctive norms scores for the DVD group did not change from baseline. However, these scores fell drastically from baseline levels in the exergame group at the four-week point. The change in scores was represented by a large effect size of d = 1.19.

Descriptive norm. The results from the ANOVA analyses yielded a large effect size for the group by time interaction effect ($F_{1,16}$ = 2.76, p = .12; η^2 = .14).

Based on the post-hoc between-group comparisons, scores for descriptive norm were for the DVD group was lower than the exergame group at the end the laboratory phase. The effect size representing the difference between the two exercise groups approached a medium effect size (d = .44).

Post-hoc baseline comparisons found a moderate decrease of d = .64 in the DVD group at week four. In the exergame group, scores increased from baseline at week four. This increase was represented by a moderate effect size of d = .51.

Perceived behavioural control. The PBC scores were identical in the DVD and exergame groups and there were no differences between the two groups ($F_{1,16}$ = 0.00).

Intention. Based on the results from the mixed ANOVA, the time by group interaction yielded a large effect size of η^2 = .22 and was statistically significant ($F_{1,16}$ = 4.92, p = .04).

Post-hoc analyses showed that the exergame group had lower intention scores than the DVD group. The magnitude for the group difference at the end of the laboratory phase approached a medium effect size (d = .47).

Relative to baseline intention scores, intention scores increased in the DVD group at the end of the intervention. This change was denoted by a large effect size of d = .93. Conversely, intention scores decreased in the exergame group after baseline measures. The decrease in scores was approached a moderate effect of d = .47.

Table 5

Intervention Effects on Theory of Planned Behaviour Variables During the Laboratory Phase

	N	Baseline *M* (*SD*)	4-Week *M* (*SD*)
Affective Attitude			
DVD	9	5.50 (1.09)	5.67 (1.22)
Exergame	9	5.89 (0.60)	5.89 (0.74)
Instrumental Attitude			
DVD	9	6.94 (0.17)	7.00 (0.00)
Exergame	9	6.72 (0.44)	6.72 (0.67)
Injunctive Norm			
DVD	9	2.67 (1.73)	2.56 (2.13)
Exergame	9	3.89 (2.15)	1.78 (1.30)
Descriptive Norm			
DVD	9	6.78 (0.44)	6.00 (1.66)
Exergame	9	5.78 (2.04)	6.56 (0.73)
PBC			
DVD	9	6.89 (0.17)	6.89 (0.33)
Exergame	9	6.89 (0.33)	6.89 (0.33)
Intention			
DVD	9	6.67 (0.50)	7.00 (0.00)
Exergame	9	7.00 (0.00)	6.89 (0.33)

Note. PBC = perceived behavioural control.

Regression Analyses for Laboratory Adherence

The TPB was used to frame the regression analyses for predicting adherence during the in-lab phase of the study. Pre-intentional constructs such as affective attitude, instrumental attitude, injunctive norm, descriptive norm, and PBC were used as predictors of intention. To analyze adherence during the in-lab phase of the study, a forced entry regression analyses was used. For this model, the in-lab adherence was regressed on PBC and intention.

As seen in Table 6, 15% of the variance in intention was explained by the proposed constructs ($F_{2,15} = 0.43$; p = .82). Of the proposed predictors of intention, both affective and instrumental attitude were not significant predictors of intention (affective attitude $\beta = .16$, $p = .68$; instrumental attitude $\beta = -.05$, $p = .89$). However, the analysis yielded a negative small-to-

medium effect size for descriptive norm (β = -.28, p = .40); injunctive norm (β = -.20, p = .56); and PBC (β = -.26, p = .53). Tolerance levels derived from the collinearity statistics ranged from .48 to .69 for each construct, indicating that there was no presence of collinearity in the data.

The results from the second model predicting in-lab adherence yielded an R^2 of .09 for the initial model ($F_{2,15}$ = 0.77; p = .48) (Table 7). The standardized coefficient for intention approached a moderate effect size (β = .28), while PBC was found to not be a significant predictor in the model (β = -.08). Tolerance statistics supported showed that there were no issues of collinearity among the variables, which was .98.

Table 6

Regression Analyses Predicting Intention during the In-Lab Phase

	F	*df*	*R*	R^2	Unstd. B (SE)	β
Intention	0.43	2,15	.39	.15		
AA					0.07 (0.17)	.16
IA					-0.06 (0.38)	-.05
IN					-0.04 (0.07)	-.20
DN					-0.07 (0.08)	-.28
PBC					-0.31 (0.48)	-.26

Note: AA = affective attitude; IA = instrumental attitude; IN = injunctive norm; DN = descriptive norm; PBC = perceived behavioural control. Level of significance set at $p < .05$.

Table 7

Regression Analyses Predicting In-Lab Adherence

	F	*df*	*R*	R^2	Unstd. B (SE)	β
Adherence	0.77	2,15	.31	.09		
Intention					.38 (0.33)	.28
PBC					-.12 (0.39)	-.08

Note: AA = affective attitude; PBC = perceived behavioural control. Level of significance set at $p < .05$

In-Home Phase and Intervention Follow-Up

Primary Outcomes

Adherence

The mean and standard deviations for the overall, in-lab, and in-home adherence are presented in Table 8.

Participants were able to complete a total of 24 in-home exercise sessions over a period six weeks. The adherence rate for the DVD group was 73% (M = 17.56, SD = 8.02), while the exergame condition was 72% (M = 17.22, SD = 8.44). The average number sessions attended per week were similar in both exercise groups (DVD: 2.93 sessions/week, SD = 1.34; exergame: 2.87 sessions/week, SD = 1.41). An independent t-test showed that there was no difference between the two groups for adherence during the in-lab phase (t_{16} = 0.09, p = .93; d = .04)

The overall adherence rates over the course of the nine-week interventions were 79% for the DVD group (M = 28.44, SD = 8.67) and 78% for the exergame group (M = 28.22, SD = 8.22). Participants assigned to the DVD group attended an average of 3.14 sessions per week (SD = 0.96), while participants in the exergame group attended an average of 3.16 sessions per week (SD = 0.91). An independent t-test was performed to examine whether there was a significant difference in the overall adherence between the two exercise groups. The results showed that there was no significant difference between the two groups for overall adherence (t_{16} = -0.06, p = .96; d = .03).

Table 8

Intervention Effects on Overall, In-Lab, and In-home Adherence (number of sessions/week)

Condition	Lab *M* (*SD*)	Home *M* (*SD*)	Overall *M* (*SD*)
DVD	3.58 (0.59)	2.93 (1.34)	3.14 (0.96)
Exergame	3.74 (0.43)	2.87 (1.41)	3.16 (0.91)

Moderate-to-vigorous physical activity. Results from the mixed ANOVA analyses showed that the effect size for group by time interaction was represented by a moderate effect size of $\eta^2 = .08$ ($F_{2,24} = 1.07$, $p = .36$). For the time main effect, the effect size was negligible ($F_{1,24} = 0.06$, $p = .81$; $\eta^2 = .00$)

Illustrated in Figure 5, improvements in MVPA levels from baseline were seen in both exercise groups when compared to the control group at the end of the intervention. Post-hoc analyses showed that the DVD group engaged in more minutes of MVPA than the control group at the end of the intervention, which is represented by a moderate effect size of $d = .64$. Participants in the exergame group were also accumulating more minutes of MVPA than the control; however, this effect was small ($d = .24$). Comparisons of MVPA levels between the DVD and exergame groups showed that the DVD group was engaging in more minutes than the exergame group. A small effect size of $d = .35$ represented the difference between the two exercise groups.

Post-hoc within-group comparisons showed a small increase in MVPA levels in the DVD group at the end of the intervention ($d = .25$). The exergame group saw levels of MVPA similar to baseline levels ($d = .07$). In the control group, levels of MVPA fell below baseline levels, which was represented by a moderate effect size of $d = .55$.

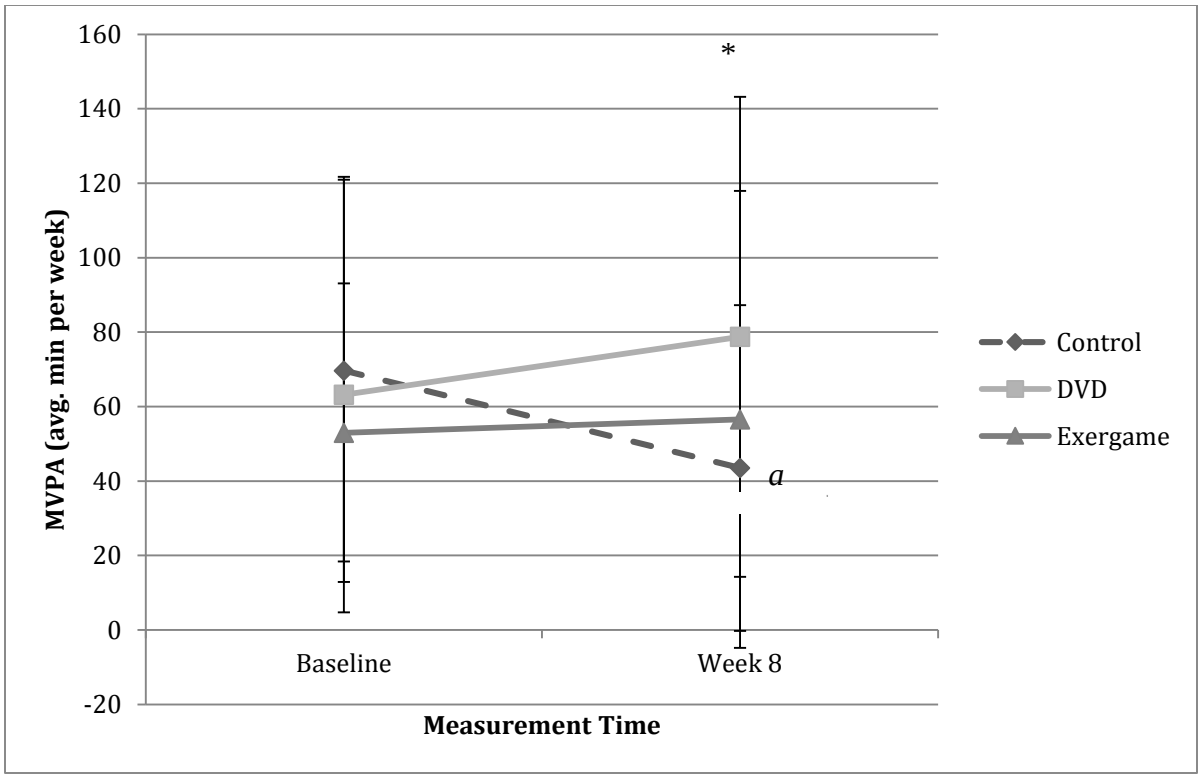

Figure 5. Minutes of MVPA per week during the in-home phase of the intervention.

Note: * = meaningful difference, where $d > .50$ between at least one exercise group and control group; *a* = meaningful difference, where $d > .50$ between baseline and week 8 measurement.

Total physical activity. The mixed ANOVA analysis found a moderate effect size of $\eta^2 = .08$ for the group by time interaction effect ($F_{2,24} = 1.11$, $p = .35$). For the main time effect, a negligible effect was found ($F_{1,24} = 0.00$, $p = .98$; $\eta^2 = .00$).

Shown in Figure 6, overall PA was higher in both exercise groups compared to the control group at the end of the intervention. Post-hoc group comparisons between the DVD and control group showed that the DVD group engaged in slightly higher PA levels at the end of the intervention. The difference between the control group and DVD group yielded a small effect size of $d = .24$. Larger differences in overall PA levels were seen between the exergame group and control group. The effect size for this between-group difference approached a large effect

size (*d* = .74). Comparisons between the DVD and exergame groups resulted in an effect size of *d* = .54, indicating a moderate difference and higher MVPA in the exergame group in relation to the DVD group at the end of the intervention.

Post-hoc within-group comparisons showed that overall PA for the DVD group did not change from baseline levels at the end of the intervention (*d* = .08). Participants assigned to the exergame group increased PA levels towards the end of the intervention. The effect size for the increase in PA was represented by a small effect size of *d* = .35. Compared to baseline levels, PA levels in the control group fell below baseline levels at week 8 (*d* = .39).

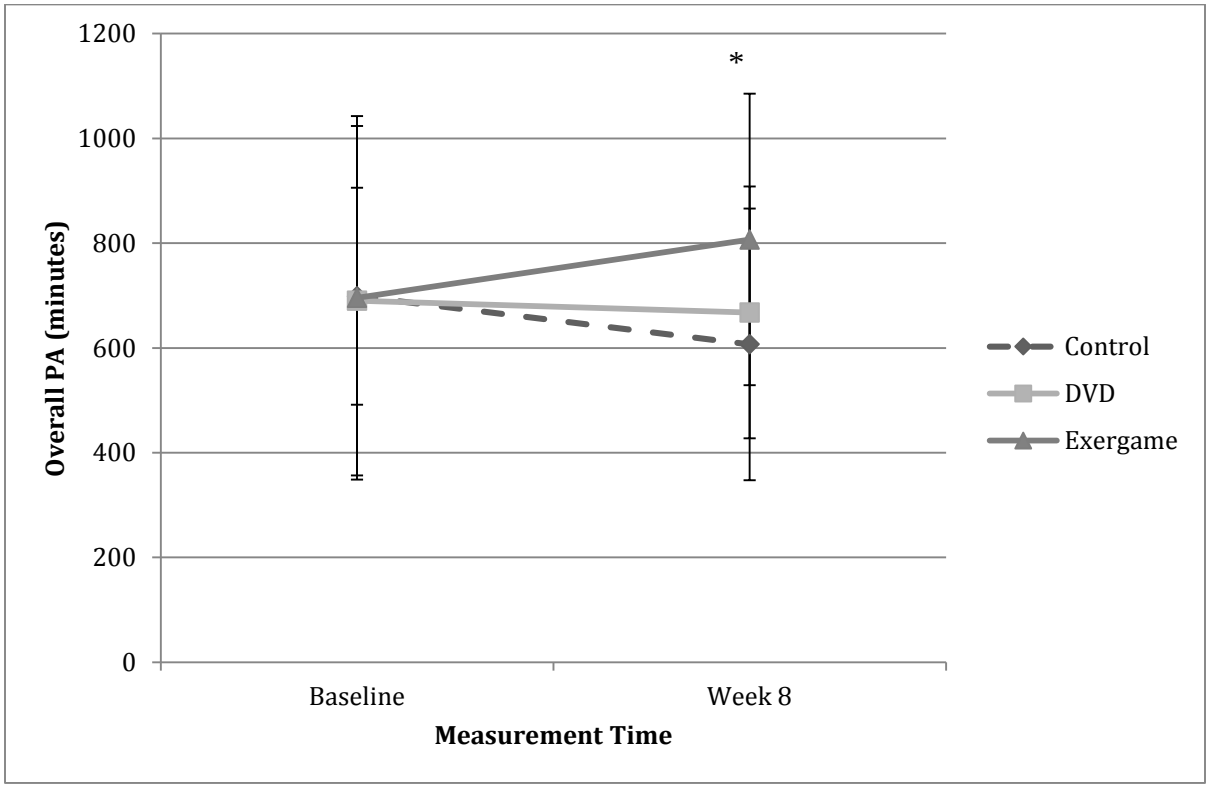

Figure 6. Minutes of overall PA per week during the in-home phase of the intervention.

Note: * = meaningful difference, where *d* > .50 between at least one exercise group and control group; *a* = meaningful difference, where *d* > .50 between baseline and week 8 measurement.

Secondary Outcomes

Theory of Planned Behaviour Variables

Means and standard deviations for the TPB constructs during the in-home phase of the intervention are presented on Table 9.

Affective attitude. Results from the RM ANOVA did not reveal a time by group interaction effect ($F_{1,16}$ = 0.00, p = .95; η^2 = .00). For the main effect of time, a medium effect was found ($F_{1,16}$ = 1.00, p = .33; η^2 = .06).

Subsequent post-hoc analyses for the between-group comparisons found negligible differences between the exercise groups at the end of the intervention (d = .20).

Analyses for the within-group differences found that affective scores decreased in both groups at the end of the intervention For both exercise groups, the decrease was represented by small effect sizes of d = .31 and .34 for the DVD and exergame group, respectively.

Instrumental attitude. ANOVA results indicated that there was no time by group interaction effect ($F_{1,16}$ = 0.08, p = .77; η^2 = .00). However, a large effect of η^2 = .17 was identified for the main time effect ($F_{1,16}$ = 3.33, p = .09).

Post-hoc analyses for the group comparisons showed higher scores in the DVD group than the exergame group at the end of the intervention. The difference in instrumental attitude scores was represented by a small effect size of d = .32.

For the within-group comparisons, scores in the DVD group saw a moderate decrease of d = .61 from baseline measurements at the end of nine weeks. Similarly, scores for instrumental attitude in exergame group saw a moderate decrease of d = .64 at the end of the intervention.

Injunctive norm. Findings from the mixed ANOVA analysis resulted in a large and significant effect size of η^2 = .26 for the time by group interaction ($F_{1,16}$ = 5.57, p = .03).

Post-hoc analyses comparing the differences in scores between the DVD and exergame group found that scores in the DVD group were higher than the exergame group at the nine-week follow-up. The difference in scores yielded a large effect size of $d = .81$.

For the within-group comparisons, the DVD group saw a moderate increase from baseline levels, represented by a medium effect of $d = .65$. Conversely, scores for the exergame group fell drastically from baseline levels at the end of the intervention. This decrease in scores approached a large effect size ($d = .79$)

Descriptive norm. The results from the ANOVA analyses found a negligible interaction effect ($F_{1,16} = 0.05$, $p = .83$; $\eta^2 = .00$). For the main time effect, the effect size was small ($F_{1,16} = 0.75$, $p = .40$; $\eta^2 = .04$).

Perceived behavioural control. Based on these estimates from the mixed ANOVA, a large effect size of $\eta^2 = .17$ was found for the time by group interaction effect ($F_{1,16} = 3.27$, $p = .09$). For the main time effect, the analyses yielded a small effect size of $\eta^2 = .02$ ($F_{1,16} = 0.36$, $p = .56$;).

Follow-up between-group comparisons found that PBC scores were moderately lower in the exergame group compared to the DVD group at the end of the nine-week intervention ($d = .66$).

Post hoc analyses found that PBC scores in the DVD group increased from baseline levels. The overall increase in PBC scores approached a medium effect size ($d = .47$). In contrast, PBC scores in the exergame group decreased slightly relative to baseline scores, which was denoted by a small effect size of $d = .40$.

Intention. Based on results from the mixed ANOVA, the time by group interaction yielded a small effect size of $\eta^2 = .02$ ($F_{1,16} = 0.34$, $p = .57$). The main time effect yielded a large effect of $\eta^2 = .19$ ($F_{1,16} = 3.92$, $p = .07$).

Post-hoc group comparison found comparable intention scores between the DVD and exergame groups at the end of the intervention ($d = .11$).

Relative to baseline intention scores, within-group comparisons both exercise groups saw a decrease in scores. For the DVD group, the decrease in scores approached a moderate effect size ($d = .47$), while a large effect size of $d = .90$ reflected the decrease in the exergame group.

Table 9

Intervention Effects on Theory of Planned Behaviour Variables During the In-Home Phase

	N	Baseline *M* (*SD*)	9-Week *M* (*SD*)
Affective Attitude			
DVD	9	5.50 (1.09)	5.11 (1.43)
Exergame	9	5.89 (0.60)	5.44 (1.79)
Instrumental Attitude			
DVD	9	6.94 (0.17)	6.50 (1.00)
Exergame	9	6.72 (0.44)	6.11 (1.34)
Injunctive Norm			
DVD	9	2.67 (1.73)	3.89 (2.03)
Exergame	9	3.89 (2.15)	2.33 (1.80)
Descriptive Norm			
DVD	9	6.78 (0.44)	6.44 (0.88)
Exergame	9	5.78 (2.04)	5.22 (2.17)
PBC			
DVD	9	6.89 (0.17)	7.00 (0.00)
Exergame	9	6.89 (0.33)	6.67 (0.71)
Intention			
DVD	9	6.67 (0.50)	6.00 (1.94)
Exergame	9	7.00 (0.00)	5.78 (1.92)

Note. PBC = perceived behavioural control.

Regression Analyses for In-Home Adherence

The TPB was used to frame the regression analyses for predicting adherence during the in-home phase of the study. Affective attitude, instrumental attitude, injunctive norm, descriptive norm, and PBC were used as predictors of intention. To analyze adherence during in-home phase of the study, a forced entry regression analyses was used. For this model, the in-home adherence was regressed on PBC and intention.

The initial model examining the predictors of intention during the in-home portion of the study was explained by 10% of the variance from the proposed predictors ($F_{2,15}$ = 0.27; p = .92) (Table 10). In this model, injunctive norm (β = -.34, p = .30), affective attitude (β = .20; p = .62), and PBC (β = -.19, p = .59) were small effect sizes, while the effect sizes for instrumental attitude (β = -.11; p = .75) and descriptive norm (β = .02, p = .95) were negligible. Collinearity statistics found that that tolerance levels ranged from .49 to .90 for all the predictors in the analysis.

The regression analyses to predict adherence during the in-home phase of the intervention found that intention and PBC explained 5% of the variance ($F_{2,15}$ = 0.35; p = .71) (Table 11). In this model, intention had a small effect on in-home adherence (β = -.21; p = .42), while PBC was did not have an effect in the model (β = -.05; p = .86). Based on the tolerance level of .99, there was evidence of no collinearity among the predictor variables.

Table 10

Regression Analyses Predicting Intention During the In-Home Phase

	F	*df*	*R*	R^2	Unstd. B (SE)	β
Intention	0.27	2,15	.32	.10		
AA					0.05 (0.07)	.20
IA					-0.05 (0.25)	-.11
IN					-0.05 (0.08)	-.34
DN					0.00 (0.04)	-.02
PBC					-0.14 (0.35)	-.19

Note: AA = affective attitude; IA = instrumental attitude; IN = injunctive norm; DN = descriptive norm; PBC = perceived behavioural control. Level of significance set at $p < .05$.

Table 11

Regression Analyses Predicting In-Lab and In-Home Adherence

	F	*df*	*R*	R^2	Unstd. B (SE)	β_1
Adherence						
	0.35	2,15	.21	.05	-1.19 (1.43)	-.21
Intention						
PBC					-0.19 (1.04)	-.05

Note: AA = affective attitude; PBC = perceived behavioural control. Level of significance set at $p < .05$.

Tertiary Outcomes

Functional Fitness and Physiological Outcomes

The means and standard deviations for the fitness-related variables are presented on Table 12.

Resting heart rate. Results from the mixed ANOVA yielded small effect sizes for the group by time interaction ($F_{2,21}$ = 0.26, p = .78; η^2 = .02) and time main effects ($F_{1,21}$ = 0.67, p = .42; η^2 = .03).

Systolic and Diastolic Blood Pressure. Mixed ANOVA analyses found a small group by time interaction effect for mean systolic ($F_{2,21}$ = 0.33, p = .72; η^2 = .03). The interaction effect for diastolic blood pressures yielded a large effect size of η^2 = .17 ($F_{2,21}$ = 2.36, p = .12). The time main effect for systolic resulted in a negligible effect size ($F_{1,21}$ = 0.03, p = .85; η^2 = .00), while the time main effect for diastolic blood pressures produced a moderate effect size ($F_{1,21}$ = 2.07, p = .17; η^2 = .07).

Post-hoc comparisons between the baseline and 9-week measures in the exergame group found a significant decrease in diastolic blood pressure at follow-up. Baseline diastolic blood pressure 6.56 mmHg at the 9-weeks, which yielded an overall moderate effect size of d = -.73. While diastolic blood pressures for the DVD and control remained relatively the same (d = .08 and -.10, respectively)

BMI. ANOVA resulted in small effect sizes for the time by group interaction ($F_{2,21}$ = 0.20, p = .82; η^2 = .02) and time main effects ($F_{1,21}$ = 0.11, p = .74; η^2 = .01).

Waist circumference. The findings from the RM ANOVA for the combined effect of group by time had a small effect size of η^2 = .03 ($F_{2,21}$ = 0.35, p = .71). For the main time effect, a large effect size was found ($F_{1,21}$ = 4.25, p = .05; η^2 = .16).

Subsequent baseline and follow-up comparisons found a decrease in waist circumference in the DVD group from 98.44 cm (SD = 9.77) to 96.25 cm (SD = 8.45), which yielded a small effect size of d = .24. While the control group and exergame group did not see substantial changes to waist circumference (d = -.09).

Grip strength. Mixed ANOVA analyses resulted in small effect sizes for the group by time interaction ($F_{2,21}$ = 0.41, p = .67; η^2 = .04) and time main effects ($F_{1,21}$ = 0.53, p = .47; η^2 = .02).

Sit-to-stand. Results from the factorial RM ANOVA revealed a moderate group by time interaction effect ($F_{2,21}$ = 1.27, p = .30; η^2 = .08). For the main time effect, a large effect size of η^2 = .22 was found ($F_{1,21}$ = 6.68, p < .05).

Subsequent within-group comparisons saw a significant increase in the number of repetitions perform at follow-up in the DVD group. The group increased the total number of repetitions at follow-up by two repetitions, which represented a moderate-to-large effect size of d = .77. Participants in the exergame group saw a less dramatic increase. The increase in the exergame group yielded a small effect size of d = .43. Participants in the control group saw negligible changes in the number of repetitions at follow-up (d = .06)

Sit-and-reach. The interaction effect for the sit-and-reach performance was found to be small ($F_{2,21}$ = 0.44, p = .65, η^2 = .03). A large effect size effect was identified for the time main effect ($F_{1,21}$ = 7.17, p < .05; η^2 = .25).

Follow-up comparisons showed that hamstring flexibility significantly increased only in the DVD group at the nine-week follow-up. The DVD group improved hamstring flexibility by 3.94 cm from baseline, which was represented by a small effect size of d = .35. Both the

exergame and control group did not see improvements in hamstring flexibility at follow-up (d = .13 and .19, respectively)

Up-and-go test. Mixed ANOVA analyses yielded moderate effect sizes for the time and group interaction ($F_{2,21}$ = 1.41, p = .27; η^2 = .11) and main time effect ($F_{1,21}$ = 2.09, p = .16; η^2 = .08).

Post-hoc analyses found improvements in both exercise groups. Participants in the DVD group saw a decrease in the overall time needed to complete the up-and-go test. This decrease in time was represented by a moderate effect size (d = .53). Participants in the exergame group saw smaller improvements in which the change was equivalent to a small effect size of d = .33. Participants in the control group did not see any changes at the follow-up assessment (d = .09).

Table 12

Intervention Effects on Functional Fitness and Physiological Outcomes

	N	Baseline *M* (*SD*)	9-Week *M* (*SD*)	Mean Difference M (95% CI)	*d*
Resting Heart Rate (bpm)					
Control	7	74.29 (7.80)	76.57 (12.57)	+2.29 (-3.48, 8.05)	.22
DVD	8	70.00 (6.12)	71.63 (7.31)	+1.63 (-3.77, 7.02)	.24
Exergame	9	69.33 (10.48)	69.11 (9.84)	-0.22 (-5.31, 4.86)	-.02
Systolic BP (mmHg)					
Control	7	127.29 (17.04)	131.86 (15.12)	+4.57 (-9.51, 18.65)	.28
DVD	8	131.50 (13.64)	131.88 (19.51)	+0.25 (-12.92, 13.42)	.02
Exergame	9	131.44 (14.17)	128.67 (18.64)	-2.78 (-1.20, 9.64)	-.16
Diastolic BP (mmHg)*					
Control	7	78.57 (10.60)	77.71 (6.85)	-0.86 (-6.66, 4.95)	-.10
DVD	8	75.88 (13.15)	76.75 (9.59)	+0.88 (-4.56, 6.31)	.08
Exergame	9	78.78 (8.37)	72.22 (9.47)	-6.56 (-11.68, 1.44)	-.73
BMI (kg/m2)					
Control	7	24.93 (2.93)	25.03 (2.47)	+0.10 (-0.57, 0.77)	.04
DVD	8	29.30 (5.24)	29.14 (5.52)	-0.11 (-0.70, 0.48)	-.03
Exergame	9	26.04 (4.35)	25.93 (4.13)	+0.10 (-0.57, 0.77)	-.03
Waist Circumference (cm)					
Control	7	88.50 (9.98)	87.66 (7.60)	-0.84 (-3.44, 1.75)	-.09
DVD	8	98.44 (9.77)	96.25 (8.45)	-2.19 (-4.61, 0.24)	-.24
Exergame	9	86.72 (13.93)	85.57 (12.21)	-1.16 (-3.44, 1.13)	-.09
Grip Strength (kg)					
Control	7	58.33 (16.43)	56.86 (18.49)	-1.47 (-7.22, 4.27)	-.08
DVD	8	70.66 (15.91)	68.19 (18.75)	-2.48 (-7.86, 2.90)	-.14
Exergame	9	55.50 (11.25)	56.17 (13.80)	+1.47 (-7.22, 4.28)	.05
Sit to Stand (reps)*					
Control	7	12.00 (2.38)	12.14 (1.95)	+0.14 (-1.73, 2.02)	.06
DVD	8	12.13 (2.48)	14.13 (2.69)	+2.00 (0.25, 3.75)	.77

Exergame	9	13.91 (4.07)	15.56 (3.54)	+1.65 (0.00, 3.30)	.43
Sit and Reach (cm)*					
Control	7	6.50 (11.85)	8.71 (11.21)	+2.21 (-1.59, 6.02)	.19
DVD	8	-5.94 (9.76)	-2.00 (12.56)	+3.94 (0.38, 7.50)	.35
Exergame	9	0.22 (13.53)	2.06 (14.33)	+1.83 (-1.52, 5.19)	.13
Up and Go (sec)*					
Control	7	7.56 (1.47)	7.69 (1.27)	+0.13 (-0.46, 0.71)	.09
DVD	8	7.06 (0.68)	6.55 (1.18)	-0.51 (-1.06, 0.03)	-.53
Exergame	9	7.18 (1.45)	6.72 (1.33)	-0.28 (-0.79, 0.24)	-.33
Six-Minute Walking Test (m)*					
Control	7	559.79 (47.71)	554.53 (40.94)	-5.26 (-42.27, 32.76)	-.12
DVD	8	577.63 (59.87)	619.46 (64.02)	+41.84 (6.28, 77.40)	.67
Exergame	9	528.54 (49.44)	592.87 (78.02)	+64.32 (30.80, 97.85)	.98
FAB					
Control	7	33.43 (3.41)	33.43 (2.64)	0.00 (-2.25, 2.25)	.00
DVD	8	36.13 (3.09)	35.75 (2.61)	-0.38 (-2.48, 1.73)	-.13
Exergame	9	36.00 (2.40)	36.56 (2.56)	+0.56 (-1.43, 2.54)	.23

Note. bpm = beats per minute; BMI = body mass index; BP = blood pressure; FAB = Fullerton Advance Balance. * = meaningful effect sizes

Six-minute walking test. Mixed ANOVA analyses revealed a statistically significant large effect size for the time by group interaction effect ($F_{2,21} = 4.15$, $p < .05$; $\eta^2 = .20$).

Post-hoc analyses found that the exercise groups significantly increased the total distance covered in six minutes, while the distance covered by the control group did not significantly change from baseline. For the DVD group, a moderate effect size of $d = .67$ was representative of the increase in distance covered in the six minutes. For the exergame group, a large effect size of $d = .98$ was indicative of the improvement in performance at the 9-week follow-up. Participants in the control group saw negligible changes ($d = -.12$).

Table 13 presents the manipulation check for the baseline and follow-up for the six-minute walking test. According to the Borg CR-10 scale (Foster et al., 2001), participants reported a moderate intensity while performing the six-minute test at baseline and follow-up. Moreover, recorded heart rate data indicated that participants were working at approximately 75% of maximal heart rate (Tanaka et al., 2001). Results from a dependent t-test showed that both the heart rate and perceived exertion were not significantly different between the two measurement points ($p > .05$).

Table 13

Six-Minute Walking Test Manipulation Check

	Baseline *M* (*SD*)	Follow-up *M* (*SD*)	*d*	*p*-value
6MWT Heart Rate (bpm)	121.10 (16.60)	123.95 (14.59)	.18	.63
6MWT RPE	2.86 (0.94)	3.03 (0.75)	.20	.58

Note. bpm = beats per minute; HR = heart rate; RPE = rating of perceived exertion; 6MWT = six-minute walking test

Balance. The mixed ANOVA analyses resulted in small and statistically insignificant time by group ($F_{2,21} = 0.23$, $p = .80$; $\eta^2 = .02$) and time main effects ($F_{1,21} = 0.01$, $p = .92$; $\eta^2 = .00$).

Separate mixed ANOVA analyses were performed for each individual assessment to identify any potential changes among the three experimental groups. No time by group interaction or time main effects were identified for each of the individual assessments ($p > .05$).

Health-Related Quality of Life Outcomes

Table 14 illustrates the baseline and follow-up mean scores, standard deviations, and effect sizes for the eight SF-36 domains.

Physical functioning. For physical functioning, a small time by group effect ($F_{2,22} = 0.49$, $p = .62$; $\eta^2 = .04$) and negligible time main effect were found ($F_{1,22} = 0.07$, $p = .79$; $\eta^2 = .00$).

Social functioning. Based on the analyses, the effect size for the time by group interaction was moderate ($F_{2,22} = 1.00$, $p = .38$; $\eta^2 = .08$), while the main effect was small in magnitude ($F_{1,22} = 0.58$, $p = .46$; $\eta^2 = .02$).

Post-hoc analyses indicated an increase in social functioning scores in the DVD group, which was represented by a small effect size of $d = .32$. Scores for the exergame and control group were comparatively similar to baseline levels ($d = -.18$ and .11, respectively).

Roles limited by physical health. For the scores for roles limited by physical health showed a small time by group effect ($F_{2,22} = 0.27$, $p = .77$; $\eta^2 = .02$). The main effect of time yielded a moderate effect size of $\eta^2 = .08$ ($F_{1,22} = 1.98$, $p = .17$).

In both exercise groups, moderate decreases were seen in these scores from baseline. In the DVD group, participants reported fewer limitations at the follow up (d = .55). Participants assigned to the exergame group reported decrease in these scores to a lesser degree. The effect size for this decrease was small in magnitude (d = .35). In the control group, negligible changes were seen (d = -.08).

Roles limited by emotional problems. A moderate interaction effect was found for the mean scores for the activities of roles limited by emotional problems ($F_{2,22}$ = 0.68, p = .52; η^2 = .06). The main effect of time was negligible ($F_{1,22}$ = 0.00, p = .97; η^2 = .00).

Post-hoc analyses found greater decreases in scores regarding roles limited by emotional problems in the control group. The effect size representing this decrease was small in magnitude (d = .42). While both exercise group saw minor increases in limitations in this domain (d = .24).

Mental health. For mental health scores, ANOVA analyses yielded a large time by group interaction effect ($F_{2,22}$ = 2.48, p = .11; η^2 = .18). For the main time effect, the mean scores were not different at baseline and follow-up ($F_{1,22}$ = 0.06, p = .80; η^2 = .00).

Subsequent post-hoc analyses showed that the exergaming group improved in mental health scores. The improvement was equivalent to a small effect of d = .44. In contrast, the participants in the control group saw a reduction in mental health scores, represented by a small effect size of d = .44. Participants in the DVD group did not see any change in scores (d = -.12).

Vitality. Mixed ANOVA results for the vitality scores found no time by group interaction effects ($F_{2,22}$ = 2.92, p = .08). However, the effect size for this interaction was large in magnitude (η^2 = .19). Main effect of time was moderate and not statistically significant ($F_{1,22}$ = 2.19, p = .15; η^2 = .07).

Post hoc-analyses saw improvements in both exercise groups. In the exergaming group, a large increase from baseline scores was seen and denoted by a large effect size d = .89. Participants in the DVD and control groups did not see significant changes to vitality scores (d = .26 and -.19, respectively).

Bodily pain. Analyses based on the mean scores for bodily pain, the overall magnitude for the interaction effect was moderate in size ($F_{2,22}$ = 1.39, p = .27; η^2 = .11). The main time effect was small ($F_{1,22}$ = 0.92, p = .35; η^2 = .04).

Post-hoc analyses found moderate improvement in bodily pain scores in the DVD group. The effect size for representing this improvement was marked by a moderate effect size (d = -.62). Pain scores in the control and exergame groups were relatively similar to baseline levels (d = .12 and -.05, respectively).

General health perceptions. For general health, a large effect size of η^2 = .15 was found for the time by group interaction effect ($F_{2,22}$ = 2.12, p = .14). The time main effect was identified as a small effect size ($F_{1,22}$ = 1.66, p = .21; η^2 = .04).

Subsequent analyses showed that the general health perception scores in the DVD group improved at the 9-week follow-up. This difference yielded a moderate effect size of d = .67. General health scores remained relatively similar to baseline levels in both the control (d = -.09) and exergame groups (d = .12)

Table 14

Intervention Effects on Quality of Life Domains

	N	Baseline *M* (*SD*)	9-Week *M* (*SD*)	*d*
Physical functioning				
Control	7	80.00 (15.27)	80.71 (18.13)	.04
DVD	9	84.44 (12.61)	82.33 (17.61)	-.14
Exergame	9	83.44 (17.08)	86.67 (18.37)	.18
Social functioning*				
Control	7	79.07 (20.19)	82.57 (40.43)	.11
DVD	9	86.50 (23.71)	78.11 (28.50)	.32
Exergame	9	90.28 (12.15)	87.50 (17.68)	-.18
Roles limited by physical health*				
Control	7	67.86 (40.09)	64.29 (45.32)	-.08
DVD	9	88.89 (18.16)	69.44 (46.40)	-.55
Exergame	9	83.37 (35.26)	69.44 (42.90)	-.42
Roles limited by emotional health				
Control	7	85.71 (26.23)	71.81 (38.72)	-.42
DVD	9	79.78 (32.79)	87.19 (28.19)	-.24
Exergame	9	83.48 (33.01)	90.89 (27.33)	-.24
Mental health*				
Control	7	81.71 (14.02)	76.00 (16.97)	-.44
DVD	9	75.11 (16.22)	72.89 (20.86)	-.12
Exergame	9	79.56 (15.68)	85.78 (12.67)	.44
Vitality*				
Control	7	60.71 (18.80)	56.43 (26.10)	-.19
DVD	9	56.67 (15.61)	60.56 (14.46)	.26
Exergame	9	57.22 (17.34)	71.11 (13.64)	.89
Bodily pain*				
Control	7	67.50 (19.04)	70.36 (29.13)	.12
DVD	9	77.78 (18.52)	62.50 (29.61)	-.62
Exergame	9	75.00 (18.67)	73.89 (21.91)	-.05
General health perceptions*				
Control	7	69.29 (28.05)	67.14 (20.38)	-.09
DVD	9	68.33 (16.77)	78.33 (12.75)	.67
Exergame	9	72.78 (14.39)	74.44 (13.79)	.12

Note. ADL = activities of daily living. * = meaningful effect sizes.

Qualitative Interviews

The responses from the qualitative interviews provided two overarching themes and seven subthemes based on the TPB framework. Table 15 illustrates the organization of these themes.

Table 15

Qualitative Analysis Themes and Subthemes

Theme	Subtheme
Theme 1: Attitude	Subtheme 1a: Positive affect Subtheme 1b: Negative affect Subtheme 1c: Instrumental attitude
Theme 2: Perceived behavioural control	Subtheme 2a: General exercise barriers/disruptions in regular use Subtheme 2b: Equipment/program-related barriers Subtheme 2c: Facilitators

Theme one: Attitude. Based on the TPB, attitude is dictated by behavioural beliefs centred on the consequences of engaging in a particular behaviour (Ajzen, 1991). In this regard, a person's attitude refers to a positive or negative appraisal derived as a product of performing the behaviour (Ajzen, 1991). In the attitudinal domain, respondents discussed positive and negative affective beliefs, as well as their instrumental beliefs regarding the regular use of the exercise DVD and exergame. The elicited beliefs and frequency counts are described in Table 16. For the subtheme of positive affect, many participants found the DVD and exergame to be an enjoyable way to get exercise. The following quotes provide a perspective on the participants' experiences while using the DVD and exergame.

> *The DVD was really enjoyable. I really enjoyed the presenters and it had easy to follow instructions with options to tailor the workout.*

> *It was felt really enjoyable especially when the [exer]game says "you've done 5 hours" and I go "Wow, that was five hours. That's great!"*

Participants in the exergaming condition expressed more positive affective experiences than the DVD group. Several people indicated that the game provided them with a sense of competition and pushed them to work harder. As well, some participants indicated that it was a fun way to exercise and the gaming features distracted while they were performing the exercises. Participants enrolled in the exergaming condition discussed the gameplay in the following manner.

> *I was motivated to work harder because I knew at the end I'd be able to see the results and so it gave me a reason to push myself. One of the goals was to always beat the curve.*

> *It's sort of like brainwashing. It's like the music comes on and you kind of, you know you sort of becomes part of what you do and sort of like meditation in a way. You sort of slip into the moment and all the different things associated with it [exergame].*

> *You could just go mindless on it [exergame] and just do whatever comes up.*

Negative affective experiences were fairly different between the two exercise groups. Participant responses in the DVD group were focused on the programming content. Many shared the view that the DVD as boring or redundant, it felt like work, and became less challenging over time. Several quotes from the participants in the DVD group exemplify this.

> *It's the same program all the time. There's no variance in it, so there's nothing to hold your interest in it.*

> *I guess the anticipation was a part of it [exercises]… the anticipation was good, but by the end, there was too much anticipation and it was a little bit boring.*

For the exergaming group, the negative affective experiences were generally centered on the technical features and usability of the game. Main issues raised here was that the game sensors did not consistently pick up the user's movement and disrupted the gameplay, and that some settings were not flexible to the user's needs.

> *I would be doing an exercise and it would not be recording it [repetitions] and I would have to stop and start again and that got me fed up after a while.*
>
> *I couldn't reset the calendar. I had a problem with that. Some of the exercises it didn't register my movement, it was looking for, you know, full, flat on the floor and I couldn't get down there which is a little frustrating.*

Participants' in both groups discussed a wide range of instrumental beliefs regarding the regular use of the programs. Despite being frequently mentioned in both groups, participants in the exergame group were more likely to mention that the program provided a good assortment of exercises and focused on different fitness components. As well, many of the participants indicated that the program allowed them to incorporate and maintain a regular exercise routine in their lives. An illustration of this is as follows:

> *It [the DVD] got me into a routine and what I really liked about it is how it addressed all the different muscles in the body. It seemed to look at different exercises that involved different muscle groups. It felt really great. It was wonderful for me to see which muscle groups were being focused on with each exercise and so it just made me so aware of all these different muscle groups that I've not been using.*
>
> *It [the exergame] got me working out regularly. So that was more than norm and the variety of the exercises was really, really good too. So it didn't get boring.*

Individuals assigned to the DVD and exergame groups also discussed the benefits to their overall health and well-being. Respondents indicated that the exercise programs made them feel better, more energetic, helped improve their overall body image, and increased their general fitness. Below are quotes that highlight the overall experiences for both groups.

> *I feel that I have gained some strength and flexibility [from the DVD program]. I think there's a positive feeling about doing this exercise. You feel like you've done something for yourself.*
>
> *Using it [exergame] on a consistent basis I really felt healthier. I actually felt my muscles tone up to a considerable degree and I did felt that I was doing something good.*

The major difference between the two groups was those assigned to the exergaming condition communicated several additional advantages to using the game. Participants in this

group indicated the benefit of receiving performance feedback and gaining a sense of accomplishment from the feedback, pushing the person to work harder, and allowing the user to set fitness goals. It was also mentioned by a participant that the program provided them the confidence to participate in other forms of PA.

> *Every once in a while, they [the exergame] would show you how far you've gone or how far you'd achieved. Those little milestones were kind of neat cause they were unexpected and I wasn't anticipating them.*
>
> *It [the feedback given] was measurable you can see improvement or lack of improvement.*

Table 16

Elicited Beliefs for Attitude

Subtheme	Condition	Elicited Belief	Frequency	Percentage
Positive affect	DVD	It is enjoyable.	4	44%
	Exergame	It is enjoyable.	5	56%
		It provides a sense of competition.	3	33%
		It provides a distraction from the exercises.	2	22%
		It is fun.	1	11%
Negative affect	DVD	It is boring/redundant.	5	56%
		It feels like work.	2	22%
		It is not challenging over time.	1	11%
	Exergame	It is frustrating to use.	3	33%
		It is not motivating.	1	11%
Instrumental attitude	DVD	The program got me into an exercise routine.	4	44%
		The program is comprehensive and provides a variety of exercises.	3	33%
		It makes me feel good/healthier/toned/energetic.	2	22%
		It is an investment to myself.	1	11%
		It provides a sense of accomplishment.	1	11%
	Exergame	The program is comprehensive and provides a variety of exercises.	7	78%
		It makes me feel good/healthier/toned/energetic.	4	44%
		The program got me into an exercise routine.	3	33%
		The game provides me feedback on my progress.	3	33%
		It provides a sense of accomplishment.	3	33%
		The game makes me work harder.	2	22%
		It sets fitness related goals.	1	11%
		The program encouraged other physical activities.	1	11%

Theme two: Perceived behavioural control. The TPB suggests that PBC is comprised of a person's beliefs regarding the ease of performing a specific behaviour, otherwise known as control belief (Ajzen, 1991). Additionally, the ease of performing the behaviour is dictated by the presence of barriers or facilitators. Within the major theme of PBC, three subthemes were created: general exercise barriers or disruptions in regular use, equipment- or program-related barriers, and facilitators (See Table 17).

One of the common general exercise barriers or issues that disrupted regular use of the DVD or exergame in both groups was injury or illness. Participants that incurred injuries indicated that it was not directly related to the program rather the injuries were acquired from general domestic activities (e.g., performing yard work or carrying heavy loads and aggravating old injuries). The following quotes are an illustration of these elicited beliefs:

> *I was ill for an extended period of time and was only able to use the DVD a couple of times per week.*

> *Not using it [exergame] the last couple of weeks were not due to the game at all. It was because I was carrying bags of soil and not paying attention to my back.*

One of the responses elicited for exercise barriers that differed between the groups was that participants in the DVD condition mentioned that finding time to exercise in their schedule was difficult. Whereas individuals in the exergame condition mentioned travelling, lack of social support, and disruptions at home affected the person's compliance to the exercise prescription. Below are several quotes underscore the different responses unique to each group.

> *My life is just busy right now. I need to make sure I really plan for it [DVD], but sometimes your plan just doesn't happen and so time gets away from you.*

> *I had to play catch up too because of illness and being away. So some weeks I did it [exergame] five, you know, more times than expected.*

> *The best part is that you do it [exergame] at home. The worst part is that you were doing it alone. So there's no one forcing you to do it. If I had someone there who said "ok, it's*

> *time to do it" or "meet me at the gym", it would have been better. So that's what I meant by a two-edged sword. It's great that you could do it at home alone, but then you have the strength of commitment to do it at home alone.*

In both groups, the elicited beliefs surrounding barriers that were specific to the program content or equipment was generally centered on the elements found on the DVD or game. Participants found that issues such as vague instructions or cues, the leadership style found on the DVD, and delays in the videogame to be problematic. The following responses were expressed that illustrate the common issue of programming for both the DVD and exergame.

> *I didn't like the woman, like the patronizing tone. I couldn't find a beat to the music and at the end I switched the sound off and just followed it [DVD]. And I also found after a little while, that she spent an awful lot of time telling me what you we're going to do. So I'd keep exercising as she was explaining everything. It was an awful amount of time and it was too slow.*

> *I found I would tend to get flustered if I needed further instruction [from the exergame].*

Unique to the exergame group, participants mentioned issues surrounding the technology itself. Here participants indicated that sensors in some cases did not correctly track movement. Other issues mentioned were that the exercise band was cumbersome to use and the exercises became too difficult to perform.

> *I just felt that if you weren't doing it, like lifting you leg 2 inches, which it was where it [exergame] would record. Say you lifted you leg an inch and a half it wouldn't record.*

> *I couldn't reset the calendar. I had a problem with that. Some of the exercises didn't register my movement, it [exergame] was looking for, you know, full, flat on the floor and I couldn't get down there, which is a little frustrating.*

Majority of the participants in both the DVD and exergame group specified that one of the major factors that facilitated their regular program use was it was a simple setup within the convenience of their own home. As well, exercisers in both groups found that the ability to exercise within their own home provided them with the flexibility to adapt their exercise sessions to changing schedules. For instance, the following quotes from the DVD group exemplify this.

> *One can do it in the privacy of one's own home and it's also helpful it something that doesn't necessarily involve others. Where as I go out, decide to play a game of tennis, I've got to go find a partner to be involved in that.*
>
> *It was easy to set up a schedule even though the schedule might differ from day to day.*
>
> *There's not time required to go to the gym or go somewhere. It's right there.*

For the exergaming group, participants describe the facilitating factors in this manner.

> *I can do it in my home, which really works well for me cause I don't really like going out and using public gyms. It's just motivating to have it in my home.*
>
> *The benefits for me are that I can do it at home, in my own time. So if I had an exercise class at 5 and something happened to my mother and I couldn't get there I'd miss it. I've got it at home. So it's that flexibility being able to do it in my own time, in my own space. I loved that.*

When comparing the exergaming and DVD conditions, participants in the exergame group were more likely to find the game to be user-friendly and ability to simply follow along. The follow excerpt describes the experiences regarding the usability for the DVD and exergame participants.

> *It [DVD] had easy to follow instructions with options to tailor the workout.*
>
> *It was straightforward. You switch on the Wii, switch on the TV, and follow the instructions. There are no challenges.*
>
> *You don't really have to think about it, you just follow it [exergame] along*
>
> *I don't have to plan so many minutes of warm-up and I don't have to plan so much of upper body and lower body. It's laid out for me and so it's all built in there [exergame]. So I don't have to design the exercise program.*

The DVD group differed from the exergame group with the remaining responses for factors that facilitated equipment use. Participants from the DVD group indicated that they were comfortable and confident with the DVD program because it was catered to their age group. A participant also indicated that the simplicity of the DVD program allowed them to portability and the ability to exercise while they were travelling. While a participant from the exergame group

indicated that the game was a good way to exercise indoors when they did not feel like going outside.

> *It [DVD] is aimed at an older person. So you know that it's going to be safe and within your abilities.*
>
> *So if I were travelling, it would be easy enough to take it [DVD] along and use it in a hotel room or something like that. It was minimal. It's equipment for a minimalist. That's what I liked about it. It wasn't a lot of heavy big machines and gears and grinders and things like that… Simple.*
>
> *You don't have to go anywhere for training, it [exergame] is a good alternative to going outside if you don't feel like going outside*

Table 17

Elicited Beliefs for Perceived Behavioural Control

Subtheme	Condition	Elicited Belief	Frequency	Percentage
General exercise barriers/disruptions in regular use	DVD	I had a physical limitation (ex. injury, illness).	3	33%
		It is difficult to find time.	2	22%
	Exergame	I had a physical limitation (ex. injury, illness).	4	44%
		I was travelling.	2	22%
		Exercising alone/lack of social support.	2	22%
		There were distractions/interruptions at home.	1	11%
Equipment/program-related barriers	DVD	I did not like some of the elements found on the DVD (ex. leadership style, lacking exercise cues).	3	33%
	Exergame	There were technology issues.	4	44%
		I did not like some of the elements found on the exergame (ex. vague instructions, delays in the game).	3	33%
		The equipment was cumbersome.	1	11%
		The exercises became too hard.	1	11%
Facilitators	DVD	Simple setup and a convenient way to exercise at home.	6	67%
		Exercises were appropriate for my age.	2	22%
		It does not require a lot of equipment.	2	22%
		I can fit the exercises easily into my schedule.	2	22%
		The equipment is portable.	1	11%
		The program is easy to follow and user friendly.	1	11%
	Exergame	Simple setup and a convenient way to exercise at home.	5	56%
		The program is easy to follow and user friendly.	4	44%
		I can fit the exercises easily into my schedule.	1	11%
		It is a good way to get exercise indoors.	1	11%

Adverse Events

Over the course of the nine-week intervention period there were a total six adverse events reported, most unrelated to the research. Only one case was related to the exercises performed in the DVD condition, where the participant indicated that some of the aerobic exercises performed exacerbated a lower-back injury. Four cases (exergame, $n = 2$; DVD, $n = 1$; control, $n = 1$) were based on the re-aggravation of old injuries while performing activities of daily living (e.g., lower back injury from lifting heavy objects, bruised hip). One adverse event in the control group was due to the fact that a participant was receiving surgery for a lower back condition.

Post-Intervention Follow-Up

Primary Outcomes

Moderate-to-vigorous physical activity. The findings from the mixed ANOVA analyses showed revealed a large effect size for the group by time interaction effect ($F_{2,24} = 2.30$, $p = .12$; $\eta^2 = .15$). For the time main effect, the effect size was small ($F_{1,24} = 1.44$, $p = .24$; $\eta^2 = .05$).

As illustrated on Figure 7, MVPA levels were higher in the exercise groups control group at the 12-week post-intervention follow-up. Post-hoc group comparisons showed that the difference between the control and DVD group was denoted by a large effect size of d = 1.03 at the 12-week follow-up. The difference between the control and exergame group yielded a moderate effect size of $d = .66$, favouring the exergame group. Comparisons of MVPA levels for the DVD and exergame groups showed that groups were relatively the similar at the post-intervention follow-up ($d = -.14$).

For the within-group comparisons to baseline, moderate increases from baseline levels were seen in both the DVD and exergame groups (d = .49 and .60, respectively). However, MVPA levels in the control group substantially decreased at 12-weeks (d = .47).

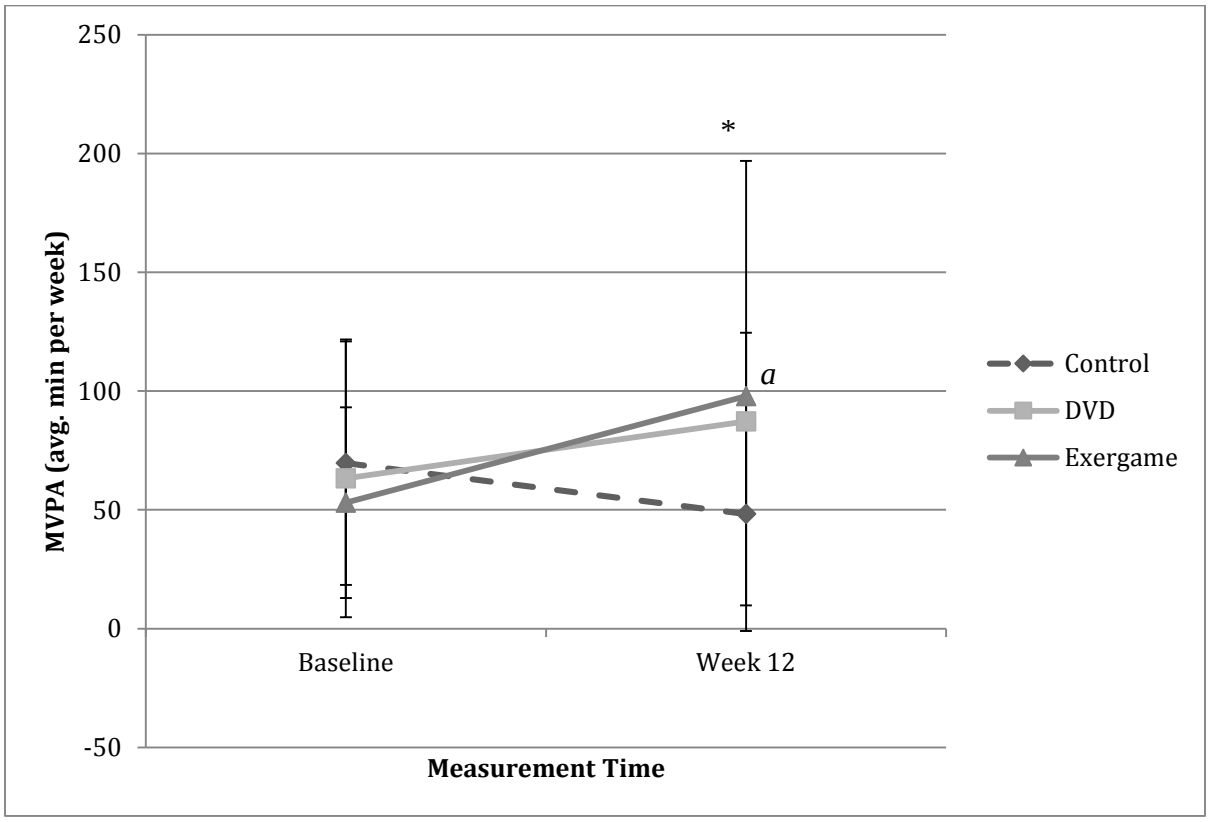

Figure 7. Minutes of MVPA per week at the 12-week post-intervention follow-up.

Note: * = meaningful difference, where d > .50 between at least one exercise group and control group; *a* = meaningful difference, where d > .50 between baseline and week 8 measurement.

Total physical activity. The findings from the mixed ANOVA analysis resulted in a moderate effect size of η^2 = .11 for the group by time interaction effect ($F_{2,24}$ = 1.49, p = .25). For the main time effect, the analysis yielded a small effect size of η^2 = .04 ($F_{1,24}$ = 1.26, p = .27).

Overall PA was generally higher in both exercise groups compared to the control group at the 12-week follow-up (see Figure 8). Post-hoc group comparisons between the DVD and control group approached a large effect size of d = .79, favouring the DVD group over control group at 12-weeks. Similar trends were seen with the comparisons between control and exergame groups. At the follow-up, the exergame group was engaging in higher levels of PA compared to the control group, which was marked by a medium effect size (d = .58). Comparisons between the exercise groups showed that the DVD group accumulated more minutes of overall PA than the exergame group (d = .35).

At the post-intervention follow-up, overall PA levels for both the DVD and exergame groups were relatively comparable to baseline levels (d = .15 and -.21, respectively). For the control group, a large effect size of d = 1.02 was representative of the decrease in PA levels from baseline levels.

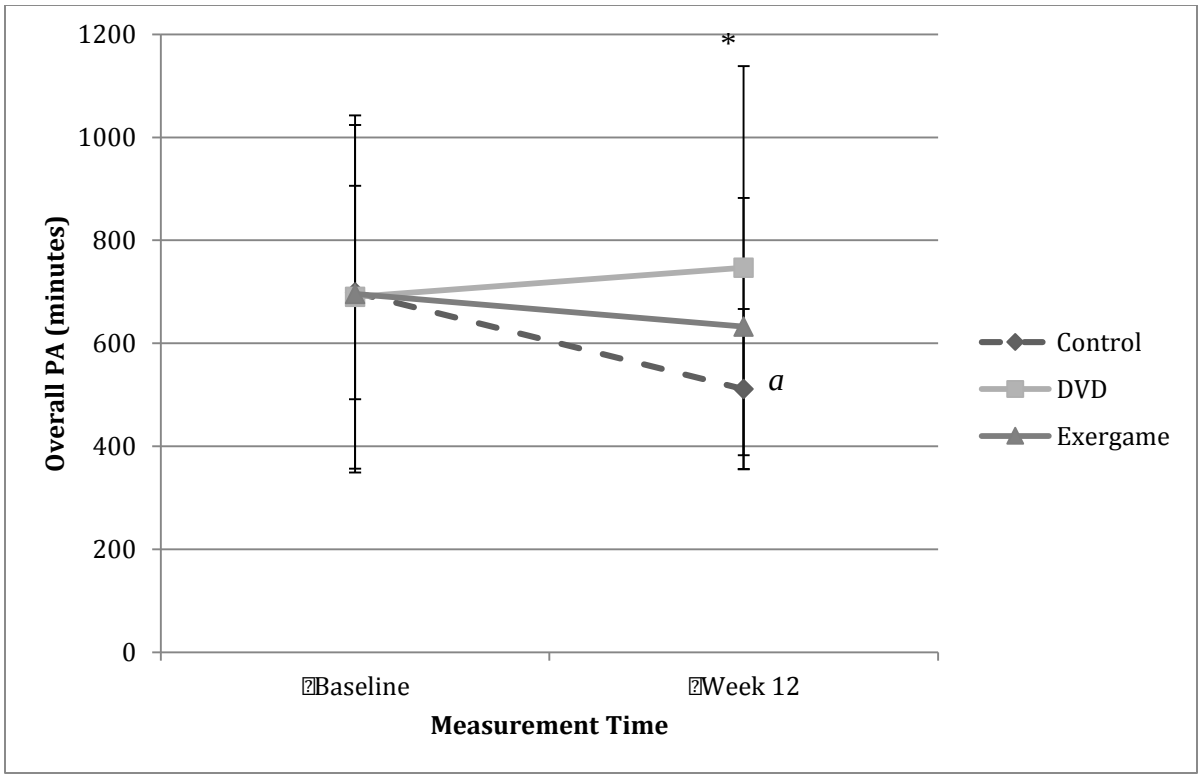

Figure 8. Minutes of overall PA per week at the 12-week post-intervention follow-up.

Note: * = meaningful difference, where $d > .50$ between at least one exercise group and control group; *a* = meaningful difference, where $d > .50$ between baseline and week 8 measurement.

Equipment Adoption and Use. At the 12-week follow-up, six of the nine individuals assigned to the DVD condition indicated that they were using a DVD-based exercise program three to four times per week. In contrast, only three of the nine participants originally assigned to the exergame group had adopted an exergame program and were using the game one to three times per week.

Cross-tabulation assumptions for the chi-square tests were violated, where 100% of the cells had actual counts less than the expected counts. Therefore, the p-value from Fisher's Exact Test was used. Based on a two-tailed test, the results showed that the two groups were not

statistically different (p = .35). However, the effect size determined for the difference between the proportions was moderate in size (h = .33)

Chapter 5: Discussion

One innovative and technological approach to increasing PA may be through the augmentation of the home environment with multimedia-based programs such as DVD and exergames. By changing the home environment to support PA behaviour, important correlates such as affective attitude and PBC can be targeted and allow for behaviour change. The main objective of this study was to explore the prospective and acceptability of multimedia-based exercise programs, like DVDs and exergames, on adherence and PA behaviour and justify whether a full experimental trial is needed. Indicators of program feasibility and acceptance were based on rates of overall adherence, post-intervention program adoption and maintenance, and retention, as well as program satisfaction. A secondary aim was to examine the utility of the TPB in DVD- and videogame-based exercise, as well as the outcomes related to functional fitness, quality of life, and the elicited beliefs about multimedia-based exercise.

In this discussion chapter, sections have been organized based on outcomes found at the end of the laboratory and in-home phases, and at the post-intervention follow-up. Finally, the chapter will conclude with limitations to the research, and conclusions and future recommendations.

Laboratory Phase

It was hypothesized that adherence would be higher in the exergame group compared to the DVD group during the laboratory phase of the intervention. According to the results, this hypothesis was supported. The findings indicated that the exergame group had slightly higher

adherence than the DVD group, which was represented by a small effect size of d = .31. In terms of PA behaviour, it was postulated that the intervention would increase MVPA and overall PA in both exercise groups above baseline levels, while levels of MVPA and overall PA would remain relatively stable in the control group. The hypotheses were partially supported by the results. A group by time interaction MVPA approached a moderate effect size in favour of the exercise conditions (η^2 = .05). In terms of overall PA, the group by time interaction for overall PA was negligible (η^2 = .01). At the end of the in-lab phase, only the exergame group was found to be engaging in more MVPA than the control group (d = .33) and substantially increased MVPA above baseline levels (d = .65).

Speculation to why the exergame had the higher adherence and subsequent MVPA levels may be described through the TPB constructs. It was posited that key constructs such as affective attitude and intention would be higher in the exergame group compared to the DVD group, and would subsequently lead to higher adherence in the exergame group. According to our results, higher affective scores in the exergame group was not supported, rather these scores were comparable between both groups. However, the support for higher intention scores in the exergame group was seen. What was unexpected was the higher injunctive norms scores for the exergame group at baseline, which was represented by a moderate effect size of d = .63.

Prior exergaming interventions conducted in a laboratory setting have shown that exergames elicit higher adherence than traditional modes of exercise (i.e., cycling on a stationary bike) or DVD-based exercise in adults (Keats et al., 2011; Rhodes, Warburton, et al., 2009). According to these studies, the mechanisms for increased adherence were due to the enhancement in affective attitudes and intentions leading to higher adherence levels (Garn et al., 2012; Keats et al., 2011; Mark & Rhodes, 2013; Rhodes, Warburton, et al., 2009). However,

affective attitude scores were similar in both exercise groups during the in-lab phase, indicating that the affective component found in the exergame may have not influenced program adherence. In conjunction to the these affective attitude scores, participants in both exercise groups were found to be high intenders at baseline and at the end of the lab phase, which may have translated to similar adherence rates during the laboratory phase.

In-Home Phase and Intervention Follow-Up

It was hypothesized that the in-home and overall adherence for the exergaming group would be higher than the DVD group during the in-home component of the study; however, this hypothesis was not supported by the results. Comparisons between the two exercise groups indicated that adherence was similar in both groups (in-home: d = .04; overall: d = .03). In terms of PA behaviour, it was postulated that MVPA levels would be highest in the exergaming group relative to the DVD and control groups; while overall PA would be higher in the exercise groups compared to the control group. In addition to this, it was hypothesized MVPA and overall PA would be higher than baseline levels for the exergame group. According to the results, group by time interaction effects for MVPA and overall PA were represented by moderate effect sizes (η^2 = .08). Post hoc analyses partially supported the hypothesis. The findings showed that the DVD group was the only group engaged in higher levels of MVPA (DVD and control: d = .64; DVD and exergame: d = .35). While the exergame group engaged more overall activity, however, these activities were of lower intensities (exergame and control: d = .74; DVD and exergame: d = .54). Hypothesis regarding the change in PA levels from baseline were also partially supported. Differing from the hypothesis, MVPA levels in both exercise groups were relatively similar to baseline levels (DVD: d = .25; exergame: d = .07). In terms of overall PA, the hypothesis was

partially supported such that the exergame group was engaging in higher levels of PA (d = .35), but the DVD group was similar to baseline PA levels (d = .08).

It was anticipated that the exergame group was more likely to adhere to the program than the DVD group because of the progressive, interactive, and self-regulatory features coupled with the potential to enhance the affective experience during exercise. A reason to why the exergame group may have experienced lower adherence rates than expected may have been associated with the decreased motivation to engage in videogame-based exercise. It was posited that motivation to engage in videogame-based exercise would be higher than DVD-based exercise, particularly in the affective and intentional domains; while instrumental attitude, subjective norm and injunctive norm would be fairly similar between the two groups. As well, it was expected that PBC scores decrease and be lower in the exergame group. Based on the results, affective attitude scores were marginally higher in the exergame group at the end of the nine-week intervention (d = .20). However, substantial decreases in instrumental attitude (d = .64), injunctive norm (d = .79), and PBC domains (d = .40) were seen in the exergame group. In conjunction with the decrease in these scores, intention decreased drastically (d = .90) and may have contributed to the diminution in adherence.

With the aid of the responses acquired from the post-intervention interviews, it may provide specific details and a deeper understanding to why motivation and subsequent adherence rates were attenuated. In the area of negative affective beliefs, the responses were mainly associated with the usability of the device. Approximately seven of the nine respondents indicated that the exergame was frustrating to use, while the remaining response indicated they were simply not motivated to use the exergame. In the area of PBC, participants in the exergame group expressed exercise and equipment/program related barriers. Specifically, four respondents

indicated that they had acquired an injury or became ill over the course of the intervention and were unable to participate on a regular basis. Of these particular respondents, half indicated an adverse event that prevented them from adhering to the program for most of the in-home phase. Participants also indicated that technical difficulties were experienced during the in-home phase (44%). An example of some of the technical issues experienced by the participants was that the sensors were unable to pick up some of the movements and consequently making the exercises more difficult to perform. In addition to the technical difficulties, the exercises on the game became increasingly more intense and complex over time (e.g., compound exercises, longer exercise sessions, higher intensities), which may have increased the negative affective beliefs and lead to reduced motivation to use the exergame.

Despite the slight attenuation in adherence in the exergame group, both exercise groups exhibited high overall adherence and retention rates. Previous DVD and exergaming studies have found adherence rates ranging from 71-76% and attrition rates ranging from 10-15% (McAuley et al., 2013; Rhodes et al., 2009). In this particular sample, the adherence rates were nearing 80% for both exercise groups. The attrition rate was markedly lower at 7%, with no attrition from any of the exercise groups.

In the area of program satisfaction, participants from both exercise groups identified various aspects of enjoyment, expectations, and need in their responses from the post-intervention interviews. A considerable proportion of participants from both groups indicated that the program was enjoyable (DVD: 44%; exergame: 56%). One particular area of concern for participants assigned to the DVD condition was that the program became boring and redundant over time. Program expectations were met, such that many participants from both groups indicated that the program was comprehensive and offered an assortment of exercises that

improved various aspects to their fitness (DVD: 44%; exergame 78%). More than half of the participants from the DVD and exergame conditions expressed that the program met their needs. More specifically, many of the respondents indicated that the program was a simple home setup with the added advantage of scheduling an exercise session with ease based on their day-to-day demands.

Due to the comprehensive nature of the exercise programs, it was predicted that there would be improvements would be seen in the physiological/functional fitness measures, as well as the quality of life measures, particularly in the area of physical functioning, vitality, and general health perceptions. In the area of physiological/functional fitness, the hypothesis was partially supported. Meaningful effects were identified for diastolic blood pressure, leg strength, hamstring flexibility, mobility, and aerobic endurance (η^2 = .08-20). However, no changes were found with variables such as resting heart rate, systolic blood pressure, waist circumference, body mass index, grip strength, and balance. Post-hoc analyses showed that participants assigned to the DVD group improved from baseline measures in the area of leg strength (d = .77), hamstring flexibility (d = .35), mobility (d = -.53), and aerobic endurance (d = .67). Participants assigned to the exergame group saw substantial improvements at follow-up for diastolic blood pressure (d = -.73), leg strength (d = .43), mobility (d = -.33), and aerobic endurance (d = .98).

DVD and exergaming interventions have shown the potential to improve functional outcomes and aerobic fitness in the older adult population (Laufer et al., 2014; McAuley et al., 2013). For instance, in the McAuley and colleagues' work in 2013, older adults that underwent a six-month DVD-based intervention saw significant improvements in balance and strength outcomes. Also, these findings were found to be consistent with a recent systematic review of RCT that investigated the effects of exergaming on balance control and functional performance

in independent functioning older adults (Laufer et al., 2014). In this review, the authors identified four exergaming studies resulted in increased performance for the chair sit-to-stand test (Jorgensen, Laessoe, Hendriksen, Nielsen, & Aagaard, 2013; Maillot, Perrot, & Hartley, 2012), six-minute walking test (Maillot et al., 2012), and the Tinetti balance test (Toulotte, Toursel, & Olivier, 2012). However, unlike the previous studies, the current results did not show improvements to balance. Though the chosen assessment tool is touted to test higher-level balance than the Tinetti balance test (REF), an explanation for the current findings may be related to the level of sensitivity of this assessment battery and may have not been suitable for this particular age group. Many of the participants were younger, in good health, and did not have any major functional limitations, which resulted in a ceiling effect on many of the individual assessments and relatively high score at baseline.

Along with the improvements to the functional fitness, it was predicted that improvements quality of life domains such as physical functioning, bodily pain, and general health perceptions would be seen in the exercise groups. The results partially supported the hypotheses, indicating meaningful group by time interaction and time main effects favoring the exercise conditions for bodily pain and general health perceptions (η^2 = .11 and .15, respectively); however, no changes were found for physical functioning. Improvements to social functioning, roles limited by physical health, roles limited by emotional problems, mental health, and vitality was not expected. Moderate to large effect sizes were representative of these changes (η^2 = .06-.19). Post-hoc analyses showed that improvements at follow-up were seen in four of the eight domains in the DVD group: social functioning (d = .32), roles limited by physical health (d = -.55), bodily pain (d = -.62), and general health perception domains (d = .67). While

in the exergame group, improvements were seen in three of the eight domains: roles limited by physical health (d = -.42), mental health (d = .44), and vitality (d = .89).

According to previous exergaming interventions, exergames have shown the potential to improve general health perceptions and bodily pain (Strand et al., 2014) though not seen in the current results. However, quality of life outcomes derived from DVD-based exercise have not been previously explored. In broad terms, a number of reviews have supported a positive association between PA and many but not all domains quality of life (Chodzko-Zajko et al., 2009; Rejeski & Mihalko, 2001).

A potential reason why the exergame group did not see as many improvements across quality of life domains may be due to the number of injuries and illness incurred in the group. As mentioned before, four of the nine participants reported injury or illness during the intervention, which may have been detrimental to various quality of life domains. In terms of the DVD group, improvements in various domains may due to the age-appropriateness, functional, and comprehensiveness of the exercises prescription, which may have translated improving the ability to perform activities of daily living. For instance, the stretching component focused on functional dynamic stretches focused specific areas on the body that many may have limited ranges of motion (e.g., lower back, shoulders, hip flexors), whereas the exergame was generally centered on static and generic stretching exercises.

Post-Intervention Follow-Up

The purpose of the post-intervention follow-up was to determine whether PA behaviour was sustained after the exercise equipment was removed and whether the participants adopted DVD- or videogame-based exercise after the intervention was over. It was hypothesized that MVPA and overall PA levels for the exercise groups would be similar to the control group and

return to baseline levels after the intervention was over; however, this was not supported by the results.

The results showed that both group by time interaction effects yielded large (η^2 = .15) and moderate effect sizes (η^2 = .11), for MVPA and overall PA, respectively. Moreover, the differences in levels of MVPA between the exercise and control groups were denoted by moderate-to-large effect sizes when PA was assessed at 12-weeks (exergame: *d* = .66; DVD: *d* = 1.03). For overall PA, both exercise groups were engaging in more activity than the control group (*d* = .58-.79). Across time, both of the exercise groups saw moderate increases in MVPA (*d* = .49-.60) from baseline levels, while the control group considerably decreased in MVPA levels from baseline at 12-weeks (*d* = .47). However, the overall PA levels in both exercise groups were relatively similar to baseline levels (d = .15-.21).

A possible reason for the increase in MVPA may be due to the adoption of the equipment upon the completion of the intervention. Approximately two-thirds of the participants assigned to the DVD group indicated that they purchased exercise DVDs and continued to engage in DVD-based exercise three to four times per week. Prior research has reported similar findings, where 40% of the participants assigned to a DVD-based exercise stated that they were engaging in three DVD-based exercise sessions per week at a six-month post-intervention follow-up (Wójcicki et al., 2014).

Another reason that may explain the higher levels of MVPA in the DVD group may be the usability and accessibility exercise DVDs. According to the qualitative results, many participants reported that DVD-based exercise was a simple and convenient way to exercise, and that the program helped establish an exercise routine. Moreover, many of these individuals were less likely to report equipment-related barriers (e.g., technology-related issues). In conjunction

with the pervasiveness of DVD players in the home, the simplicity and convenience may have lead to likelihood for DVD-based exercise adoption and continued PA behaviour. Despite this, participants in both exercise groups indicated that participation in the intervention helped establish an exercise routine and may have led to other types of PA.

Strengths and Limitations

There are a number of limitations to this work. First, due to the small sample size, the findings derived from the study are only exploratory. Based on the findings, exergames and DVDs may have the potential to elicit high adherence levels and increase PA behaviour. An adequately powered experimental trial would be needed to determine the true effectiveness of these types of interventions.

Second, the demographic characteristics of the sample were fairly homogeneous. Participants enrolled in the study were predominantly Caucasian, female, well educated, and of a higher social economic status. Thus, it will be important to extend the investigation into older adults belonging to minority groups, men, and individuals of lower social economic status.

Third, participants enrolled in the study were not exclusively retired. Approximately 40% of the participants enrolled in the study were not retired. To truly understand PA behaviours of retirees, it may be important to restrict the sample to those who have retired or partially retired in future studies.

Fourth, the adherence during the in-home phase was based on self-reported equipment use. According to the results, the adherence levels were not significantly different despite several participants in the exergame group reporting disinterest or an adverse event that hindered use. As a result, it is possible that the adherence levels in the exergame group were overstated.

Finally, it has been found that exergaming intensities have been generally underestimated by accelerometer counts (Tripette et al., 2014). Recent research has compared the intensities various exercises found in the with Fit Plus and Wii Sports games and measured PA intensities through accelerometry and indirect calorimetry in adult participants, and determined that PA measured through accelerometry underestimated the METs compared to indirect calorimetry (Tripette et al., 2014). More importantly, about 40% of the activities performed were not correctly estimated and 20% of the activities were misclassified (Tripette et al., 2014). Based on the fact that the exercises found in the exergame and DVD groups were similar, it is likely that MVPA levels in both groups were underestimated in this study. Thus, it may be advantageous to triangulate PA measures with self-report measures to provide a depiction the participants PA behaviour, as well how and what PA behaviours are changing over time.

The strength of this work lies in the high external validity of the findings by extending the data collection within the participants' homes. As well, DVD and exergames are products that are readily available and easily implemented to the community. Such novel cost-effective, low-barrier and accessible programs have the potential to be successful in improving PA and physical functioning. Another strength is the fact that the intervention was conducted all-year around and considered the effects of seasonality of a temperate coastal climate. Finally, this current study also considered the limitations of previous work, particularly in the exergame domain, by fulfilling the need for more controlled trials and employing objective measurements of PA.

Conclusions and Future Directions

The main aim of the study was to investigate the feasibility and acceptability of multimedia-based exercise programs, such as exercise DVDs and exergames, on exercise

adherence and MVPA in older adults transitioning into retirement and determine whether further investigative efforts were necessary. A secondary purpose was to investigate the intervention effects on motivation, functional fitness, quality of life outcomes, and elicited beliefs from using multimedia-based exercise programs.

To determine program feasibility and acceptance, several indicators were used. Program indicators for this domain included overall adherence and retention, changes to MVPA, post-intervention program adoption and maintenance, and program satisfaction. Based on the findings, the adherence rates were comparable between the two experimental groups. Moreover, relative to previous studies examining DVD- and exergaming interventions (McAuley et al., 2013; Rhodes et al., 2009), both exercise groups exhibited higher levels of adherence and retention over the nine-week intervention. In terms of PA behaviour, the effect size derived from DVD-based exercise at the end of the intervention was considerably higher than previous efforts to increase PA and may be a innovative approach to increasing PA behaviour in older adults (Conn et al., 2011, 2002; Foster et al., 2005). However, these same effects were not seen in the exergame group. Regarding equipment uptake and exercise maintenance, many of the participants assigned to the DVD group adopted DVD-based exercise programs and engaging in 3-4 sessions per week. To a lesser degree, participants in the exergame group adopted exergaming behaviour. Lastly, a significant proportion of participants from both groups were satisfied with the program indicating that the program was enjoyable, comprehensive, and a simple and convenient way to exercise.

In terms of functional outcomes, both exercise programs had the potential to make sizeable improvements in terms of strength, mobility and aerobic endurance. Along with these physiological changes, many of the quality of life domains also saw improvements. Specifically,

the DVD group saw increased scores in the area of social functioning and general health perceptions, and decreased scores in bodily pain and physical limitations affecting daily routines. While the exergame group saw improvements to mental health, vitality, and limitations affecting daily routines.

Considering all the aforementioned indicators for feasibility and acceptability, it would suggest that DVD-based exercise programs might be a viable approach to increasing MVPA in adults transitioning into retirement. Based on a moderate effect size, a total of 70 participants would be necessary to conduct a full experimental trial to examine the effectiveness of DVD programs.

To advance intervention research in this area, there are a number of important considerations. Firstly, exergames may not be a sustainable approach to promoting PA in adults transitioning into retirement. Thus, it may be advantageous to limit future investigative efforts to examining the effects of exercise DVDs adherence and PA. To do this, it may be important to increase the overall sample size and intervention length. Secondly, it may be beneficial to incorporate a progressive exercise DVD program similar to the FlexToBa program (McAuley et al., 2012) to mitigate redundancy and boredom, and enhance the functional and physiological outcomes. Finally, due to the limited ability for the TPB model to predict in-home screen-based PA behaviour, the consideration for other theoretical models may be important, particularly ones that address the discordance in intention and behaviour (see Rhodes & Yao, 2015 for a full review of theories).

Despite the large market for exercise equipment, very little research has been done to examine the effects of multimedia-based exercise programs on adherence and PA behaviour (Kaushal & Rhodes, 2014). The findings from this study provide evidence for prospective

investigative efforts in this area. With the pervasiveness of DVD-players in people's homes, DVD-based exercise programs may be a viable way to promote PA with pre-retired and retired adults in the long-term. Contrary to DVD players, videogame consoles may be less common in the homes of older adults. The presence of these devices may be a consequence of providing care for grandchildren, and the uptake in exergaming behaviour might have been incidental. Although, exergames can be seen as a novel approach to exercise and may be able to garner the interest of adults in this age group. In conjunction with these behavioural changes, improvements were seen in the areas of functional fitness domain and quality of life for both programs. Participants in both groups were generally satisfied, indicating that the exercise program was enjoyable, comprehensive, and a simple and convenient way to exercise at home. Further research will be required to examine the effectiveness of exercise DVDs in promoting PA among adults transitioning into retirement.

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Appendix A: CONSORT Statement Checklist

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	i
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	iii
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	1-4
	2b	Specific objectives or hypotheses	5-7
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	27
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	n/a
Participants	4a	Eligibility criteria for participants	30
	4b	Settings and locations where the data were collected	30-33
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	33-35
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	36-46
	6b	Any changes to trial outcomes after the trial commenced, with reasons	n/a
Sample size	7a	How sample size was determined	30
	7b	When applicable, explanation of any interim analyses and stopping guidelines	n/a
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	27
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	n/a
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	n/a
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	27

Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	n/a
	11b	If relevant, description of the similarity of interventions	n/a
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	48-49
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	46-48
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	50-51
	13b	For each group, losses and exclusions after randomisation, together with reasons	50-51
Recruitment	14a	Dates defining the periods of recruitment and follow-up	30
	14b	Why the trial ended or was stopped	n/a
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	54
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	51, 54
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	57-97
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	n/a
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	57-97
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	94
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	107-108
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	108
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	98-110
Other information			
Registration	23	Registration number and name of trial registry	n/a

Protocol	24	Where the full trial protocol can be accessed, if available	n/a
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	n/a

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up to date references relevant to this checklist, see www.consort-statement.org.

Appendix B: Study Timeline

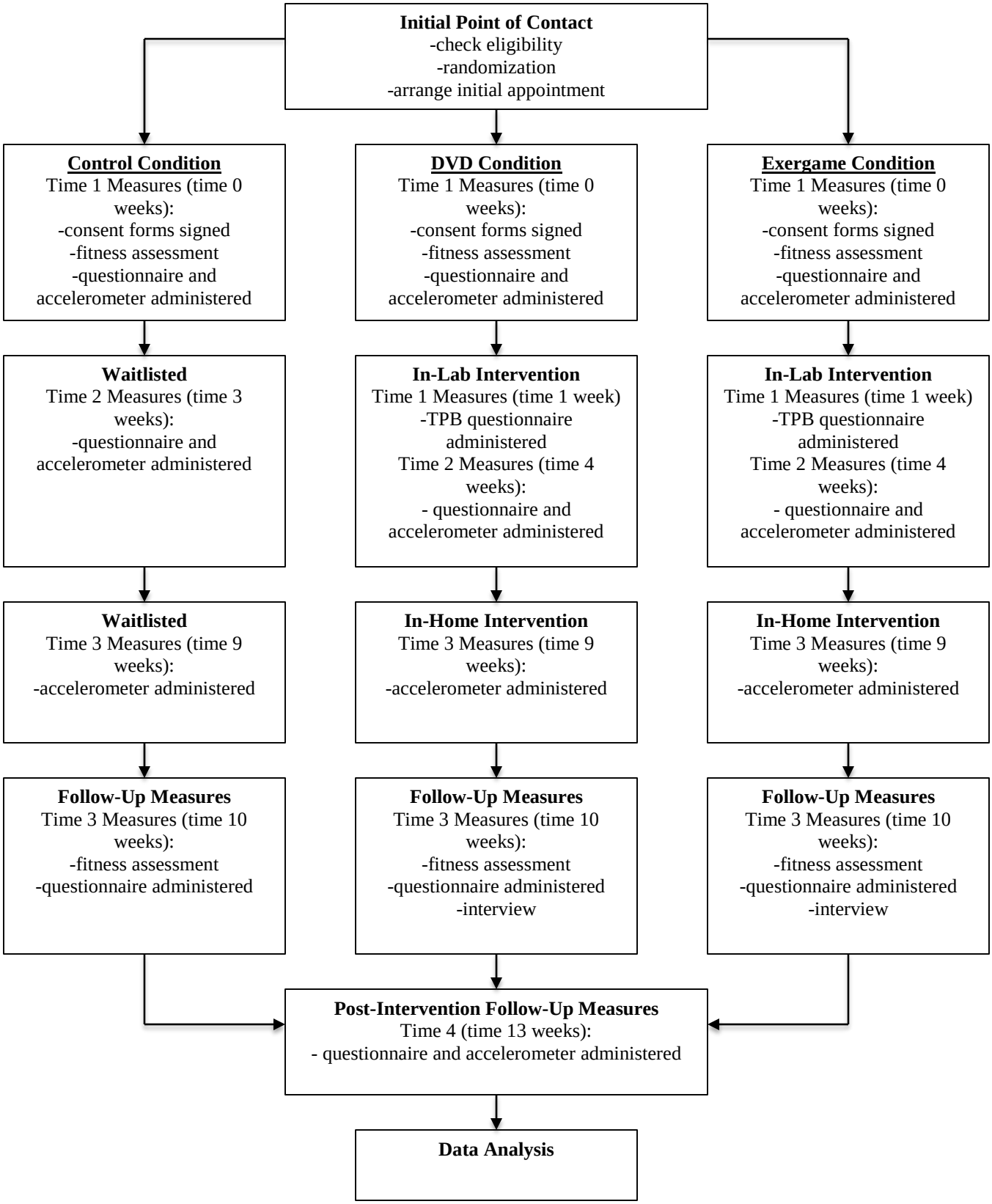

Figure 7. Intervention timeline.

Appendix C: Notice of Research

Notice of Research

My name is Christopher Yao and I am a Masters student with Dr. Ryan Rhodes at the University of Victoria, and we are conducting a study titled **"**A Randomized Control Trial Comparing Active Gaming and DVD-based Exercise Programs: Examining the Approaches to Improve Physical Fitness Among Older Adults**"**. This intervention will compare active videogames (Wii gaming system) to DVD-based exercise programs for older adults.

Involvement in this research is very important, despite the scientific evidence for the benefits of physical activity, many older adults are not meeting the current physical activity recommendations for health gains. Older adults are one of the most inactive populations, such that less than 5% meet the recommendations of 150 minutes of moderate to vigorous activity per week. In addition, physical activity interventions have had small successes, and current research suggests that physical activity opportunities should be enjoyable, challenging enough, and convenient. Research using interactive gaming equipment is minimal, but studies do show positive health benefits and increased enjoyment over some of the other traditional approaches to exercise. As a result, this research builds upon past research by examining behavioral and psychological outcomes such as adherence and enjoyment when using interactive video games for exercise.

If you decide to participate, an initial fitness assessment will be scheduled with you. At this time, consent will be attained and a questionnaire package will be given to you to complete. The questionnaire package will include questions regarding demographic information, quality of life, leisure-time physical activity, and your ability to self-regulate physical activity behaviour. Your current cardiovascular fitness, muscular strength, flexibility, balance, blood pressure, height, and weight will be also assessed. The total time required for the initial assessment will take approximately 1.5 hours. Once the assessments have been completed, an accelerometer will be given to you to wear for a week prior the start of the 9-week intervention. This device provides us with a measure of the amount of physical activity you engage in during a typical week. During this time, you will be randomized to an exercise video gaming condition, DVD-based exercise program, or a waitlisted group. Those allotted to the waitlist group will be expected to complete the same measurements at the end of 9 weeks. Individuals assigned to the exercise video game or DVD groups will start their first exercise session scheduled that will take about 60 minutes. During this first session, a research assistant will help you become familiarized with the equipment. Once the exercise session has been completed, a questionnaire assessing your motivation to participate in the program for the three weeks will be administered. At the end of the session, three 45-minute exercise sessions will be planned for the rest of the week. Over the course of the 3-week in-lab exercise sessions, a research assistant will show you the proper exercise techniques and modify the exercises if needed. Also, the research assistant will be expected to help you troubleshoot any technical issues that may arise. Attendance during the in-lab component will be tracked over the course of 3 weeks. An accelerometer will be given to you to wear during the third week. Once the in-lab sessions have been completed, you will be asked to complete a second questionnaire assessing your motivation to participate in the program across the next 6 weeks and the in-home phase will follow. The necessary equipment will be lent

to you and you will be expected to continue to exercise with the DVD or exercise video game. During the in-home component, you will be asked to keep track of your usage in an activity log. An accelerometer will be given to you to wear in the final week. Once the 9 weeks has been completed, a final assessment will be conducted. The final assessment will include the fitness assessments performed at baseline, questionnaires, and a brief interview. The final assessment will take approximately 1.5 hours. Equipment belonging to the University of Victoria such as the game consoles, video games, exercise equipment, and exercise DVDs, will be returned to the Behavioural Medicine Laboratory upon the completion of the 9-week intervention.

Participation in the study could possibly involve some physical risks and fatigue associated with physical exertion. We will do our best to prevent such risks from occurring. We do this by administering the PAR-Q; administering a fitness assessment to allow the exercise physiologist and personal trainers to gauge how much activity will be safe for you to engage in; being oriented to your program by a personal trainer; having a personal trainer or physiologist present during all your training sessions; and you being in control of what, how much and often you engage during the lab sessions.

Should you choose to participate, it is important for you to know that you can with withdraw at anytime without explanation or consequence. Thank you very much for your time, and please feel free to contact me at 250-472-5488 or cayao@uvic.ca or my supervisor, Dr. Ryan Rhodes, at 250-721-8384 for further information.

Thank you!

Appendix D: Phone Script

Phone Script for Point of Contact & Screening:

Thank you for your interest in our study. My name is Christopher Yao and I am the Research Coordinator for this study. This study is a very exciting, as it is studying exercise equipment that is interactive in nature and the motivation behind using this equipment. This research uses randomization to put individuals into one of two conditions: the first will be in a Wii Active condition, and the second will be a DVD-based exercise program. Before I go on, there are a few questions I must ask you to ensure that you are eligible to participate in the study. This screening process will consist a screening for physical activity, overall health, and cognitive status and will take approximately 10-15 minutes.

PART 1: Age and Physical Activity

Must answer YES	**YES**	**NO**
Are you between the ages of 60-70? State current age.	☐	☐
Are you currently engaging in less than 150 minutes of moderate to vigorous physical activity per week? OR What does a typical week of physical activity look like for you for the past 6 months (frequency, intensity, time, type)?	☐	☐

PART 2: General Health Questions (PAR-Q+)

Must answer NO	**YES**	**NO**
Has your doctor ever said that you have a heart condition OR high blood pressure?	☐	☐
Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?	☐	☐
Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Answer NO if the dizziness was associated with over-breathing (including vigorous exercise)	☐	☐
Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)?	☐	☐
Are you currently taking prescribed medications for a chronic medical condition?	☐	☐
Do you have a bone or joint problem that could be made worse by becoming more physically active? (Answer NO if participant has had a joint problem in the past, but it does not limit the current ability to be physically active – for example, knee ankle, shoulder or other).	☐	☐
Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

Part 3: TICS

Question	**Scoring Criteria**	**Points Awarded**
1. Please tell me your full name?	1 pt. for first name and 1 pt. for last name. **2 pts**	

2. What is today's date?	1 pt for month, date, year, day of week, and season (if incomplete, ask for specifics – e.g., What is the month? What is the season?) **5 pts.**	
3. What is your age? What is your phone number?	1 pt. for correct age. 1 pt for correct phone number including area code. **2 pts.**	
4. Count backwards from 20 to 1	2 pts if completely correct on 1st trial, 1 pt. if completely correct on 2nd trial, 0 points for anything else. **2 pts.**	
5. I am going to read you a list of 10 words. Please listen carefully and try to remember them. When I am done, tell me as many words as you can, in any order. The words are: 1. Cabin 2. Pipe 3. Chest 4. Elephant 5. Silk 6. Theatre 7. Watch 8. Whip 9. Pillow 10. Giant Now, tell me all the words you can remember.	1 pt. for each correct response. No penalty for intrusions or repetitions. **10 pts.**	
6. 100 minus 7 equals what? And 7 from that?.... Now continue to subtract 7 from what you have left over until I ask you to stop.	Stop at 5 serial subtractions. 1 pt for each correct subtraction. Do not inform the participant of incorrect subtractions, but allow for subtractions to be made from his/her last response. **5 pts.**	
7. What do people usually use to cut paper? How many things are in a dozen? What do you call the prickly green plant that grows in the desert? What animal does wool come from?	1 pt. for scissors or shears only. 1 pt. for 12 1 pt for cactus 1 pt for sheep or lamb **4 pts.**	
8. Say this "No ifs, ands or buts" Say this "Methodist Episcopal"	1 pt for each if exactly right. **2 pts.**	
9. What is the Prime Minister's name? 10. What is the name of the premier of BC?	2 pt. for Steven Harper. 2 pt. for Christy Clarke. **4 pts.**	
10. With your finger, tap 5 times on the part of the phone you speak into	2 pts if 5 taps heard, 1 pt if participant taps more or less than 5	

	times. **2 pts.**	
11. I'm going to give you a word and I want you to give me its opposite. For example, the opposite of hot is cold. What is the opposite of West? What is the opposite of generous?	1 pt. for east. 1 pt for selfish, greedy, stingy, cheap, tight, mean, meager, skimpy, or other good antonym. **2 pts**	
12. Please repeat the list of words I read earlier	1 pt. for each correct response. **10 points.**	
	Total	(must score >28)

PART 4: Television Compatibility

Must answer YES	**YES**	**NO**
Does your television support a video gaming console or a DVD player (i.e. an A/V cord hook up – red/white/yellow inputs at the front/back of you television)? If the participant does not know whether their television will support these devices: How old is you television set? –should be less than 20 years old Does it have a red/white/yellow input on the front/back of the television?	☐	☐

The person is eligible if they answer the questions pertaining to overall health status accordingly, score a minimum of 28 on the cognitive test, and own a television that is compatible with a gaming system/DVD player.

May I take a moment to briefly explain what we will be asking you to participate in?

As I mentioned before, you will be randomized to one of three groups. The conditions are either a Wii Active interactive gaming condition, DVD-based exercise program, or on a waitlist.

If you decide to participate, an initial fitness assessment will be scheduled with you. At this time, consent will be attained and a questionnaire package will be given to you to complete. The questionnaire package will include questions regarding demographic information, quality of life, leisure-time physical activity, and your ability to self-regulate physical activity behaviour. Your current cardiovascular fitness, muscular strength, flexibility, balance, blood pressure, height, and weight will be also assessed. The total time required for the initial assessment will take approximately 1.5 hours. Once the assessments have been completed, an accelerometer will be given to you to wear for a week prior the start of the 9-week intervention. This device provides us with a measure of the amount of physical activity you engage in during a typical week. During this time, you will be randomized to an exercise video gaming condition, DVD-based exercise program, or a waitlisted group. Those allotted to the waitlist group will be expected to complete the same measurements at the end of 9 weeks. Individuals assigned to the exercise video game or DVD groups will start their first exercise session scheduled that will take about 60 minutes. During this first session, a research assistant will help you become familiarized with the equipment. Once the exercise session has been completed, a questionnaire assessing your motivation to participate in the program for the three weeks will be administered. At the end of

the session, three 45-minute exercise sessions will be planned for the rest of the week. Over the course of the 3-week in-lab exercise sessions, a research assistant will show you the proper exercise techniques and modify the exercises if needed. Also, the research assistant will be expected to help you troubleshoot any technical issues that may arise. Attendance during the in-lab component will be tracked over the course of 3 weeks. An accelerometer will be given to you to wear during the third week. Once the in-lab sessions have been completed, you will be asked to complete a second questionnaire assessing your motivation to participate in the program across the next 6 weeks and the in-home phase will follow. The necessary equipment will be lent to you and you will be expected to continue to exercise with the DVD or exercise video game. During the in-home component, you will be asked to keep track of your usage in an activity log. An accelerometer will be given to you to wear in the final week. Once the 9 weeks has been completed, a final assessment will be conducted. The final assessment will include the fitness assessments performed at baseline, questionnaires, and a brief interview. The final assessment will take approximately 1.5 hours. Equipment belonging to the University of Victoria such as the game consoles, video games, exercise equipment, and exercise DVDs, will be returned to the Behavioural Medicine Laboratory upon the completion of the 9-week intervention.

Participation in the study could possibly involve some physical risks and fatigue associated with physical exertion. We will do our best to prevent such risks from occurring. We do this by administering the PAR-Q; administering a fitness assessment to allow the exercise physiologist and personal trainers to gauge how much activity will be safe for you to engage in; being oriented to your program by a personal trainer; having a personal trainer or physiologist present during all your training sessions; and you being in control of what, how much and often you engage during the lab sessions.

May we please set up an orientation when you are available? May I please have your contact information so that I can contact you to remind you about the orientation session? Thank you once again for your time and willingness to participate in this study. Have a good day.

If THE participant answered yes to a question on the PAR-Q:
Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES to. We will also provide you with a form that your doctor must complete. Once it has been completed, bring it back to us and we will determine whether or not you are eligible to participate in the study.

If the participant does not meet the inclusion criteria: Unfortunately, it is important that all participants meet the inclusion criteria. At this time, I cannot include you in the study. Thank you very much for your interest and support of this project and of research being conducted at the University of Victoria, we look forward to your involvement in future projects.

Appendix E: Consent Forms and Right to Withdrawal Form

University of Victoria | British Columbia Canada

Participant Consent Form

"A Randomized Controlled Trial Exploring the Effectiveness of Exercise DVDs and Exergames in Promoting Older Adults Physical Activity: A Pilot Study"

You are being invited to participate in a study entitled **"**A Randomized Control Trial Comparing Active Gaming and DVD-based Exercise Programs: Examining the Approaches to Improve Physical Fitness among Older Adults**"** conducted by Christopher Yao and Dr. Ryan Rhodes.

Christopher Yao is a graduate student in the department of Exercise Science, Physical and Health Education at the University of Victoria and you may contact him if you have further questions by calling 250-472-5022 or emailing him at cayao@uvic.ca.

As a graduate student, I am required to conduct research as part of the requirements for a Master of Science degree in Kinesiology. It is being conducted under the supervision of Dr. Ryan Rhodes. You may contact my supervisor at 250-721-8384.

What Is The Purpose Of This Study? The purpose is to build upon previous research by examining the motivation underlying the use of exercise videogames and DVD-based exercise programs. This 9-week intervention will be looking at the differences between 2 experimental groups (exercise videogames and DVD-based exercise) at improving physical activity levels and decrease the risk factors of falls in adults between the ages of 60-70 years.

Why Is This Research Important? Research of this type is important because physical activity promotion is beneficial for both physical and psychological health. Specifically, regular physical activity can prevent chronic diseases such as cardiovascular disease, cancer, type 2 diabetes mellitus, and depression. However, recent Canadian statistics indicate that less than 10% of older adults sufficiently active to reap health benefits (less than 150 minutes of moderate to vigorous physical activity per week). Current physical activity interventions have had limited success. Research examining the effectiveness of exercise video games in improving physical activity levels has been mostly examined in children and adolescents. Furthermore, studies investigating the effectiveness of exercise DVDs are limited. Therefore, this study builds upon past research by expanding the population studied to the older adult population in hopes of increasing physical activity levels as well as decreasing risk factors associated with falls.

Participant Selection. You are being asked to participate in this study because you are:

1) Between the age of 60-70 years.

2) Do not meet the current recommended physical activity guidelines for health benefits (i.e., less than 150 minutes moderate to vigorous activities per week).
3) In good health based on the fact that you have answered "no" to all questions on the Physical Activity Readiness Questionnaire OR if you answer "yes" to one of the questions on the questionnaire and received physician clearance to participate in the study.
4) Achieved over the minimum score on the Telephone Interview for Cognitive Status.
5) Have a television that can support a video gaming console or a DVD player.
6) Currently residing in the Greater Victoria area.

What Do Participants Have To Do?

If you decide to participate, an initial fitness assessment will be scheduled with you. At this time, consent will be attained and a questionnaire package will be given to you to complete. The questionnaire package will include questions regarding demographic information, quality of life, leisure-time physical activity, and your ability to self-regulate physical activity behaviour. Your current cardiovascular fitness, muscular strength, flexibility, balance, blood pressure, height, and weight will be also assessed. The total time required for the initial assessment will take approximately 1.5 hours. Once the assessments have been completed, an accelerometer will be given to you to wear for a week prior the start of the 9-week intervention. This device provides us with a measure of the amount of physical activity you engage in during a typical week.

During this time, you will be randomized to either an exercise video gaming condition, DVD-based exercise program, or a waitlisted group. Those allotted to the waitlist group will not be assigned to a condition until the end of 9 weeks. For these individuals, it will be expected that they complete the same measurements as the experimental groups over the 9 weeks. Individuals assigned to the exercise video game or DVD groups will start their first exercise session scheduled, which will take about 60 minutes. During this first session, a research assistant will help you become familiarized with the equipment. Once the exercise session has been completed, a questionnaire assessing your motivation to participate in the program for the three weeks will be administered. At the end of the session, three 45-minute exercise sessions will be planned for the rest of the week. Over the course of the 3-week in-lab exercise sessions, a research assistant will show you the proper exercise techniques and modify the exercises if needed. Also, the research assistant will be expected to help you troubleshoot any technical issues that may arise. Attendance during the in-lab component will be tracked over the course of 3 weeks. An accelerometer will be given to you to wear at the end of the third week.

Once the in-lab sessions have been completed, you will be asked to complete a second questionnaire assessing your motivation to participate in the program across the next 6 weeks and the in-home phase will follow. The necessary equipment will be lent to you and you will be expected to continue to exercise with the DVD or exercise video game. During the in-home component, you will be asked to keep track of your usage in an activity log. An accelerometer will be given to you to wear in the final week.

Once the 9 weeks has been completed, a final assessment will be conducted. The final assessment will include the fitness assessments performed at baseline, questionnaires, and a brief

interview. The final assessment will take approximately 1.5 hours. Equipment belonging to the University of Victoria such as the game consoles, video games, exercise equipment, and exercise DVDs, will be returned to the Behavioural Medicine Laboratory upon the completion of the 9-week intervention.

As a follow-up to the intervention, participants will be asked to wear an accelerometer for a week three weeks after the program has been completed. At this time, a survey will examine the availability of the equipment in your home will be administered.

THE TIME COMMITMENT FOR THIS STUDY IS AS FOLLOWS:

- THE INITIAL STAGE (FITNESS ASSESSMENT, PROGRAM ORIENTATION, AND COMPLETION OF QUESTIONNAIRE) WILL TAKE APPROXIMATELY 1.5 HOURS.
- FOR THE FIRST 3 WEEKS, WE WILL RECOMMEND THAT YOU COME FOR FOUR 45-60 MINUTE EXERCISE SESSIONS.
- THE FINAL FITNESS ASSESSMENT WILL TAKE APPROXIMATELY 1.5 HOURS AND WILL INCLUDE A SHORT INTERVIEW.

What are the inconveniences associated with participating? Participation in this study may cause some inconvenience to you. The main concern being the time commitment of 4 hours per week as well the parking fees incurred during the initial 3 weeks and for the final fitness assessment.

What are the risks of participating? There are some potential risks to you by participating in this study and they include physical risks, such as fatigue or stress as a result of physical exertion. To prevent or to deal with these risks, the following steps will be taken:

- THE PAR-Q WILL BE ADMINISTERED PRIOR TO THE FITNESS ASSESSMENT TO ENSURE THAT IT WILL BE SAFE FOR YOU TO BECOME MORE PHYSICALLY ACTIVE.
- THE INITIAL FITNESS ASSESSMENT WILL ALLOW THE EXERCISE PHYSIOLOGIST AND RESEARCH ASSISTANT TO GAUGE HOW MUCH ACTIVITY WILL BE SAFE FOR YOU TO ENGAGE IN. THIS WILL BE USED TO GUIDE THE PROGRESSION OF THE 3-WEEK PROGRAM.
- THE CERTIFIED EXERCISE PHYSIOLOGIST OR RESEARCH ASSISTANT WILL ORIENT YOU ON HOW TO USE THE EQUIPMENT AND ENSURE THE EXERCISES ARE PROPERLY CONDUCTED DURING THE FIRST WEEK. ALSO, EXERCISES WILL BE MODIFIED IF NECESSARY, IF DEEMED TOO DIFFICULT OR UNSAFE. YOU WILL ALSO BE TOLD TO STOP THE EXERCISE AS SOON AS YOU BEGIN TO EXPERIENCE DISCOMFORT.
- THE EXERCISE PHYSIOLOGIST OR PERSONAL TRAINER WHO WILL BE WITH YOU DURING EACH LAB SESSION WILL ENSURE THAT YOU ARE NOT

FATIGUING YOURSELF IN A MANNER THAT IS HARMFUL, AND THAT YOU ARE PERFORMING THE EXERCISES CORRECTLY.

- YOU ARE IN CONTROL OF THE FREQUENCY, DURATION AND INTENSITY OF YOUR EXERCISE PROGRAM; ASSUMING THAT IT COMPLIES WITH WHAT HAS BEEN ADVISED BY THE EXERCISE PHYSIOLOGIST AND PERSONAL TRAINERS. SHOULD YOU CHOOSE TO NOT TO PERFORM A PARTICULAR EXERCISE, THIS IS FINE. YOU DO NOT HAVE TO ENGAGE IN SOMETHING THAT YOU DON'T WANT TO DO/DON'T LIKE/DON'T FEEL COMFORTABLE WITH, OR COME ON A DAY THAT YOU DON'T FEEL LIKE BEING PHYSICALLY ACTIVE.
- OUR FITNESS TESTERS ARE CERTIFIED AND EXPERIENCED ADMINISTERING THESE PROTOCOLS, WITH THIS POPULATION. THEY ARE ALSO CERTIFIED IN CPR. FURTHERMORE, THE PHONE NUMBERS FOR CAMPUS SECURITY AND EMERGENCY PERSONNEL ARE POSTED IN THE LAB, AND THERE ARE 2 PHONES IN THE LAB.

What Are The Benefits Of Participating? This is an exciting research project because very little research has been conducted in the past that looks at this topic. As a participant, you will have the opportunity to increase your physical activity using new, innovative exercise equipment under the supervision of research assistants.

Voluntary Participation. Your participation in this research must be completely voluntary. If you decide to participate, you may withdraw from the study at any time without any consequences or explanation. If you withdraw from the study, your data will be used only if you grant us permission.

On-going Consent. At the start or end of each in-lab exercise session, BMED researchers will confirm your participation by booking your next exercise appointment. For the individual interviews conducted at the end of the study, a separate consent form will be provided.

Anonymity. In terms of protecting your anonymity, all participants will be assigned an identification number and be identified by this number on all forms with personal data. The master list that pair ID numbers will be stored in a password protected computer in the Behavioural Medicine Laboratory. All results produced will be from group data and no individuals will be identified. All names and identifying characteristics will be withdrawn from the transcripts. The transcripts will be analyzed for common themes and will be kept as group information. No individual transcripts will be separated from the rest of the group.

Confidentiality. Your confidentiality and the confidentiality of the data will be protected in the following manner: 1) Data will be stored and secured in locked file cabinets or password-protected computers in the Behavioural Medicine Laboratory at the University of Victoria and 2) Only lab personnel associated with the study will have access to this information and data.

Dissemination of Results. It is anticipated that the results of this study will be shared with others in the form of published articles and conference presentations.

Disposal of Data. Data from this study will be destroyed after 5 years. Electronic files will be deleted and paper documents will be shredded.

Contacts. You can request further information regarding this study by contacting Christopher Yao at cayao@uvic.ca or 250-472-5022 or Dr. Ryan Rhodes at rhodes@uvic.ca or 250-721-8384. In addition to being able to contact the researcher at the above phone number and email, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Board at the University of Victoria (250-472-4545).

Your signature below indicates that you understand the above conditions of the participation in this study, and that you have had the opportunity to have your questions answered by the researchers.

Name of Participant	Signature	Date

Please sign and return ONE signed copy and keep one copy for yourself.

University of Victoria | British Columbia Canada

Participant Withdrawal Form

Consent For Use of Data Following Participant Withdrawal:

I agree to allow Christopher Yao, the research coordinator for the study **"A Randomized Controlled Trial Exploring the Effectiveness of Exercise DVDs and Exergames in Promoting Older Adults Physical Activity: A Pilot Study"** to use the data collected from me from prior to the date listed below, as I have withdrawn from the study. This data may be used in the analysis of group data to be included in scholarly journals and conference presentations.

_____	_____	_____
(Name)	(Signature)	(Date)
_____	_____	_____
(Witness Name)	(Witness Signature)	(Date)

Appendix F: Questionnaires, Interview Questions, and Data Collection Forms

"A Randomized Control Trial Comparing Active Gaming and DVD-based Exercise Programs: Examining the Approaches to Improve Physical Fitness Among Older Adults"

BASELINE QUESTIONNAIRE

Christopher Yao

Primary Investigator

School of Exercise Science, Physical & Health Education

University of Victoria

ID #_____

DATE _____

Questionnaire Instructions

Please begin this questionnaire by reading all of the instructions thoroughly, and then answer the questions to the best of your knowledge. If you choose not to answer any question, just leave it blank and move on to the next question. Please note that some of the questions may appear redundant. This is done for an important reason that has to do with the reliability and validity of our questionnaire. Therefore, it is important that you answer as many questions as you can, even if they seem like they are asking the same thing. We need the most complete information possible to include your input into our results. Thank you for participating in this study! If you have any questions about completing the questionnaire, please feel free to ask the researcher for any additional help that you may require.

Any questions or concerns can be directed to:

Christopher Yao (Primary Investigator)
250-472-5022 or cayao@uvic.ca

Dr. Ryan Rhodes (Supervisor)
250-721-8384 or rhodes@uvic.ca

Part 1: Demographic Information

1) Date of Birth (MM/DD/YYYY): _____ Current Age: _____

2) Gender: Male Female

3) Ethnicity/Race: _____

4) What is the highest level of education that you completed? Please check only one.

☐ 8th grade or less ☐ Vocational school or some college

☐ Some high school ☐ College / University degree

☐ High school diploma ☐ Professional or graduate degree

5) What is your job situation? Please check one that fits you best.

☐ Homemaker ☐ Retired ☐ Student

☐ Paid full-time employment/self-employed

☐ Paid part-time employment/self-employed

☐ Temporarily unemployed

6) What is your annual household income (total income per year)?

☐ Under $25,000
☐ $25,000 - $39,999
☐ $40,000 - $49,999
☐ $50,000 - $74,999
☐ $75,000 - $99,999
☐ $100,000 - $124,999
☐ $125,000 - $149,999
☐ Over $150,000

Health Status

1) Do you currently smoke cigarettes? Yes ☐ No ☐

If yes, how many cigarettes do you usually smoke a day? _____

If no, have you ever smoked cigarettes? Yes ☐ No ☐

2) Has a doctor or nurse ever told you that you have had the following*:*

(please check all that apply)

a. Angina ☐ e. Cancer ☐

. b. Heart Attack ☐ f. High blood pressure ☐

c. Stroke ☐ g. High cholesterol ☐

d. Diabetes If yes, which type? Type 1 ☐ Type 2 ☐ Gestational ☐

3) In general, compared to other persons your age, how would you rate your health?

Poor ☐ Fair ☐ Good ☐ Very Good ☐ Excellent ☐

4) To ensure that you exercise safely AND modify exercises accordingly, Please list any previous injuries that you have had in the past, surgeries, or any conditions that may limit your exercise ability:

_____

_____

_____

Gaming History

1) Do you currently play video games? Yes ☐ No ☐

If yes, how many hours do you play each day? _____

If no, have you played video games consistently in the past? Yes ☐ No ☐

2) Do you currently play computer games? Yes ☐ No ☐

If yes, how many hours do you play each day? _____

If no, have you played computer games consistently in the past? Yes ☐ No ☐

Part 3: Quality of Life

This survey asks for your views about your health. This information will help you keep track of how you feel and how well you are able to do your usual activities.

Answer every question by selecting the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is:

1	2	3	4	5
Excellent	**Very Good**	**Good**	**Fair**	**Poor**

2. Compared to one year ago, how would you rate your health in general now?

1	2	3	4	5
Much better than a year ago	**Somewhat better than a year ago**	**About the same as a year ago**	**Somewhat worse than a year ago**	**Much worse than a year ago**

3. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	**Yes, limited a little**	**No, not limited at all**
Vigorous activities (e.g., running, lifting heavy objects, participating in strenuous sports)	**1**	**2**	**3**
Moderate activities (e.g., moving a table, pushing a vacuum cleaner, bowling, playing golf)	**1**	**2**	**3**
Lifting or carrying groceries	**1**	**2**	**3**
Climbing several flights of stairs	**1**	**2**	**3**
Climbing one flight of stairs	**1**	**2**	**3**
Bending, kneeling, or stooping	**1**	**2**	**3**

Walking more than a mile (1.6 km)	**1**	**2**	**3**
Walking several blocks	**1**	**2**	**3**
Walking one block	**1**	**2**	**3**
Bathing or dressing yourself	**1**	**2**	**3**

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

Cut down the amount of time you spent on work or other activities	**Yes**	**No**
Accomplished less than you would like	**Yes**	**No**
Were limited in the kind of work or other activities	**Yes**	**No**
Had difficulty performing the work or other activities (e.g., it took extra effort)	**Yes**	**No**

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

Cut down the amount of time you spent on work or other activities	**Yes**	**No**
Accomplished less than you would like	**Yes**	**No**
Did work or other activities less carefully than usual	**Yes**	**No**

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with friends, family, neighbours, or groups?

1	**2**	**3**	**4**	**5**
Not at all	**Slightly**	**Moderately**	**Quite a bit**	**Extremely**

7. How much bodily pain have you had during the past 4 weeks?

1	2	3	4	5	6
None	**Very mild**	**Mild**	**Moderate**	**Severe**	**Very severe**

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

1	2	3	4	5
Not at all	**Slightly**	**Moderately**	**Quite a bit**	**Extremely**

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

   How much of the time during the past 4 weeks...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
Did you feel full of pep?	**1**	**2**	**3**	**4**	**5**	**6**
Have you been a very nervous person?	**1**	**2**	**3**	**4**	**5**	**6**
Have you felt so down in the dumps that nothing could cheer you up?	**1**	**2**	**3**	**4**	**5**	**6**
Have you felt calm and peaceful?	**1**	**2**	**3**	**4**	**5**	**6**
Did you have a lot of energy?	**1**	**2**	**3**	**4**	**5**	**6**
Have you felt downhearted and blue?	**1**	**2**	**3**	**4**	**5**	**6**
Did you feel worn out?	**1**	**2**	**3**	**4**	**5**	**6**
Have you been a happy person?	**1**	**2**	**3**	**4**	**5**	**6**
Did you feel tired?	**1**	**2**	**3**	**4**	**5**	**6**

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

1 All of the time	2 Most of the time	3 Some of the time	4 A little of the time	5 None of the time

11. How TRUE or FALSE are each of the following statements for you?

	Definitely True	Mostly True	Don't know	Mostly false	Definitely false
I seem to get sick a little easier than other people	1	2	3	4	5
I am as healthy as anybody I know	1	2	3	4	5
I expect my health to get worse	1	2	3	4	5
My health is excellent	1	2	3	4	5

"A Randomized Control Trial Comparing Active Gaming and DVD-based Exercise Programs: Examining the Approaches to Improve Physical Fitness Among Older Adults"

TPB BASELINE QUESTIONNAIRE

(DVD CONDITION)

Christopher Yao

Primary Investigator

School of Exercise Science, Physical & Health Education

University of Victoria

ID #_____

DATE _____

Questionnaire Instructions

Please begin this questionnaire by reading all of the instructions thoroughly, and then answer the questions to the best of your knowledge. If you choose not to answer any question, just leave it blank and move on to the next question. Please note that some of the questions may appear redundant. This is done for an important reason that has to do with the reliability and validity of our questionnaire. Therefore, it is important that you answer as many questions as you can, even if they seem like they are asking the same thing. We need the most complete information possible to include your input into our results. Thank you for participating in this study! If you have any questions about completing the questionnaire, please feel free to ask the researcher for any additional help that you may require.

Any questions or concerns can be directed to:

Christopher Yao (Primary Investigator)
250-472-5022 or cayao@uvic.ca

Dr. Ryan Rhodes (Supervisor)
250-721-8384 or rhodes@uvic.ca

Exercise DVD Usage

The following questions ask you to rate **how you feel** about exercising regularly with the DVD-based program over the **next 3 weeks**. Here we define regular exercise as attaining at least 30 minutes of moderate to vigorous (i.e., slight perspiration, breathing faster, elevated heart rate) DVD-based exercise per day, 4 times per week. Pay careful attention to the words at each end of the scales and circle the number that best represents how you feel.

For me, exercising with the DVD-based program over the next **3 weeks** would be:

1.	1 extremely enjoyable	2 moderately enjoyable	3 slightly enjoyable	4 neutral	5 slightly unenjoyable	6 moderately unenjoyable	7 extremely unenjoyable
2.	1 extremely useful	2 moderately useful	3 slightly useful	4 neutral	5 slightly useless	6 moderately useless	7 extremely useless
3.	1 extremely pleasant	2 moderately pleasant	3 slightly pleasant	4 neutral	5 slightly unpleasant	6 moderately unpleasant	7 extremely unpleasant
4.	1 extremely wise	2 moderately wise	3 slightly wise	4 neutral	5 slightly unwise	6 moderately unwise	7 extremely unwise
5.	1 extremely exciting	2 moderately exciting	3 slightly exciting	4 neutral	5 slightly boring	6 moderately boring	7 extremely boring
6.	1 extremely beneficial	2 moderately beneficial	3 slightly beneficial	4 neutral	5 slightly harmful	6 moderately harmful	7 extremely harmful

The next questions ask you about what other people in your **social network** (e.g., friends, family, co-workers) would think about you exercising regularly with the DVD-based program over the **next 3 weeks**. Please respond to each statement using the following scale by circling a number between 1 and 7 at the end of each statement. Please answer these questions thinking only about the people in your **social network**.

1. Most people who are important to me would want me to engage in regular exercise with the DVD-based program over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

2. Most people whose opinions I value would expect me to engage in regular exercise with the DVD-based program over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

3. Most people who are important to me will exercise with the DVD-based program over the next **3 weeks** themselves.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

4. I feel pressure to exercise with the DVD-based program over the next **3 weeks** from people who are important to me.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

The following questions focus on how much **control** you believe you have over exercising regularly with the DVD-based program over the **next 3 weeks**. Remember we defined regular exercise as attaining at least 30 minutes of moderate to vigorous (i.e., slight perspiration, breathing faster, elevated heart rate) DVD-based exercise per day, 4 times per week. Please read the questions carefully and circle the number that best represents your beliefs.

1. Exercising with the DVD-based program over the next **3 weeks** is under **my control if I really wanted to do so.**

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

2. **How confident** do you feel that you could exercise with the DVD-based program over the next **3 weeks** if **you really wanted to?**

1	2	3	4	5	6	7
Extremely unconfident	Moderately unconfident	Slightly unconfident	Neutral	Slightly confident	Moderately confident	Strongly confident

3. Engaging in regular exercise with the DVD-based program over the next **3 weeks** is up to me **if I really wanted to**?

1	2	3	4	5	6	7
Strongly disagree	Moderately disagree	Slightly disagree	Neutral	Slightly Agree	Moderately Agree	Strongly agree

The following questions ask you about **your motivation and plans** to exercise regularly with the DVD-based program over the **next 3 weeks**. Please circle the answer that best represents you.

1. I **plan** to engage in regular exercise with the DVD-based program over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

2. I **intend** to engage in regular exercise with the DVD-based program over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

"A Randomized Controlled Trial Exploring the Effectiveness of Exercise DVDs and Exergames in Promoting Older Adults Physical Activity: A Pilot Study"

TPB BASELINE QUESTIONNAIRE

(WII CONDITION)

Christopher Yao

Primary Investigator

School of Exercise Science, Physical & Health Education

University of Victoria

Questionnaire Instructions

Please begin this questionnaire by reading all of the instructions thoroughly, and then answer the questions to the best of your knowledge. If you choose not to answer any question, just leave it blank and move on to the next question. Please note that some of the questions may appear redundant. This is done for an important reason that has to do with the reliability and validity of our questionnaire. Therefore, it is important that you answer as many questions as you can, even if they seem like they are asking the same thing. We need the most complete information possible to include your input into our results. Thank you for participating in this study! If you have any questions about completing the questionnaire, please feel free to ask the researcher for any additional help that you may require.

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250-472-5022 or cayao@uvic.ca

Dr. Ryan Rhodes (Supervisor)
250-721-8384 or rhodes@uvic.ca

Wii EA Sports Active 2 Usage

The following questions ask you to rate **how you feel** about exercising regularly using Wii Active 2 game in over the **next 3 weeks**. Here we define regular exercise as **attaining at least 30 minutes of moderate to vigorous (i.e., slight perspiration, breathing faster, elevated heart rate) videogame-based exercise per day, 4 times per week**. Pay careful attention to the words at each end of the scales and circle the number that best represents how you feel.

For me, exercising with the Wii EA Sports Active 2 game over the next **3 weeks** would be:

1.	1 extremely enjoyable	2 moderately enjoyable	3 slightly enjoyable	4 neutral	5 slightly unenjoyable	6 moderately unenjoyable	7 extremely unenjoyable
2.	1 extremely useful	2 moderately useful	3 slightly useful	4 neutral	5 slightly useless	6 moderately useless	7 extremely useless
3.	1 extremely pleasant	2 moderately pleasant	3 slightly pleasant	4 neutral	5 slightly unpleasant	6 moderately unpleasant	7 extremely unpleasant
4.	1 extremely wise	2 moderately wise	3 slightly wise	4 neutral	5 slightly unwise	6 moderately unwise	7 extremely unwise
5.	1 extremely exciting	2 moderately exciting	3 slightly exciting	4 neutral	5 slightly boring	6 moderately boring	7 extremely boring
6.	1 extremely beneficial	2 moderately beneficial	3 slightly beneficial	4 neutral	5 slightly harmful	6 moderately harmful	7 extremely harmful

The next questions ask you about what other people in your **social network** (e.g., friends, family, co-workers) would think about you exercising regularly using Wii Active 2 game over the **next 3 weeks**. Please respond to each statement using the following scale by circling a number between 1 and 7 at the end of each statement. Please answer these questions thinking only about the people in your **social network**.

1. Most people who are important to me would want me to engage in regular exercise with the Wii EA Sports Active 2 game over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

2. Most people whose opinions I value would expect me to engage in regular exercise with the Wii EA Sports Active 2 game over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

3. Most people who are important to me will exercise the Wii EA Sports Active 2 game over the next **3 weeks** themselves.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

4. I feel pressure to exercise with the Wii EA Sports Active 2 game the next **3 weeks** from people who are important to me.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

The following questions focus on how much **control** you believe you have over exercising regularly using Wii Active 2 game over the **next 3 weeks**. Remember, we defined regular exercise as attaining **at least 30 minutes of moderate to vigorous (i.e., slight perspiration, breathing faster, elevated heart rate) videogame-based exercise per day, 4 times per week**. Please read the questions carefully and circle the number that best represents your beliefs.

3. Exercising with the Wii EA Sports Active 2 game over the next **3 weeks** is under my control if I really wanted to do so.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

2. How confident do you feel that you could engage in regular exercise with the Wii EA Sports Active 2 game over the next **3 weeks** if you really wanted to?

1	2	3	4	5	6	7
Extremely unconfident	Moderately unconfident	Slightly unconfident	Neutral	Slightly confident	Moderately confident	Strongly confident

3. Engaging in regular exercise with the Wii EA Sports Active 2 game over the next **3 weeks** is up to me if I really wanted to.

1	2	3	4	5	6	7
Strongly disagree	Moderately disagree	Slightly disagree	Neutral	Slightly agree	Moderately agree	Strongly agree

The following questions ask you about your **motivation and plans** to exercise regularly with the Wii EA Sports Active 2 game in the lab over the **next 3 weeks.** Please circle the answer that best represents you.

1. I plan to engage in regular exercise with the Wii EA Sports Active 2 game over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

2. I intend to engage in regular exercise with the Wii EA Sports Active 2 game over the next **3 weeks**.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

University of Victoria | British Columbia Canada

Interview Questions

All questions are focused on exercising with the DVD or exercise videogame for about 30 minutes at a moderate to vigorous intensity for four times per week.

1) What do you feel are the benefits of using the exercise DVD or exercise videogame program? (Probe: Was it enjoyable to use? What would have made it more enjoyable?)
2) Did you use the exercise DVD or exercise videogame over the past six weeks? Was there an element to the DVD or exercise video game that made you use it more/less over the past 6 six weeks
3) What do you perceive as barriers to using the exercise DVD or exercise videogame (Probe: What didn't you like? What would have made you use it more?)
4) Do you think that the DVD or exercise videogame is a valuable piece of exercise equipment to have at home? (Probe: why or why not)
5) Is there anything else that you would like to add that you feel that we have missed?

ACCELEROMETER INFORMATION

The motion sensor is a 'smart' pedometer that works like the lights used in yards and carports. Like these lights, the motion sensor is always on, but is activated by movement. The motion sensor will give us an idea of your typical physical activity patterns. The motion sensor is safe, non-invasive, and is only attached to the body by the belt worn around the waist.

We would like you to begin wearing the motion sensor when you get out of bed in the morning, until you go back to bed at night; continuously for 7 days (i.e. 7 days straight), starting tomorrow morning. It should be worn each day (7 days in total) for all waking hours. In the morning you should put the belt around your waist in the correct position (see picture below) and preferably beneath your clothing. You can wear it over underclothes or a lightweight shirt if it is uncomfortable. For the readings to be accurate, the belt must be worn snugly to prevent flopping, and the motion sensor should be directly above the hip. The motion sensor **is not waterproof** so it should be taken off during baths, showers, or swims. You will notice that the light is flashing when you receive the accelerometer, this light will turn off on the first day you are assigned to wear the accelerometer.

Here is what it should look like:

Attached is an Activity Log. Each day, please record the time you begin wearing the belt in the morning and the time that you remove it in the evening. If it is removed at any other time during the day, or if something interrupts your regular routine (like illness) please record that in the log. An additional sheet is provided so that you can add information on the types of activities that you engaged in. This will help explain the activity patterns that we will see on your accelerometer.

Thank you for your help and co-operation! If you have any questions or concerns please call (250) 472-5288.

First Day Wearing the Accelerometer:

*PLEASE ENSURE THAT THE DEVICE IS WORN FOR A **MINIMUM OF 10 HOURS EACH DAY**. IF IT IS WORN FOR LESS THAN 10 HOURS/DAY, THE DATA WILL NOT BE USABLE AND YOU MAY BE ASKED TO WEAR IT AGAIN.

ACCELEROMETER 7-DAY ACTIVITY LOG

Wear accelerometer #:

Directions:

1) Please wear the motion sensor under your clothing, or over a single, thin layer.

2) The motion sensor should be fitted snugly on the waist with the sensor positioned anteriorly (in the front), above the hip. The belt should feel comfortable but not floppy.

3) The motion sensor should be worn when you wake up until you go to bed. It should only be removed during that period if you are going swimming, or taking a bath or shower. It is not waterproof.

4) Each day, in the 7-Day Activity Log (on the following page), please note the times that you put on and take off the motion sensor, as well as anything that may have affected movement patterns (i.e.: your activity patterns). Further, in the "Activities" table, please describe the activities that you engaged in each day.

5) The motion sensor is very valuable, so please be careful with this instrument.

Thank you ☺

7-DAY ACTIVITY LOG

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Date							
On Time (AM)							
Off Time (PM)							
Did weather change your routine?	No	No	No	No	No	No	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Did illness change your routine?	No	No	No	No	No	No	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was motion sensor removed during wear time?	No	No	No	No	No	No	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes
If yes, during which times?	__:__ to __:__	__:__ to __:__	__:__ to __:__	__:__ to __:__	__:__ to __:__	__:__ to __:__	__:__ to __:__
Any problems? Please explain.							

	ACTIVITIES - please describe e.g.: work (sitting at desk) 8am-3pm, aerobics 4pm-6pm, movie theatre 7-10pm.
DAY 1	
DAY 2	
DAY 3	
DAY 4	
DAY 5	
DAY 6	
DAY 7	

Data Collection Form

Date _____	**Baseline** 9-weeks
Participant ID _____	**Age** _____

Heart Rate, Blood Pressure, & Anthropometry

Resting HR _____ **bpm**	**Resting BP** _____ **mmHg**	**Waist Circumference** _____ cm
Height _____cm	**Weight** _____kg	**BMI** _____ kg/m2

Fitness Testing

Test Item	Trial 1	Trial 2	Comments
1. Chair Stand Test (# in 30 sec)	_____reps	**N/A**	
3. Grip Strength	R:_____ kg	R:_____kg	
	L:_____ kg	L:_____kg	
3. Chair Sit-and Reach Test (nearest .5 cm) Extended leg: R or L	_____cm	_____cm	
5. 3 m Timed Up-and-Go Test (nearest 1/10 sec)	_____sec	_____sec	
6. 6-min Walking Test (# m covered)	_____m	**N/A**	

Scoring Form for
Fullerton Advanced Balance (FAB) Scale

1. Stand with feet together and eyes closed
( ) 0 Unable to obtain the correct standing position independently
( ) 1 Able to obtain the correct standing position independently but unable to maintain the position or keep the eyes closed for more than 10 seconds
( ) 2 Able to maintain the correct standing position with eyes closed for more than 10 seconds but less than 30 seconds
( ) 3 Able to maintain the correct standing position with eyes closed for 30 seconds but requires close supervision
( ) 4 Able to maintain the correct standing position safely with eyes closed for 30 seconds

2. Reach forward to retrieve an object (pencil) held at shoulder height with outstretched arm
( ) 0 Unable to reach the pencil without taking more than two steps
( ) 1 Able to reach the pencil but needs to take two steps
( ) 2 Able to reach the pencil but needs to take one step
( ) 3 Can reach the pencil without moving the feet but requires supervision ( ) 4 Can reach the pencil safely and independently without moving the feet

3. Turn 360 degrees in right and left directions
( ) 0 Needs manual assistance while turning
( ) 1 Needs close supervision or verbal cueing while turning
( ) 2 Able to turn 360 degrees but takes more than four steps in both directions
( ) 3 Able to turn 360 degrees but unable to complete in four steps or fewer in one direction ( ) 4 Able to turn 360 degrees safely taking four steps or fewer in both directions

***4. Step up onto and over a 6-inch bench**
( ) 0 Unable to step up onto the bench without loss of balance or manual assistance
( ) 1 Able to step up onto the bench with leading leg, but trailing leg contacts the bench or leg swings around the bench during the swing-through phase in both directions
( ) 2 Able to step up onto the bench with leading leg, but trailing leg contacts the bench or swings around the bench during the swing-through phase in one direction
( ) 3 Able to correctly complete the step up and over in both directions but requires close supervision in one or both directions
( ) 4 Able to correctly complete the step up and over in both directions safely and independently
Revised Sept 2008 (DR)

***5. Tandem walk**
( ) 0 Unable to complete 10 steps independently
( ) 1 Able to complete the 10 steps with more than five interruptions
( ) 2 Able to complete the 10 steps with three to five interruptions
( ) 3 Able to complete the 10 steps with one to two interruptions
( ) 4 Able to complete the 10 steps independently and with no interruptions

***6. Stand on one leg**
( ) 0 Unable to try or needs assistance to prevent falling
( ) 1 Able to lift leg independently but unable to maintain position for more than 5 seconds ( ) 2 Able to lift leg independently and maintain position for more than 5 but less than 12 seconds
( ) 3 Able to lift leg independently and maintain position for 12 or more seconds but less than 20 seconds
( ) 4 Able to lift leg independently and maintain position for the full 20 seconds

***7. Stand on foam with eyes closed**
( ) 0 Unable to step onto foam or maintain standing position independently with eyes open ( ) 1 Able to step onto foam independently and maintain standing position but unable or unwilling to close eyes
( ) 2 Able to step onto foam independently and maintain standing position with eyes closed for 10 seconds or less
( ) 3 Able to step onto foam independently and maintain standing position with eyes closed for more than 10 seconds but less than 20 seconds
( ) 4 Able to step onto foam independently and maintain standing position with eyes closed for 20 seconds
Do not introduce test item #8 if test item #4 was not performed safely and/or it is contraindicated to perform this test item (review test administration instructions for contraindications). Score a zero and move to next test item.

8. Two-footed jump
( ) 0 Unwilling or unable to attempt or attempts to initiate two-footed jump, but one or both feet do not leave the floor
( ) 1 Able to initiate two-footed jump, but one foot either leaves the floor or lands before the other
( ) 2 Able to perform two-footed jump, but unable to jump farther than the length of their own feet
( ) 3 Able to perform two-footed jump and achieve a distance greater than the length of their own feet
( ) 4 Able to perform two-footed jump and achieve a distance greater than twice the length of their own feet

9. Walk with head turns
( ) 0 Unable to walk 10 steps independently while maintaining 30^{o} head turns at an established pace
( ) 1 Able to walk 10 steps independently but unable to complete required number of 30^{o} head turns at an established pace
( ) 2 Able to walk 10 steps but veers from a straight line while performing 30^{o} head turns at an established pace
( ) 3 Able to walk 10 steps in a straight line while performing 30^{o} head turns at an established pace but head turns less than 30^{o} in one or both directions
( ) 4 Able to walk 10 steps in a straight line while performing required number of 30^{o} head turns at established pace

10. Reactive postural control
( ) 0 Unable to maintain upright balance; no observable attempt to step; requires manual assistance to restore balance
( ) 1 Unable to maintain upright balance; takes two or more steps and requires manual assistance to restore balance
( ) 2 Unable to maintain upright balance; takes more than two steps but is able to restore balance independently
( ) 3 Unable to maintain upright balance; takes two steps but is able to restore balance independently
( ) 4 Unable to maintain upright balance but able to restore balance independently with only one step

TOTAL: 40 POINTS
Evaluating Risk for Falls:
Long Form Fullerton Advanced Balance (FAB) scale Cut-Off Score: ≤ 25/40 Points Short-Form Fullerton Advanced Balance (FAB) scale Cut-Off Score: ≤ 9/16 Points
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Behavioural Medicine Laboratory UVic

6-min Walking Test

Time	0-1 min	1-2 min	2-3 min	3-4 min	4-5 min	5-6 min
Heart Rate						
RPE						
Laps Completed						

Partial distance: _____

Appendix G: Intervention Materials

Example page from the equipment usage log

University of Victoria | British Columbia Canada

Activity Log

Week 4

Date	Time	Duration (minutes)	Comments
Sunday	Start Finish		
Saturday	Start Finish		
Monday	Start Finish		
Tuesday	Start Finish		
Wednesday	Start Finish		
Thursday	Start Finish		
Friday	Start Finish		

Physical Activity Guidelines

Canadian Physical Activity Guidelines

FOR ADULTS - 18 – 64 YEARS

Guidelines

To achieve health benefits, adults aged 18-64 years should accumulate at least 150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of 10 minutes or more.

It is also beneficial to add muscle and bone strengthening activities using major muscle groups, at least 2 days per week.

More physical activity provides greater health benefits.

Let's Talk Intensity!

Moderate-intensity physical activities will cause adults to sweat a little and to breathe harder. Activities like:

- Brisk walking
- Bike riding

Vigorous-intensity physical activities will cause adults to sweat and be 'out of breath'. Activities like:

- Jogging
- Cross-country skiing

Being active for at least **150 minutes** per week can help reduce the risk of:

- Premature death
- Heart disease
- Stroke
- High blood pressure
- Certain types of cancer
- Type 2 diabetes
- Osteoporosis
- Overweight and obesity

And can lead to improved:

- Fitness
- Strength
- Mental health (morale and self–esteem)

Pick a time. Pick a place. Make a plan and move more!

- ☑ Join a weekday community running or walking group.
- ☑ Go for a brisk walk around the block after dinner.
- ☑ Take a dance class after work.
- ☑ Bike or walk to work every day.
- ☑ Rake the lawn, and then offer to do the same for a neighbour.
- ☑ Train for and participate in a run or walk for charity!
- ☑ Take up a favourite sport again or try a new sport.
- ☑ Be active with the family on the weekend!

Now is the time. Walk, run, or wheel, and embrace life.

PARTICIPACTION

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