Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation Among Parents and Young Children in the Home: A Pilot Study

by

Rachel Mark
BKin, University of Calgary, 2007

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Supervisory Committee

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Abstract

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Interactive stationary bikes provide positive affective experiences and physiological benefits; however research has been limited to adults within laboratory settings. Using a randomized, controlled trial design (RCT), this study sought to examine usage of GameBikes (GB) compared to traditional stationary bikes (TSB) among families in the home-setting including the theory of planned behaviour (TPB) to understand motivation for use. Parents completed questionnaires after having a ten minute trial with the bike (T1) and then again after six weeks (T2). Usage was tracked by all family members and belief elicitation was performed with GB families following the trial. Repeated measures (RM) ANOVA for frequency of use yielded a large time effect ($F_{5,34} = 3.15$, $p < .05$; $\eta^2 = .32$); post-hoc analysis illustrated decrease by TSB ($t_{18} = 3.77$, $p < .01$; $d = .89$) and GB ($t_{20} = 1.02$, $p = .32$; $d = .32$). Parents in the GB group increased the proportion of those meeting Health Canada's Physical Activity guidelines by 33.3% compared to 8.34% for TSB ($h = .51$). RM ANOVA for affective attitude (AA) of parents yielded large time and intervention effects ($F_{1,22} = 32.73$, $p < .01$, $\eta^2 = .60$; $F_{1,22} = 8.54$, $p = .01$, $\eta^2 = .60$ respectively). GB ($t_{11} = 6.08$, $p < .01$, $d = 1.67$) and TSB ($t_{11} = 3.27$, $p < .01$, d = .88) lowered across time; GB experienced higher levels of AA at T1 ($t_{25} = 2.69$, $p < .01$, $d = 1.55$) and T2 ($t_{22} = 2.58$, $p < .05$, $d = 1.39$). Elicited beliefs were primarily affective- and control-based and concerned the equipment and sizing for children. From this study, it is noted that usage decreases less rapidly with the GB than with TSB. Also, differences in AA between groups highlight the importance of AA in PA interventions. This study provides support for the use of interactive video games to augment current PA initiatives with larger scale trials.

Table of Contents

List of Tables

List of Figures

Acknowledgments

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Dedication

I would like to dedicate this thesis to my parents.

Chapter 1: Introduction

Physical inactivity has been linked to numerous chronic diseases and conditions among adults including obesity, cardiovascular disease, hypertension, type II diabetes, various types of cancer, osteoarthritis and impaired function (Warburton, Katzmarzyk, Rhodes, & Shephard, 2007). Children and adolescents can also experience negative impacts on health as a result of physical inactivity. Physical activity has been linked with healthy development, healthy body weight and can help prevent obesity and disease as an adult (Boreham & Riddoch, 2001; Hills, King, & Armstrong, 2007). Physical inactivity also creates a huge economic burden within Canada. In 2001, the total cost of physical inactivity was $5.3 billion, accounting for 2.6% of the total health care dollars spent within Canada in one year (Katzmarzyk & Jansen, 2004). As well, the Centers for Disease Control and Prevention (2007) estimated that 300,000 preventable deaths occur annually in the U.S. as a result of sedentary behaviours.

Despite these known benefits of physical activity, a large percentage of the population still remains inactive. Forty-eight percent of Canadian men and 54% of Canadian women are considered inactive, such that they expend less than 1.5 kilocalories per kilogram of body weight per day (Warburton, Katzmarzyk et al., 2007). Further, over 51% of Canadians over the age of 20 years are completely sedentary (Canadian Fitness and Lifestyles Research Institute, 2005). Physical activity levels among youth are low as well, with 57% of children and youth between the ages of five and 17 not currently participating in the necessary levels of physical activity to achieve health benefits (Craig, Cameron, Russell, & Beaulieu, 2001).

While physical activity participation seems to be difficult among the general populace, there are certain populations who are more at risk than others. Not only have physical activity levels been shown to decrease as individuals get older (Statistics Canada, 2004), but there have been many noted declines in physical activity among individuals ages 20 to 45 (Brown & Trost, 2003). Along with other transitions that occur during this time, a major life change associated with this age rage is parenthood. Reviews in this area have demonstrated that parents and particularly mothers are at high risk for physical inactivity (Bellows-Riecken & Rhodes, 2008). Alongside their parents, children and youth are also not active enough to reap the possible health benefits including a decreased risk of disease and obesity later in life (Hills et al., 2007). Because parents and their children spend a significant amount of time in their homes, there may be opportunity to promote physical activity to both at risk groups at the same time in order to better understand their low physical activity levels and develop interventions to help counteract this.

The importance of physical activity is well-noted, and as a result, improving activity levels has become a public health priority through the development of interventions. Most of the interventions developed are self-regulatory in nature, using techniques such as planning, goal setting and self-monitoring, and are based on the persuasive ability of the benefits of physical activity such as weight management and decreasing the risk of developing a disease (Kahn et al., 2002). While numerous interventions of this nature have been introduced with the hopes of improving participation, they have proven to have only a modest effect (Foster, Hillsdon, & Thorogood, 2005; Rhodes & Pfaeffli, in press). School-based interventions are used

frequently to increase physical activity among children and adolescents; however, these have also had very little success at increasing physical activity without reinforcement in other settings such as the home (Van Sluijs, McMinn, & Griffin, 2007).

In order to understand what makes people active, research efforts have focused on the determinants and correlates of physical activity. Behavioural theories can be used to help explain behavioural motivation, as they have tested constructs which have been shown to contribute to the uptake of new behaviours. One that has commonly been applied to the exercise and physical activity domain is the theory of planned behaviour (TPB) (Hagger & Chatzisarantis, 2002; Symons Downs & Hausenblas, 2005b). This theory suggests that attitude (appraisal the individual has of a behaviour), subjective norm (the individual's perception of the social pressure to perform the behaviour) and perceived behavioural control (PBC) (the ease that the individual perceives in performing a certain behaviour) predict behavioural intention which in turn predicts behaviour (Ajzen, 1991). While attitude, subjective norm and PBC have all been found to influence behaviour indirectly through intention, PBC also directly influences behaviour without the mediation of intention (Hagger & Chatzisarantis).

Attitude, which has been broken down into an affective component and an instrumental component, has been found to have strong association with both intention and directly with behaviour (Lowe, Eves, & Carroll, 2002). Affective beliefs are concerned with feeling states and emotional judgments, whereas instrumental beliefs are concerned with costs and benefits associated with a behaviour (Lowe et al.). Research concerning affective beliefs is limited; however, the findings have been supportive, as it has been found to be a better predictor of both intention and behaviour than instrumental

attitude (French et al., 2005; Rhodes, Blanchard, & Matheson, 2006). Because of these positive associations between affective attitude and behaviour, it is important to develop physical activity opportunities which focus on enjoyable feeling states and that help to prevent boredom.

Interactive gaming is a newer physical activity initiative and may be promising in terms of physical activity participation. Interactive gaming involves the use of new equipment that has been developed to combine video gaming and exercise. These games are interactive in nature, such that they require body movement of some kind in order for the game to work. Examples of these include GameBike, Dance Dance Revolution, Eye Toy and Wii.

Interactive gaming has already been shown to produce a number of benefits. Physiologically, these games have produced significantly higher energy expenditure, heart rate and oxygen uptake and lower rates of perceived exertion (e.g.; Ridley & Olds, 2001; Sell, Lillie, & Taylor, 2008; Tan, Aziz, Chua, & The, 2002; Unnithan, Houser, & Fernhall, 2006; Warburton, Bredin et al., 2007). These studies have mostly used child and youth participants and were focused on physiological outcome measures. Using equipment such as GameBike, Wii, Dance Dance Revolution and EyeToy, they compared these active video games to sedentary video games.

Of the equipment used, stationary bikes providing virtual reality and interaction have been shown to have both psychological and physiological benefits (Warburton, Bredin et al., 2007; Annesi & Mazas, 1997). Virtual reality-enhanced stationary bikes have shown to have both higher attendance and adherence rates than traditional stationary upright and recumbent bikes (Annesi & Mazas). GameBike, which is a stationary bike

that links into a Playstation has been shown to significantly improve maximal oxygen consumption and maximal power output, and significantly decrease heart rate within the experimental group of a randomized, controlled trial (RCT) (Warburton, Bredin et al.). GameBike has also been shown to provide greater adherence rates (Warburton, Bredin et al.; Rhodes, Warburton, & Bredin, in press) as well as greater affective experiences (Rhodes, Warburton et al.) in comparison to control conditions.

Regardless of the positive results of GameBike and other interactive games, there are still many gaps in the current state of research. First, there are very few studies that directly measure psychological measures such as motivation and adherence. Only one study has measured adherence using the GameBike, and while results were in favour of the interactive gaming condition (Warburton, Bredin et al., 2007), further research is needed which extend both the sample and the data collection setting. Annesi and Mazas (1997) measured adherence using virtual reality-enhanced stationary bikes and had favourable results where the intervention group had both higher adherence and attendance rates over the control condition. Second, studies using the GameBike and virtual reality-enhanced stationary bikes have all been laboratory- or facility-based and therefore lack ecological validity to transfer results to the general population. The samples used within the GameBike studies have also been limited, as they only include college-aged men (Warburton, Bredin et al.; Warburton et al., 2009; Rhodes, Warburton et al., in press). There is also little research which explains potential mechanisms for making these games successful, whether it is distraction from the exercise task at hand, or if it is the interactive engagement that the game provides. Therefore, this research aimed to build upon existing research by measuring adherence and motivation for equipment

use, transferring the research setting to the home, expanding the sample to include families, and applying a RCT to test the difference between equipment providing distraction from equipment providing interaction.

Purpose Statement

The purpose of this study was to perform a pilot study that built upon previous research by examining the motivation underlying the use of a GameBike in comparison to a traditional stationary bike placed in front of the television among parents and children in the home-setting. It addressed these differences by focusing on motivational beliefs at the individual level among parents using the theory of planned behaviour and by tracking usage of the equipment among all family members. This study also aimed to perform a belief elicitation study for GameBike use in the home based on the TPB.

Research Questions

This study aimed to address the following questions:

1. Are there differences in the usage of exercise equipment among parents at home depending on whether the equipment is interactive in nature?
2. Are there differences in the usage of exercise equipment among children at home depending on whether the equipment is interactive in nature?
3. Does usage of the equipment change over the course of the intervention?
4. Are there motivational differences based on the constructs of the TPB between usage of home exercise equipment depending on whether the equipment is interactive in nature?

5. Are there changes in the social cognitive measures over the span of the intervention for parents?

6. Based on the TPB, what are the elicited beliefs by the intervention group about using interactive gaming equipment for exercise in the home?

Hypotheses

The hypotheses for this study were that compared to a traditional stationary bike placed in front of the television:

1. Parents given the GameBike would use the equipment more than parents given the traditional stationary bike.

2. Children given the GameBike would use the equipment more than children given the traditional stationary bike.

3. Usage of the bike will decrease over the course of the intervention.

4. According to questionnaires based on the TPB, participants given the GameBike would indicate higher levels of affective attitude.

5. Of the social cognitive constructs, parents will experience a decrease in affective attitude over the course of the intervention.

6. Beliefs elicited about the interactive gaming equipment would be greater for both affective attitude and perceived control over the behaviour.

Assumptions

1. Participants tracked usage of the equipment truthfully.

2. Parents accurately tracked the usage of the equipment by their children.

3. Participants answered all questions truthfully and to the best of their ability.

Delimitations

1. Parents, either married or common-law over the age of 18 who have at least one child between the ages of four and six.
2. Residents of Victoria, British Columbia.
3. Parents could not be meeting the Health Canada recommendations for physical activity requiring that they accumulated 60 minutes of physical activity daily, or 30 minutes of moderate to vigorous activity four days per week (Health Canada, 2002).

Limitations

1. Participation was voluntary which may have decreased the degree to which the results of the study can be generalized.
2. All measures were made through self-report.
3. Beliefs listed in the questionnaire may not have included all beliefs individuals experience in regards to physical activity participation.
4. Parents were asked to track the usage of the equipment by the children.
5. Data collection was performed throughout the summer, which may have decreased the amount of activity performed indoors by participants.

Operational Definitions

1. GameBike: A stationary cycle ergometer linking to a Sony Playstation 2. The bicycle is used in front of the television with a Playstation 2 game. The participant moves the game's characters by pedaling and steering the bike (see figures 1 and 2).

Figure 1. GameBike system.

Figure 2. Photograph of GameBike system.

Chapter 2: Literature Review

This literature review has been divided into six areas: physical activity and the family, the TPB, sedentary activities and physical activity, interactive video gaming, distraction hypothesis, and a summary.

Physical Activity and the Family

Parenthood.

Throughout the course of an individual's life, a number of events can influence physical activity levels. Allender, Hutchinson, and Foster (2008) conducted a review examining these life-changing events which have been noted to influence physical activity participation. One life event that this review highlighted was becoming a parent.

The three studies included in this review (Barnekow-Bergkvist, Hedberg, Janlert, & Jansson, 1996; Bell & Lee, 2005; Brown & Trost, 2003) all indicated decreases in physical activity participation levels among parents, and particularly among women. Bellows-Riecken and Rhodes (2008) also conducted a review examining parenthood and physical activity participation. Parents were found to engage in lower levels of physical activity than non-parents with a small to moderate summary effect (d=.41) in ten studies (Bellows-Riecken & Rhodes).

This difference in activity levels between parents and non-parents is a clear indicator that parents perceive and/or experience more barriers to regular activity. In a cross-sectional study examining constraints to leisure activities among mothers, several barriers were identified (Brown, Brown, Miller, & Hansen, 2001). In rank order, the barriers identified by mothers to leisure activities include no time due to commitment to

children, no time due to commitment to housework and shopping, no time due to commitment to partner, lack of energy, no time due to commitment to work, lack of money, no one to exercise with, not feeling sporty, not enjoying it, poor health, and no transport (Brown et al.). McIntyre and Rhodes (2009) found that control issues such as time, fatigue, social support, and childcare influenced post-partum physical activity among mothers. Because of these noted barriers, it becomes clear that interventions are needed which are convenient, accessible, affordable and enjoyable. One such intervention may place a new piece of exercise equipment in the home which can provide an enjoyable and accessible exercise experience for the entire family.

Children and youth.

Currently, 57% of children and youth between the ages of five and 17 are not participating in high enough levels of physical activity to achieve health benefits (Craig et al., 2001). In an attempt to increase physical activity for individuals in this age group, a number of school-based interventions have been developed. A review of school-based interventions has shown that while these interventions may increase physical activity levels within a physical education class, and even at school, there are minimal, if any significant differences in physical activity levels outside of school (Van Sluijs et al., 2007). Biddle, Gorely, and Stensel (2004) suggest that while small positive changes to activity levels within the school-setting may occur as a result of these types of interventions, it is too difficult to influence activity levels outside of the school-setting. Therefore, it may be necessary to provide home-based reinforcement to help change behaviour.

Family-based interventions.

Many relationships between parent and child physical activity levels have been found (Gustafson & Rhodes, 2006). Parental support has been found to influence child self-efficacy (Trost et al., 2003), and parents who are active themselves, have been found to be more supportive and encouraging of child physical activity than non-active parents (Welk, Wood, & Morss, 2003).

Regardless of the influences that parents can have on their children's physical activity levels, there are very few studies applying physical activity interventions to the family-setting. Studies have shown increasing trends in physical activity as a result of a family-based intervention, although the increases did not reach significant levels (Anand et al., 2007; Heimendinger et al., 2007). These studies were weak in design such that they did not use objective measures of physical activity.

Compared to the number of school-based interventions that have been developed, there are relatively few family-based interventions in comparison. Children and adolescents spend so much time outside of the school-setting (before school, after school and weekends), that without support from the family, it is nearly impossible to expect a school-based intervention to increase overall physical activity levels (Wechsler, Devereaux, Davis, & Collins, 2000). Since youth have been shown to spend almost half of their time outside of school daily with their family (Larsen & Richards, 1991), it becomes necessary for parents and siblings to be involved in any sort of intervention in order to help build effectiveness and provide reinforcement to children.

The Theory of Planned Behaviour

Many theories and social cognitive frameworks have been developed and each suggests different constructs which may contribute to behaviour uptake and maintenance. The TPB has often been used in the exercise domain and suggests that the intention to perform a behaviour directly influences performing the desired behaviour (Ajzen, 1991). The three components that influence intention (attitude, subjective norm and PBC) are all composed of individual beliefs that can act as either facilitators or barriers to physical activity. Therefore, attitude, subjective norm and PBC can be broken down into individual beliefs that contribute to the main construct depending on the domain that the beliefs are being elicited within (Symons Downs & Hausenblas, 2005a); see Figure 3.

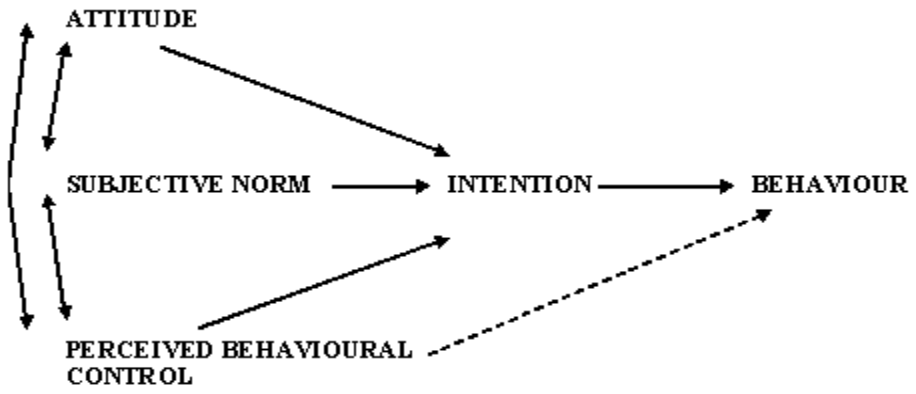

Figure 3. The theory of planned behaviour.

The TPB has often been used in physical activity research. In a meta-analytic review by Symons Downs and Hausenblas (2005b), significant effect sizes were found between all of the constructs of the TPB, including intention, with behaviour. Of the studies included in the review, large mean effect sizes were found between intention and exercise (d = 1.01), intention and PBC (d = .90), and intention and attitude (d = 1.07) (Symons Downs and Hausenblas). Symons Downs and Hausenblas found moderate mean effect sizes between PBC and behaviour (d = 0.51), and between intention and subjective norm (d = 0.59). These moderate to large effect sizes for all constructs suggest that the TPB can provide a successful framework for physical activity interventions by providing a structure for the basic components of the intervention.

Along with the traditional three constructs of the TPB (attitude, subjective norm and PBC), an expanded multi-component model has also been used. This expanded model separates attitude into both affective and instrumental components, subjective norm into descriptive and injunctive components and perceived behaviour control into skills/abilities, opportunities and resources (Rhodes et al., 2006). This multi-component model has shown significant predictions of behaviour intention through both affective attitude and perceived opportunity (Rhodes et al.).

The component of affective attitude is important, because it is the evaluation that individuals make immediately while performing a behaviour. Physical activity can have many immediate negative outcomes such as physical discomfort and fatigue, particularly for those individuals who are new to exercise (Lowe et al., 2002). These evaluations are proximal, such that they are present immediately while performing the behaviour, whereas the distal evaluations or the instrumental beliefs such as improvements in health

and decreased risk of disease are far less influential on behaviour (Bandura, 1998). Because many individuals are already aware of the instrumental benefits of physical activity, and many media campaigns that use this technique have been unsuccessful (Cavill & Bauman, 2004), it becomes necessary to design physical activity interventions that are based on positive affective experiences to help build physical activity participation rates (Lowe et al.).

Control beliefs such as time and inconvenience are often perceived as major barriers to physical activity (Symons Downs & Hausenblas, 2005a). This research attempted to facilitate these common barriers by placing exercise equipment in the home.

When using the TPB as a framework in an intervention, it is recommended that researchers perform an elicitation study where a sample from the population of interest can disclose the behavioural, normative and control beliefs that they have in relation to the behaviour of interest (Ajzen & Fishbein, 1980). These elicited beliefs are then used in questionnaire construction. While some interventions attempt to change beliefs about a certain behaviour, the purpose of others may be to introduce a new behaviour, thereby developing a new set of beliefs. This creation of a new belief system by introducing a new behaviour or information is often easier than changing a previous set of beliefs (Ajzen, 2006).

By using the TPB in this research study, the aim was to primarily address both affective attitude and behavioural control with an intervention providing new exercise equipment which has been found in previous studies to be high in affective attitude (Rhodes, Warburton et al., in press). This research study also aimed to have participants elicit a new set of beliefs about a new type of behaviour and exercise equipment, which

may provide an enjoyable experience, as well as a convenient and accessible exercise setting.

Sedentary Activities and Physical Activity

During an individual's limited leisure time, sedentary activities such as television and video games are often performed. Daily use of video games is a factor thought to be taking time away from physical activity opportunities, particularly among children and youth. According to Roberts, Foehr, and Rideout (2005), 59% of youth ages eight to 10, 57% of youth ages 11 to 14 and 39% of youth ages 15 to 18 use video games daily. Television viewing is also quite prevalent among adults, with 16.2% of males, and 15.4% of females accumulating over 21 hours of viewing weekly (Shields & Trembley, 2008). This high amount of television watching has also been correlated to overweight and obesity status where nearly a quarter of the males and females who watch over 21 hours of television weekly are obese (Shields & Trembley).

There are a number of elements that contribute to the strong appeal of video games. Some of these include being fun, involving fantasy and virtual worlds, and providing an interactive experience (Baranowski, Buday, Thompson, & Baranowski, 2008). Video games are also thought to induce flow (Sherry, 2004) which can be characterized as a balance between an individual's skill level and the challenge level of the activity at hand leading to optimal performance and experience (Csikszentmihalyi & Csikszentmihalyi, 1988).

The appeal of video games not only affects children and youth, but adults as well. Softpedia (2005), found that the average player of both video and computer games was 30 years of age. This would suggest that while children are most often viewed as the

prime users of gaming equipment, interventions targeting gamers could be geared towards people of all ages.

Behavioural choice theory or behavioural economics is a theory which suggests that individuals engage in behaviours that are accessible and reinforcing and that this choice is often made by individuals about performing either physical activities or sedentary activities (Epstein, Kilanowski, Consalvi, & Paluch, 1999). Although these studies have been performed mostly using children as participants, limited leisure-time suggests that all individuals need to make choices regarding their activities during this time.

Epstein and Roemmich (2001) suggest that due to limited amounts of leisure-time and the numerous activities that could be performed during these times, individuals' choice to participate in sedentary activities such as screen viewing could have an effect on the time that they have left to participate in physical activities. Sedentary activities such as television, computer and video games have all been thought to take away from time being physically active. Rhodes, Blanchard, and Bellows (2008) have found that television viewing was negatively correlated with physical activity. As well, Salmon, Owen, Crawford, Bauman, and Sallis (2003) found in a study of physical activity and sedentary behaviours that 63% of participants stated that enjoyment of sedentary leisure-time activities was a barrier to performing physical activity.

Video games have proven to be enjoyable and are very commonly used (Roberts et al., 2005). As well, there is evidence suggesting that there may be a trade off during leisure time between sedentary activities and physical activity (Epstein & Roemmich, 2001). As a result of this evidence, there is hope that by using interactive video gaming

exercise equipment in an intervention, that individuals who were previously inactive may be attracted to this type of activity and that the equipment may be helpful in providing a new affective experience by eliminating the possible perceived boredom of regular physical activity.

Interactive Video Gaming

The prevalence of video game use among youth has created an opportunity for the development of new video games which provide an interactive component. These interactive video games have been used with rehabilitation populations for skill acquisition and development, as well as motor control after stroke or injury (Schultheis & Rizzo, 2001). In recent years, however, the use of these games has been expanded to the general population, with the purpose being to increase energy expenditure and physical activity levels.

The physiological benefit to these interactive games has been widely illustrated among many introductory research studies. Energy expenditure has been measured in a number of studies comparing energy expenditure during interactive gaming to energy expenditure either at rest, or while playing a sedentary video game (Graves, Stratton, Ridgers, & Cable, 2008; Lanningham-Foster et al., 2006; Maddison et al., 2007). One study compared the energy expended while playing Wii bowling, boxing and tennis with the energy expended while playing a sedentary XBOX 360 game (Graves et al.). Graves and colleagues found that energy expenditure was significantly greater for the three Wii games in comparison to the sedentary XBOX game ($p < 0.001$). Another study compared energy expenditure during seated television viewing, while playing a sedentary video game, while playing two active video games (Eye Toy and Dance Dance Revolution) and

while walking on a treadmill at 1.5 miles per hour among 25 children of various body weights (Lanningham-Foster et al.). This study found that there were significant increases in energy expenditure in television watching over resting, in seated video gaming over resting, in walking on a treadmill over resting, and in the two active video games over resting energy expenditure (Lanningham et al.). Maddison and colleagues also illustrated significantly higher energy expenditure among youth ages 10 to 14 while playing an active video game in comparison to playing a sedentary video game.

Heart rate and oxygen consumption have also been measured and compared between interactive gaming conditions and sedentary conditions. Oxygen consumption was found to be significantly higher among active games compared to sedentary games in a population of youth between the ages of 10 and 12 (Ridley & Olds, 2001). Heart rate and oxygen consumption were also found to match the guidelines put forth by the American College for Sports Medicine for developing and maintaining cardiorespiratory fitness (60% of maximum heart rate) for 40 individuals with an average age of 17.5 years while playing Dance Dance Revolution (Tan et al., 2002).

Current research supports interactive video games because of their positive physiological values. There is, however, less research examining the psychological motivation and outcomes of these types of games. Adherence to an interactive gaming intervention has been measured in very few studies. Studies among university-aged males showed that an intervention group using a GameBike attended 30% more sessions than a control group using ordinary stationary exercise bikes and had higher levels of affective attitude and intention (Warburton, Bredin et al., 2007; Rhodes, Warburton et al., in press). Annesi and Mazas (1997) found that participants given a virtual reality-

enhanced stationary bike as an intervention adhered to the 14 week program 83.3%, whereas adherence rates for the traditional stationary bike group was 57.1%. Studies using interactive stationary bikes have illustrated both greater affect and adherence rates (Annesi & Mazas; Rhodes, Warburton et al.). However, they have employed limited samples and settings for data collection which warrants the expansion of the population of interest and the location of data collection to provide for stronger ecological validity in future research.

Distraction Hypothesis

It has been thought that by distracting oneself from an unpleasant or painful situation, it can be beneficial in getting through the situation (Annesi, 2001). Distraction or dissociation can be defined as focusing attention on anything other than the body and its physiological sensations (Masters & Ogles, 1998). Silva and Appelbaum (1989) suggest that non-elite athletes employ dissociative strategies to "tune out" while running. By dissociating from the task at hand, it was believed that the runners may not have been as aware of effort, pace or energy expenditure (Silva and Appelbaum). Weinberg, Smith, Jackson, and Gould (1984) found that participants who were told to dissociate during a leg lifting task had greater endurance and could hold the leg longer than a group asked to associate, or "tune in" to the body's sensations.

In a study by Annesi (2001), it was found that participants who were able to use a combination of entertainment equipment (television and music) versus only one piece of entertainment equipment had exercise sessions that were longer in duration and that there were fewer dropouts. This study suggests that the use of distraction may help individuals to "tune out" of the exercise session, thereby overriding negative affective feeling.

Pennebaker and Lightner (1980) also found that participants' perceived rate of exertion and fatigue levels were lower when dissociating during a treadmill test. This research indicates that by dissociating, individuals experienced lower rates of perceived exertion, negative feeling states and fatigue, and higher levels of endurance.

While research suggests that using exercise modalities that allow for distraction may be helpful for individuals who do not positively experience exercise, it is unknown in the case of interactive gaming whether it is the distraction that the game provides, or if it is the actual enjoyment of playing the game that individuals positively experience.

Summary

Preliminary research using interactive video games to promote physical activity levels has been restricted mostly to physiological measures. While these physiological outcomes are encouraging for health promotion, illustrating significantly higher energy expenditure, oxygen consumption and heart rate for individuals using interactive gaming equipment, there has been little research conducted that examines psychological determinants and behavioural adherence. The few studies using GameBike exercise equipment showed that adherence was significantly higher for the interactive gaming group, and also provided for similar physiological benefits to other interactive games in terms of physical fitness, heart rate and oxygen consumption (Warburton, Bredin et al., 2007; Rhodes, Warburton et al., in press).

This research study expanded on the current literature in order to better understand the psychological determinants and outcomes of interactive gaming. As well, the study aimed to increase the ecological validity of other studies by extending the data

collection setting to the home rather than the laboratory and extend use of the equipment to all family members rather than only children or only adults.

Chapter 3: Methods

Research Design

This research study employed a RCT design following the CONSORT trial system (Altman et al., 2001). See Appendix A for CONSORT Statement Checklist. By employing this type of research design, any differences between groups will be able to be attributed to the type of exercise equipment used in order to test effectiveness for future intervention purposes. This study differs from traditional RCTs such that there was no true baseline measurement taken. Time one measurements took place after each participant had had a ten minute trial period on the equipment in their home. This type of approach made more sense than a traditional baseline, since prior to the first experience with the bike, usage of the equipment was novel for participants, and thus they had no expectancies for usage over the trial period. This design follows that of Rhodes, Warburton and colleagues (in press).

Quantitative questionnaires were used to gather information about participants' beliefs towards physical activity and use of the exercise equipment. Questionnaires are used to obtain information about people's beliefs and attitudes about a certain topic (Thomas, Nelson, & Silverman, 2005, p. 269). These questionnaires were administered after an equipment orientation session (time one) and after the six week intervention period (time two).

Qualitative focus groups with GameBike families were conducted after the six week intervention period. These focus groups discussed usage and enjoyment and gave participants the opportunity to discuss anything that could not be noted on the questionnaire. They also acted as an opportunity to perform a belief elicitation study in

accordance with the TPB. It also gave the children a chance to discuss their experiences, as they did not complete the questionnaires. See Appendix B for timeline.

Theory Base

The theory guiding this research study was the TPB. Past research has used the TPB in association with physical activity behaviours with much success (Symons Downs & Hausenblas, 2005b). The emphasis from this model was placed on affective attitude and PBC. This model was discussed in further detail in chapter two.

Participants

Desired participants for this study were two-parent families. The parents had to be over 18 years of age and have at least one child between the ages of four and six. The families also had to be residents of Victoria, British Columbia. In order to be eligible to participate, the parents could not be meeting the physical activity guidelines outlined by Health Canada and the Canadian Society for Exercise Physiology (2002) which state that individuals should accumulate 60 minutes of activity daily, or 30 minutes of moderate to vigorous activity four days per week.

Participant Compensation

All participating families were entered into a lottery to win a one year family membership at a local recreation centre.

Recruitment and Sampling

In order to collect a diverse sample of families, recruitment was performed throughout all communities of Greater Victoria. Specifically, advertising for the study

took place through recreation centres, health care centres, children's recreation classes, daycares and preschools, online classified websites such as Craig's List and Used Victoria as well as shopping malls. See Appendix C for notice of research. Advertisements had contact information for the researcher and potential participants were screened for eligibility when they called for more information. See Appendix D for phone scripts.

Snowball sampling was also performed, where participating families were given the option of passing along information about the study to other families who were eligible to participate. For every referred family who was deemed eligible and who chose to participate, the referring family received an extra ballot in the lottery.

As this study was a pilot, recruitment was performed for five months. At this point there were seven families in each group which would act as an adequate sample for a pilot.

Experimental Conditions

Intervention group.

Families who were randomized to the intervention group received a GameBike (Cat Eye Electronics Ltd., Boulder, Colorado) for the six week trial period. The GameBike is a stationary bicycle that reads both speed and steering allowing participants to play a number of driving games on a Sony Playstation 2 (Sony Computer Entertainment America Inc, Foster City, California) gaming console. If families who were randomized to receive a GameBike did not own a Playstation 2, they were be loaned one by the researcher for the six weeks. Each family in the intervention group received three games for usage with the Playstation 2 gaming console. These were Shrek

Smash'N'Crash, ATV Offroad Fury and Grand Turismo 3. The GameBike also came with two seat sizes (small for children and large for adults) as well as wooden blocks that could be placed on the pedals if necessary to facilitate better use of the bicycle by small children.

Control group.

Families who were randomized to the control group received a GameBike without the interactive components installed. This allowed participants to use the bicycle as a traditional stationary bicycle. Families of this group also received two different seats and wooden pedal blocks. Participants in this group were instructed to place the bicycle in front of the television and to engage in TV viewing while riding the bike.

Ethical Considerations

This research study was granted ethical approval from the Human Research Ethics Board at the University of Victoria prior to commencing. Prior to beginning the study, consent forms were signed by parents and verbal consent was obtained by children. Secondary consent forms were completed prior to participating in the focus groups. See Appendix E for consent forms.

As well, participants were notified that they could withdraw from the study at any time without explanation or consequence. If they gave permission for data that had been collected to date to be used in the analysis they had to sign and complete a form stating this. See Appendix E for right to withdraw form.

Procedures

After interested participants contacted the researcher and were determined to be eligible to participate in the study, families were be randomized into either a control condition or an intervention condition using a random number table, where the first identification number encountered was in the control group, the second in the intervention group and so on (Thomas et al., 2005, p. 101).

An orientation session was scheduled with the families where the equipment was brought to the home and set up, and all family members including the children were given the opportunity to use the equipment. At this time, families were shown how to change the seats depending on the bicycle user as well as how to use the wooden block pedals.

At the orientation session, consent was obtained by both parents (in writing) and children (verbally). As well, parents completed the Physical Activity Readiness Questionnaire (PAR-Q) (Canadian Society for Exercise Physiology, 2002). The family was given a copy of Canada's Physical Activity Guide and Canada's Physical Activity Guide for Children to act as a resource specifying the recommended amount of physical activity to be performed as described by Health Canada. After using the equipment, the parents completed questionnaires as a time one measure for intention to use the equipment over the next six weeks. The usage log was given to the family and the family members were asked to track their usage of the equipment during the six week trial period. After the six week period, parents were given a follow-up questionnaire to complete and all family members of the GameBike group were asked to participate in brief qualitative focus groups.

Quantitative Instruments

Questionnaires were administered to parents only as the main measurement tool. The questionnaire addressed a number of variables as outlined below. Follow-up questionnaires contained all of the same variables as at time one, except for demographic information. See Appendix F for questionnaires.

Demographics and health status.

Basic demographic information including age, gender, ethnicity, marital status, education level and household annual income were obtained. Questions regarding health status including smoking status, high blood pressure, high cholesterol, or the presence of any disease or chronic condition (cancer, diabetes, heart disease or angina) were also posed, as well as questions pertaining to previous video and computer gaming experience.

By understanding basic demographic information it was possible to ensure that the families were as close as possible in all aspects of life so that motivational belief differences between groups were based solely on the type of exercise equipment.

Beliefs about physical activity.

Beliefs about physical activity and use of the given equipment were measured using the TPB. Behavioural, normative and control beliefs were measured through previously validated measures for the three constructs of the TPB (Rhodes, Warburton et al., in press). All questions used seven point likert scales and referred to "using the equipment at a moderate intensity for at least 30 minutes on at least four days of the week" as outlined by Health Canada.

Instrumental attitude was measured by three items (useful-useless, wise-unwise, beneficial-harmful) and *affective attitude* (enjoyable-unenjoyable, pleasant-unpleasant, exciting-boring). Subjective norm employed seven point likert scales ranging between 1 (strongly disagree) and 7 (strongly agree). *Injunctive norm* was measured through two items: "Most people who are important to me would want me to engage in regular exercise on the GameBike/stationary bike in front of the television over the next six weeks" and "Most people whose opinions I value would expect me to engage in regular exercise on the GameBike/stationary bike in front of the television over the next six weeks." *Descriptive norm* was measured through the item: "Most people who are important to me will exercise on a GameBike/stationary bike in front of the television over the next six weeks themselves." *PBC* was measured on seven point scales using three items: "exercising on a GameBike/stationary bike in front of the television over the next six weeks is under my control if I really wanted to do so" (ranging from 1, strongly disagree to 7, strongly agree), "how confident do you feel that you could engage in regular exercise on a GameBike/stationary bike in front of the television over the next six weeks if you really wanted to?" (ranging from 1, extremely unconfident, to 7, extremely confident) and "is engaging in regular exercise on a GameBike/stationary bike in front of the television over the next six weeks up to you if you wanted to do so?" (ranging from 1, not at all, to 7, very much). *Exercise intention* was measured by two items using a seven point scale (ranging from 1, strongly disagree, to 7, strongly agree): "I intend to engage in regular exercise on a GameBike/stationary bike in front of the television over the next six weeks" and "I plan to engage in regular exercise on a GameBike/stationary bike in front of the television over the next six weeks."

Leisure-time.

An open-ended question was asked to determine the amount of time that an individual perceives to have as leisure time. It was stated as "Outside of work and my household obligations, on my typical day, I have an average of _____ hours of leisure time."

General physical activity recall.

In order to assess individual physical activity levels, a modified Godin Leisure-Time Exercise Questionnaire (Godin, Jobin, & Bouillon, 1986) was used. This asked for the amount of physical activity performed during leisure-time, throughout a typical week. Intensities were broken into mild, moderate and vigorous. Participants were asked to state the average frequency for each intensity as well as average duration of each bout.

As well as individual physical activity recall, parents were asked to recall physical activity performed as a family. This was broken into formal or structured activity (e.g. children's classes such as kinder-gym, swimming, etc) and informal or unstructured activity (e.g. family walks, family bike rides, playing in the park, etc.). For each of these the average frequencies per week as well as the average duration of each bout were asked.

Equipment usage logs.

Families were asked to track the usage of the equipment in an equipment usage log. They were instructed to record the date and time of usage, the duration of equipment use, and some brief comments about their experience using the machine. As well, participants were asked to list who else was in the room while they were using the

equipment, as well as who else was at home. Parents were asked to ensure that the usage of the equipment by their children was logged either by the children themselves or by the parents. See Appendix F for a sample page of the equipment usage log.

Qualitative Focus Groups

Qualitative focus groups were conducted with each family member of the intervention group (GameBike users). This aimed to act as an elicitation study as suggested by Ajzen and Fishbein (1980) to understand beliefs held by individuals about use of this type of exercise equipment. Questions also addressed usage and enjoyment, as well as if participants thought that the GameBike is a viable piece of home exercise equipment. Belief elicitation was not performed in regards to the subjective norm construct of the TPB. Due to the nature of the subjective norm construct and the novelty of the GameBike, such questions did not seem to be appropriate or useful. See Appendix F for focus group questions.

Data Analysis

As the purpose of this study was to perform a pilot study that built upon previous research by extending GameBike usage to a new population (parents and their children) and setting (in the home), the focus of data analysis was on exploring trends in the data, rather than focusing on significance. Thomas et al. (2005) recommend using pilot work to determine whether procedures are appropriate for the study and to determine whether it is beneficial to perform larger scale studies in the same area based on the data obtained. Due to a limited sample size, and therefore lack of statistical power, the emphasis of the

analysis was on effect sizes to help determine whether significance would be reached if the sample size was increased.

Six effect size measures were used in the analysis. The first, *r*, was used for correlational analyses. Cohen (1992) quantifies the magnitudes of the *r* effect size as .10 for a small effect, .30 as a medium effect and .50 as a large effect. Eta squared effect sizes were used for ANOVA analyses. These effects are quantified as .02 for a small effect, .06 for a medium effect and .14 for a large effect. Post-hoc analyses from ANOVAs use a Cohen's *d* effect size. Cohen states that .20 is a small effect, .50 is a medium effect and .80 is a large effect. Effect size *h* was used to test for the difference between two independent proportions. This effect is quantified in the same manner as effect size *d*. The f^2 effect is calculated from the R^2 provided in a regression analysis. This effect size is quantified as .02 for a small effect, .15 for a medium effect and .35 for a large effect (Cohen). The last effect size used is beta which is also given in a regression analysis. This effect size is interpreted in the same manner as *r*.

Data cleaning.

Prior to beginning analysis, data was assessed and cleaned. First, data was checked for key punch mistakes manually in the data file, using frequency plots and by spot checking data entry. Next, the internal consistency of TPB variables was determined. Cronbach's alpha was high for all variables scoring .76 for instrumental attitude at time one and .93 at time two, .86 for affective attitude at time one and .83 at time two, .85 for injunctive norm at time one and .55 at time two, .85 for PBC at time one and .73 at time two, and .97 for intention at time one and .98 at time two. Following this, the distribution of these variables was assessed for normality. Attitude variables were

also reverse scored. Using the *z*-score distribution, skewness greater than 2.58 as well as outliers greater than 3.29 were considered to be problematic (Field, 2005). Both the aggregated variables for time one PBC and time one intention were negatively skewed, which led to an investigation into the presence of outliers. Both of these variables had one extreme outlier. To remedy the outlier and the skewed distribution, the outlier was curbed, such that it was brought in to equal the highest value within the normal range (Field), which resulted in a skewness statistic of -1.14 for PBC and -.49 for intention.

Usage data was assessed in the same way, creating separate variables for each week's frequency and total minutes of use. Two outliers existed in this data, creating a non-normal distribution. These outliers were curbed as well, bringing them in to the highest normal value. This eliminated the skewness of the variables, reducing the skewness to 2.02 for week three's total minutes variable and 2.40 for week five's total minutes of use variable.

Descriptive statistics.

Descriptive statistics were performed to obtain participant characteristics for age, ethnicity, education level, occupation status and annual income. Descriptive statistics were also assessed between the groups to determine that there were no significant differences between demographics and pre-existing health conditions using an independent *t*-test.

A correlation matrix was developed for each group to determine the presence of relationships between descriptive variables, TPB variables and usage variables.

Analysis of usage.

From the equipment usage logs, frequency of use per week was tallied for each family member, as well as his or her total minutes of use for each week. To compare usage between groups on a weekly basis, a factorial Analysis of Variance (ANOVA) was performed. Separate analyses were performed for mothers, fathers, four year old children, five year old children, and six year old children. Mothers and fathers were also grouped together for analysis, as well as all children together, and five and six year olds together. Five and six year olds were grouped together due to the limited sample size of six year olds (n = 2 for the GameBike group and n = 0 for the control group). The fixed factor used was group (intervention or control), and the dependent variable was the frequency of use, or the total minutes of use for each week.

To compare changes in usage over the six week time period, a repeated measures (RM) ANOVA was performed. First the entire GameBike group was compared to the entire control group. After this, separate analyses were performed for mothers, fathers, four year old children, five year old children, six year old children, parents together, children together and children ages five and six. Here, the independent variables were time and group, while the dependent variable was frequency of use or total minutes of use each week.

Theory of planned behaviour variables.

A 2x2 factorial ANOVA was performed to assess differences on social cognitive measures of the TPB between groups and genders at time one. Here, the fixed factors were gender and group, and the dependent variable was each construct of the theory. To

retain as high of a sample size as possible in each group, the analysis was also performed without gender separation.

To test whether there were significant changes in the social cognitive constructs over the course of the intervention, a RM ANOVA was performed, comparing scores for these constructs at both the beginning and end of the intervention. In this analysis, the independent variable was time, and the dependent variable was each construct of the theory. Separate analyses were performed for each group.

Multiple regression analysis was performed to predict intention, total frequency over the six weeks and total minutes of use over the six weeks. Affective attitude, instrumental attitude, injunctive norm, descriptive norm, and PBC were used as predictor variables for intention. Hierarchical multiple regression was performed to predict usage where PBC and intention were entered as predictor variables (as outlined in the TPB) in the first block, and then affective attitude was added in the second block.

Qualitative data analysis.

Qualitative data recorded during the elicitation study was recorded and transcribed verbatim removing all names and identifying characteristics. After transcription occurred, they were imported into NVivo Qualitative Analysis Software to assist with coding. Content analysis, or the effort to reduce and make sense of qualitative data, was performed as outlined by Patton (2002). According to Morse (1994), this is known as the "comprehending" step in qualitative analysis, where the aim is to tag and label the text in order to develop categories within the data.

First, the transcripts were read through to recognize common words or phrases and to develop preliminary codes (Patton, 2002). They were then read repeatedly, trying

to sift the significant information from the insignificant. This is known as the "synthesizing" step of analysis (Morse, 1994). This second set of coding allowed more substantial themes to emerge. The data was reviewed to make more sense of the categories that had initially emerged. Here categories were redefined to help make meaning of the data (Morse). Morse labels this the "theorizing" stage of analysis. Coding and theming was conducted use a tree-structure within NVivo. The last step of analysis involved linking the themes back to the TPB, which had guided the initial question development.

Chapter 4: Results

Family Participation

Forty four families contacted the researcher for participation in the study. Of these families, 26 were excluded because their reported physical activity levels were higher than Health Canada's Physical Activity Guidelines for Adults and four were excluded for being a one-parent household. Fourteen remaining families were randomized to either the GameBike condition (n = 7 families, 14 parents) or the control condition (n = 7 families, 14 parents). One father participant of the GameBike condition refused to participate in the study; however time one data was collected from the mother. This family refused to participate in the follow-up measures of the study, as well as one family from the control condition, although both allowed their collected time one data to be used in the final analysis. See Figure 4.

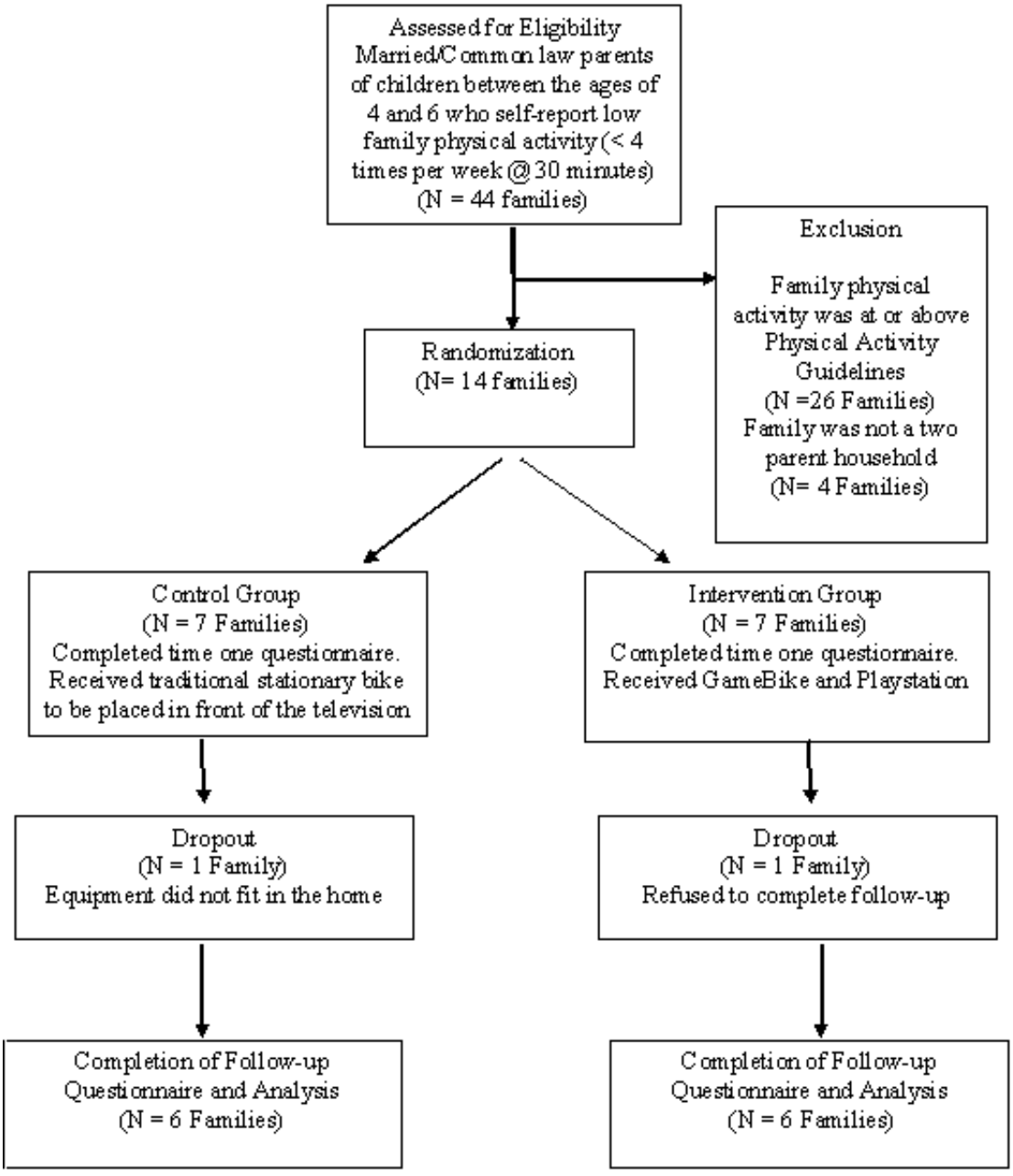

Figure 4. Participant flow diagram.

Participant Characteristics

Participant characteristics are illustrated in Table 1. No significant differences between age, percentage of participants who are a visible minority, percentage of

participants who have completed university, percentage of participants whose household income was over $60,000 per year, percentage of participants who are employed full-time, percentage of participants who are smokers, reported leisure-time hours, time one and time two reported physical activity or BMI were found ($p < .05$).

Table 1

Descriptive Statistics

Characteristic	Experimental (n = 13)	Control (n = 14)	Effect size *d*	*p*-Level
Parent demographic profile				
Mean age (*SD*)	34.54 (7.88)	36.29 (5.24)	.22	.50
% female	53.85	50.00		.85
% visible minority	7.69	28.57		.18
% completed university	53.85	71.43		.36
% household income >$60,000	66.67	50.00		.43
% currently employed full-time	69.23	42.86		.18
% smokers	15.38	14.29		.94
Mean reported hours of leisure time daily (*SD*)	1.50 (.68)	1.71 (1.55)	.16	.65
Mean reported hours of video game usage per week (*SD*)	1.62 (2.58)	1.50 (3.21)	.05	.92
Parental physical activity mean (*SD*)				
Weekly bouts of moderate and vigorous activity at time one	3.54 (2.96)	1.79 (1.81)	.59	.07
Duration of moderate and vigorous activity bouts at time one	23.58 (21.05)	22.50 (29.79)	.05	.92
Weekly bouts of moderate and vigorous activity at time two	4.50 (3.26)	2.42 (1.83)	.64	.07
Duration of moderate and vigorous activity bouts at time two	29.38 (17.97)	26.04 (18.51)	.19	.66
BMI	28.52 (5.03)	27.97 (4.92)	.11	.78

Demographics, Theory of Planned Behaviour and Usage

Correlations between demographic variables, TPB variables and total usage variables were calculated separately for both the GameBike group and the control group. Correlations can be seen in Table 2 for the GameBike group and Table 3 for the control group. Cohen (1992) qualifies small effect size *r* as .10, medium as .30 and large as .50.

Table 2

Bivariate Correlations between Demographics, Theory of Planned Behaviour Variables and Usage for Parents of the GameBike Group

	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Age	-.18	-.41	-.48	.07	-.08	-.12	-.24	.23	.34	.04	-.01
2. Gender		.44	.00	-.13	-.25	-.08	-.20	-.12	-.05	.08	.05
3. BMI			-.16	.20	.19	.21	.48	.00	.01	.11	.06
4. Income				.23	.36	.20	.09	-.61	-.57	.20	.23
5. Affective attitude					.56	.32	.41	.12	.48	.29	.25
6. Instrumental attitude						.40	.51	-.31	-.08	-.08	-.12
7. Injunctive norm							-.01	-.04	.07	.08	.00
8. Descriptive norm								-.14	-.01	-.19	-.11
9. PBC									.69	.06	-.02
10. Intention										.03	.01
11. Total frequency											.98
12. Total minutes of use											

Table 3

Bivariate Correlations between Demographics, Theory of Planned Behaviour Variables and Usage for Parents of the Control Group

	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Age	-.14	-.10	.29	-.35	.05	.08	-.07	.26	.23	.25	.19
2. Gender		-.24	.00	.27	.09	-.11	-.04	.26	.28	.10	.01
3. BMI			.44	-.11	.16	.10	-.41	.36	.36	-.32	-.33
4. Income				.24	.46	.24	.12	.80	.61	.01	-.03
5. Affective attitude					.29	.56	.49	.19	.38	.39	.37
6. Instrumental attitude						.60	.35	.51	.47	.51	.49
7. Injunctive norm							.68	.42	.63	.69	.65
8. Descriptive norm								.26	.23	.53	.54
9. PBC									.87	.29	.19
10. Intention										.53	.38
11. Total frequency											.98
12. Total minutes of use											

Usage

RM ANOVAs were performed to compare all participants of the GameBike group (parents and children) to the traditional bike counterparts on total minutes of use and frequency over the six weeks. When comparing total minutes of weekly use, the analysis

yielded a large eta squared effect size for time ($F_{5,34}$ = 4.85, p < .01; η^2 = .42) which was also found to be significant. Follow-up tests showed that there was a large, significant effect for the control group (t_{18} = 3.87, p < .01; d = .91). The effect size for the GameBike group was small and not found to be significant (d = .33). See figure 5. When comparing weekly frequency a large eta squared effect size for time was also found ($F_{5,34}$ = 3.15, p < .05; η^2 = .32). Post-hoc analysis revealed a large effect size d for the control group (t_{18} = 3.77, p < .01; d = .89) which was also significant. Although not significant, a small effect size (d = .32) was found for the GameBike group. See figure 6.

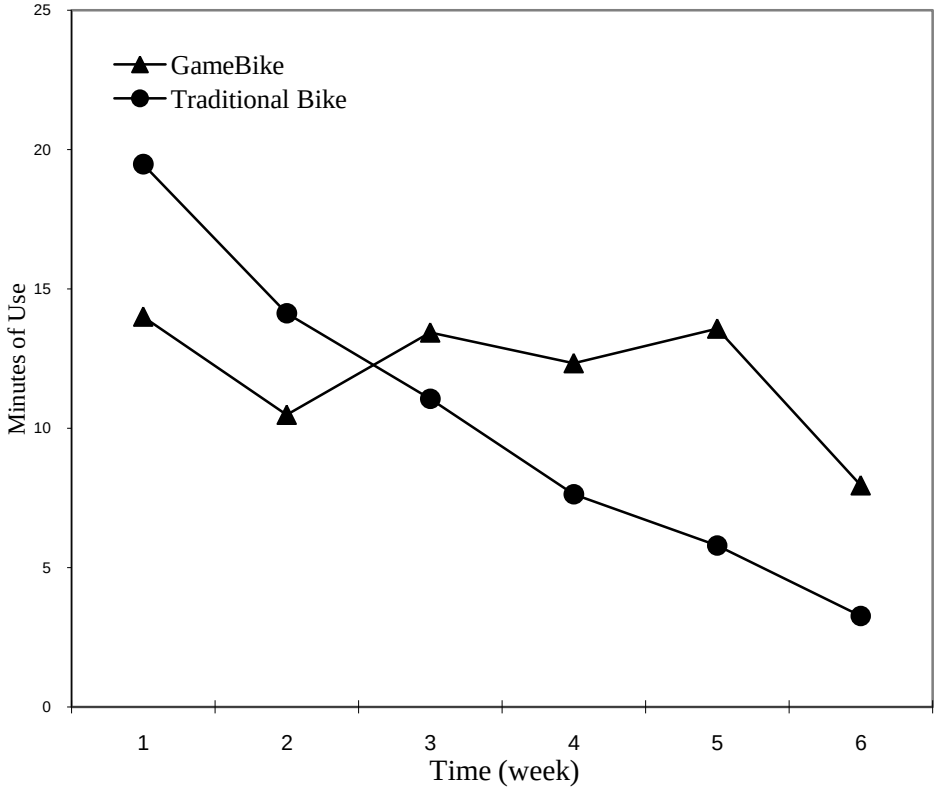

Figure 5. Comparison of total minutes of use across six weeks between families receiving a GameBike and families receiving a traditional stationary bike.

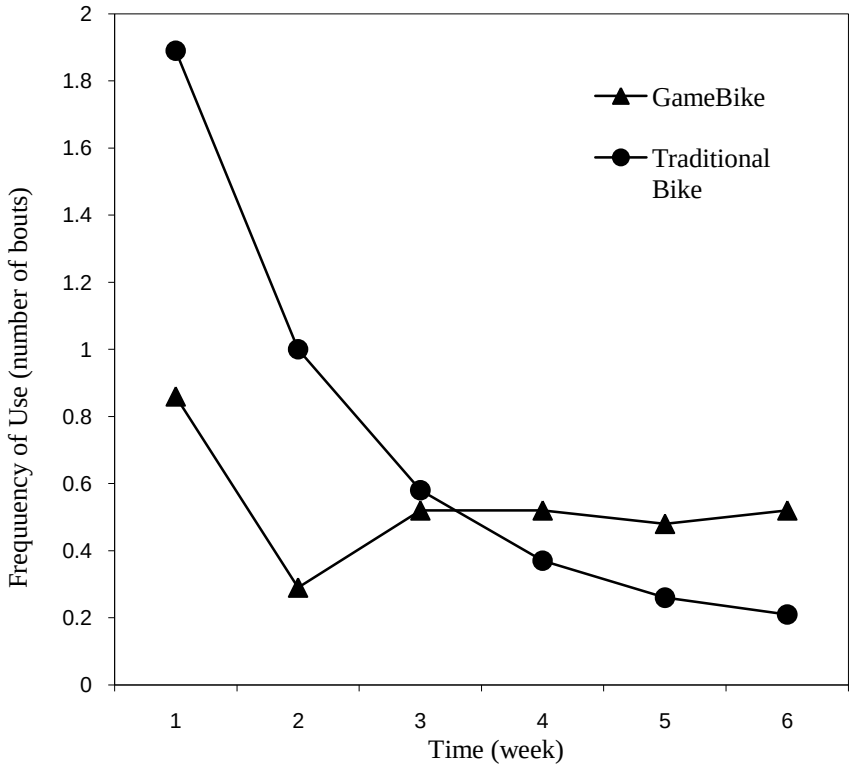

Figure 6. Comparison of frequency of use across six weeks between families receiving a GameBike and families receiving a traditional stationary bike.

RM ANOVAs were performed separately among mothers, fathers, four year olds, parents and children for both frequency and total minutes of weekly use. Both the five year old and six year old analyses was excluded due to limited sample size (n = 2 for the GameBike group and n = 4 for the control and n = 2 for the GameBike group and n = 0 for the control group, respectively), however they were grouped together for analysis. No significant results were found from the RM analyses, however, eta squared effect sizes were large for the main time effect of all analyses (η^2 = .44-.73) and for the group by time effect (η^2 = .35-.73). Mothers in both the GameBike and control group experienced a

decline in both frequency and total minutes of use across the six weeks. Mothers in the GameBike group had small effect sizes for frequency (d = .39) and medium effect sizes for total minutes of use (d = .52) while mothers in the control group had large effects for both frequency (d = .97) and total minutes (d = 1.03). Fathers in the GameBike group experienced increases in both frequency and total minutes of use, yielding small effect sizes for both frequency (d = .21) and total minutes (d = .30). Fathers in the control group decreased in both frequency and total minutes. The effect size for frequency was medium sized (d = .51) while it was small for total minutes (d = .44). Four year old children in the GameBike group experienced a decline and then increase during the sixth week for both frequency and total minutes, while those in the control group experienced solely a decline. The effect sizes for the GameBike group were small for frequency (d = .36) and trivial for total minutes (d = .07), while those for the control group were medium for both frequency (d = .58) and total minutes (d = .58). When analyzed together, parents, children and five and six year olds in both the GameBike and the control groups experienced declines in both frequency and total minutes. Parents in the GameBike group had small effects for both frequency (d = .27) and total minutes (d = .41) while parents in the control group had a large effect for both frequency (d = 1.10) and total minutes (d = 1.02). Children in the GameBike group yielded small effects for both frequency (d = .34) and total minutes (d = .33) while those in the control group yielded large effect sizes for both (d = .83 and d = 1.05 respectively). Lastly, when grouped together, children ages five and six in the GameBike group had small effects for both frequency (d = .41) and total minutes (d = .39), whereas their counterparts in the control group had large effects for frequency (d = 1.03) and total minutes (d = 1.01).

Weekly factorial ANOVAs for usage (both frequency and total minutes of use) among mothers, fathers, four year olds, five year olds, parents, children and children ages five and six yielded no significant condition effects. However, the majority of eta squared effect sizes for both weekly frequency and total minutes of use fell in the small to large range (η^2 = .02-.43).

The frequency of usage by mothers in the control group was higher than those in the GameBike during weeks one (η^2 = .08), three (η^2 = .11) and four (η^2 = .04), whereas frequency was higher for the mothers in the GameBike group during weeks five (η^2 = .18), and six (η^2 = .07). Total minutes of use was higher for mothers in the control group during week three (η^2 = .06), whereas it was higher for mothers in the control group during weeks five (η^2 = .19), and six (η^2 = .06). Fathers in the control group had a higher frequency of use during week three (η^2 = .11), and week four (η^2 = .04), whereas those on the GameBike group had a higher usage during weeks five (η^2 = .18), and six (η^2 = .07). Total minutes of use was higher among fathers in the control group during week three (η^2 = .06), while fathers in the GameBike group had higher minutes of use during weeks five (η^2 = .19), and six (η^2 = .06). Frequency among children age four was higher among the control group during week one (η^2 = .12), two (η^2 = .24), and three (η^2 = .02), whereas those in the GameBike group used it more times during week four (η^2 = .09), week five (η^2 = .09), and week six (η^2 = .20). Total minutes of use was higher among those four year olds in the control group during week two (η^2 = .24), whereas those in the GameBike group used it for more minutes during weeks one (η^2 = .03), three (η^2 = .03), four (η^2 = .09), five (η^2 = .09), and six (η^2 = .20). Five year olds in the control group used the bike more than those in the GameBike group during weeks one (η^2 = .38), and two (η^2 = .43),

whereas those in the GameBike group used it more during weeks four ($\eta^2 = .32$), five ($\eta^2 = .10$), and six ($\eta^2 = .21$). Total minutes of use was higher for five year old in the control group during weeks one ($\eta^2 = .28$), and two ($\eta^2 = .31$), while it was higher for the GameBike group during weeks three ($\eta^2 = .30$), four ($\eta^2 = .38$), five ($\eta^2 = .36$) and six ($\eta^2 = .28$). This trend remains the same for grouped variables (parents, all children and children ages five and six) where the control group had higher usage during weeks one and two, and the GameBike group had higher usage during weeks four, five and six. Weeks that were not listed had less than small effects ($\eta^2 < .02$).

Theory of Planned Behaviour Variables

Means and standard deviations for all TPB variables can be seen in Table 4.

Table 4

Means and Standard Deviations for Theory of Planned Behaviour Variables at Time One and Time Two

Variable	Experimental		Control	
	Time One (n = 13) *M* (*SD*)	Time Two (n = 12) *M* (*SD*)	Time One (n = 14) *M* (*SD*)	Time Two (n = 12) *M* (*SD*)
Affective attitude	5.90 (.75)	4.58 (.90)	4.74 (1.37)	3.33 (1.41)
Instrumental attitude	6.13 (.80)	5.42 (1.10)	5.93 (.79)	5.53 (1.50)
Injunctive norm	5.77 (.75)	4.67 (1.09)	4.93 (1.41)	4.25 (1.69)
Descriptive norm	3.62 (1.85)	4.08 (1.16)	4.64 (1.69)	3.75 (1.76)
PBC	6.56 (.39)	5.17 (1.24)	6.12 (.86)	5.89 (.95)
Intention	6.38 (.62)	3.63 (1.69)	6.18 (.67)	4.29 (2.15)

Factorial ANOVAs were performed for each variable of the TPB model from the time one questionnaires. A large effect was found for affective attitude ($\eta^2 = .23$). This effect was also found to be significant ($F_{1,25} = 7.25$, $p = .01$) in favour of the GameBike condition. Small effects were found for instrumental attitude ($\eta^2 = .02$) and intention ($\eta^2 = .03$), while medium effects were found for injunctive norm ($\eta^2 = .13$), descriptive norm ($\eta^2 = .08$) and PBC ($\eta^2 = .10$). These effects were all in favour of the GameBike condition, except for descriptive norm which was in favour of the control group. The *F* statistic was not significant for any of the other variables than affective attitude.

The RM for affective attitude yielded a large effect ($\eta^2 = .60$) for a time effect and a large effect ($\eta^2 = .60$) for the intervention effect. Both the time effect ($F_{1,22} = 32.73$, $p < .01$) and the intervention effect ($F_{1,22} = 8.54$, $p = .01$) were also found to be significant. Follow-up post hoc tests showed that the time effect was significant for both the GameBike group ($t_{11} = 6.08$, $p < .01$, $d = 1.67$) and the control group ($t_{11} = 3.27$, $p < .01$, d = .88) with both groups experiencing a decrease in affective attitude from time one to time two. The significant group effect on affective attitude showed that the GameBike group experienced higher levels of affective attitude at both time one ($t_{25} = 2.69$, $p < .01$, $d = 1.55$) and time two ($t_{22} = 2.58$, $p < .05$, $d = 1.39$). All of these post-hoc effect sizes are categorized as large. Analysis for injunctive norm yielded a large effect size for time ($\eta^2 = .33$). This time effect was also found to be significant ($F_{1,22} = 10.82$, $p < .01$). The follow-up tests indicated large effect sizes for the GameBike group ($d = 1.39$) and showed that this effect was only significant for the GameBike group ($t_{11} = 3.65$, $p < .01$) where injunctive norm decreased from time one to time two. The interaction effect for descriptive norm was large ($\eta^2 = .18$) as well as significant ($F_{1,22} = 4.69$, $p < .05$). PBC

had large effects for both time ($\eta^2 = .35$) and interaction ($\eta^2 = .29$). Both the time ($F_{1,22} = 11.64$, $p < .01$) and interaction effects ($F_{1,22} = 9.10$, $p = .01$) were found to be significant. Follow-up tests for the time effect indicated a large effect ($d = 1.43$) for the GameBike group that showed significant decreases in PBC from time one to time two ($t_{11} = 4.23$, $p < .01$). Intention had a large time effect ($\eta^2 = .59$) which was also significant ($F_{1,22} = 32.20$, $p < .01$). Both the GameBike ($d = .47$) and the control group (d=.40) had small effects in the post-hoc tests which indicated a significant decrease from time one to time two for both the GameBike group ($t_{11} = 5.07$, $p < .01$) and the control group ($t_{11} = 3.04$, $p < .01$).

Regression Analysis

Regression analysis was performed where intention was regressed on affective attitude, instrumental attitude, injunctive norm, descriptive norm and PBC. The analysis yielded an R^2 of 0.66, which results in an f^2 effect size of 1.94 which is classified as large. Affective attitude had a small effect ($\beta = .18$), as well as injunctive norm ($\beta = .11$). PBC had a large effect ($\beta = .70$), which was also found to be significant ($p < .05$). Overall, the regression was significant and explained 66% of the variance in intention ($F_{5,21} = 8.18$, $p < .01$, $R^2 = .66$). See Table 5 for regression analysis to predict intention.

A hierarchical regression analysis was performed regressing total frequency over the six weeks on PBC and intention and adding in affective attitude in the second model. The original R^2 resulting from the first model was .09. This results in an f^2 effect size of .10 which is classified as small. Intention had a medium effect ($\beta = .35$) on the equation, however it was not statistically significant due to the small sample size. After adding affective attitude, the R^2 changed to .12, a difference of .03. This results in an f^2 effect

size of .14 which is classified as small. Both intention and affective attitude had small effects (β = .26 and β = .19 respectively).

The final regression analysis regressed total minutes of use over the six weeks on PBC and intention in the first model and added affective attitude in the second model. The resulting R^2 of the first model was .05 which equates to a small f^2 effect size of .05. Intention had a small effect (β = .27) on the equation, however it was not significant. In the second model, the resulting R^2 was .09, corresponding to a small f^2 effect size. This was an R^2 change of .05. Both intention and affective attitude had small effects on the equation (β = .16 and β = .24 respectively). Regression analyses for usage can be seen in Table 6.

Table 5

Regression Analyses to Predict Intention

	F	*df*	*R*	R^2	β
Exercise intention	8.18	5,21	.81	.66	
Affective attitude					.18
Instrumental attitude					-.09
Injunctive norm					.11
Descriptive norm					.01
PBC					.70**

** p = .05, *df* = degrees of freedom

Table 6

Hierarchical Regression Analyses to Predict Behaviour

Step	*F*	*F* change	*df*	R^2 change	β_1	β_2
Total frequency						
1. Intention	.97	.97	2,21	.09	.35	.26
PBC					-.08	-.06
2. Affective attitude	.86	.68	3,20	.03		.19
Total minutes of use						
1. Intention	.50	.50	2,21	.05	.27	.16
PBC					-.08	-.06
2. Affective attitude	.69	1.06	3,20	.05		.24

df = degrees of freedom

Analysis of Physical Activity Guidelines

The proportion of parents meeting Health Canada's Physical Activity Guidelines was assessed between time one and time two. At time one, 33.33% of parents in the GameBike group and 33.33% of parents in the control group were meeting Health Canada's Physical Activity Guidelines. At time two, 66.66% of parents in the GameBike group and 41.67% of parents in the control group were meeting these guidelines. This difference between groups at time two, yields and effect size *h* of .51, which is classified as a medium effect.

Qualitative Analysis

Qualitative focus group transcripts were analyzed for emerging themes in relation to the TPB. These themes and their subthemes can be seen in Table 7.

Table 7

Themes and Subthemes of Qualitative Analysis

Theme	Subtheme
Theme 1: Attitude	Subtheme 1a: Positive affect
	Subtheme 1b: Negative affect
	Subtheme 1c: Instrumental attitude
Theme 2: GameBike usage	Subtheme 2a: Overall usage
	Subtheme 2b: Usage as a family
	Subtheme 2c: Children's usage
Theme 3: Perceived behavioural control	Subtheme 3a: General barriers
	Subtheme 3b: Bike and games as barriers
	Subtheme 3c: Weather and seasons
	Subtheme 3d: Benefits

Theme one: Attitude.

The TPB states that an individual holds behavioural beliefs about a given behaviour which in turn make up his or her attitude, or the evaluation that one has regarding this behaviour. The data obtained from the focus groups indicated that individuals experienced both affective and instrumental beliefs in regards to GameBike

usage. This theme has therefore been broken into four subthemes: positive affect, negative affect, and instrumental attitude.

Lowe et al. (2002) describe affective attitude as the emotional judgments that an individual makes while performing a behaviour. These judgments can be either positive or negative. Participants within this study commented on both positive and negative affective experiences associated with using the bike. Participants expressed that using the GameBike was fun and exciting and that it also helped with stress relief. On the other hand, negative comments included that the bike was too hard, frustrating and tiring. Two quotes have been highlighted below illustrating the opposing points of view.

> *Oh yeah, I had a great time! It was fun when you were doing it.*
>
> *And he was really excited to use it, and then when he realized how difficult it was to use he didn't want to use it again because it was just too hard.*

Participants also discussed how the GameBike acted as a mechanism for distraction from the work they needed to perform while cycling. They stated that playing the game while riding took their mind off of the pain, the fatigue and working hard. An example quote is stated below.

> *I did notice that having something else to focus your attention on took away from noticing the fatigue.*

In relation to instrumental attitude, participants had a number of comments in relation to the benefits of the GameBike. First, participants felt that the incorporation of sedentary video games with physical activity was a beneficial way of maximizing screen time activities. They also felt that the GameBike provided a good workout and means of getting some exercise. Below are two quotes highlighting the instrumental benefits of the GameBike.

I think it would just be a really good option like I said when it's a rainy day and you can't send your kids outside and say "oh, go, go ride on the bike for half an hour and burn some energy".

It's beneficial for our bodies more so than sitting on our bums.

Theme two: GameBike usage.

Participants were posed questions in regards to their usage of the GameBike over the six week span. Of particular interest were the distribution of usage among family members, and the frequency of GameBike usage. Responses were in relation to overall usage of the GameBike (mainly frequency), usage as a family, and usage by children. This theme has therefore been broken into those three subthemes.

Participants indicated that the usage of the bike was occasional and that it tapered over the six week period which is supported by the quantitative analysis. They commented that their average frequency ranged between one and three times a week and they often stated that they didn't use the bike very much or as much as they had hoped. Below are two quotes highlighting this subtheme.

We probably both used it the same. And that being not very much.

I think I used it three times the first week, and then two or three times the second week and then I just didn't use it again.

Usage of the bike as a family was highlighted throughout the focus groups. Parents indicated that children often had a difficult time using the bike alone because they were too small and as a result, the family had to work together to help the kids use it successfully. From this developed interaction, they suggested that the GameBike helped create family time and allowed for the parents to spend more time with the kids which they enjoyed. One quote to highlight this is stated below.

Then, you know, there were times where an adult was cranking the, ha, cranking the wheel in order to have the boys do the steering and that kind of stuff, so it was just a new thing we can do to interact together.

Usage of the GameBike by children was also highlighted by every family. Overall, parents found that children in this age group (age four to six) were too young for the size of this equipment. Even with the addition of blocks to the pedals and smaller seat posts, they stated that most children could not reach the pedals comfortably and therefore could not pedal with the force necessary to power the Playstation game. Parents suggested that the bike would be more suitable for older children and that if their children were older that they were quite sure that the bikes would be more thoroughly enjoyed. Below are two quotes to highlight these points.

He couldn't really ride it because his feet couldn't touch the pedals.

You know kids like playing video games, and I'm sure if our kids were older they'd be all over it.

Theme three: Perceived behavioural control.

Ajzen (1991) suggests that PBC is made up of control beliefs, or beliefs referring to the ease an individual perceives to performing a behavioural. These are often seen as either barriers or facilitators. This theme has been separated into four subthemes: general barriers, the bike and games as barriers, weather and seasons, and benefits.

The general barriers listed concerning using the GameBike were conducive with barriers often reported in relation to general physical activity (Symons Downs & Hausenblas, 2005). The primary barriers listed by parents were fatigue, and lack of free time to use the bike. Most stated that after coming home from work, they had about an hour of free time for that day. Parents also stated that they were busy with their kids, and

some stated that they had a household rule that limited screen time daily, and that during that time they and the kids would rather watch television than use the GameBike. Below is a quote highlighting fatigue as a major barrier.

> *Oftentimes I just got home from work, I was just really beat and I was just, you know, I was being lazy.*

There were a number of barriers that arose during discussions about the bike and games. In relation to the games, individuals expressed that different types of games would be helpful other than the racing games provided. They also commented that the bike was not immediate at responding to the game, creating a delay between bike and game, resulting in the participant always coming in last in the races.

In relation to the bike itself, parents commented that the bike itself was a barrier to the children, as it was simply too large for the children to use effectively. Statements also included that a true controller would have made using the bike easier and that the bike itself was hard to move and had an uncomfortable seat. It was also noted that the handlebars should be adjustable and that the steering could be improved. Another topic within this subtheme was the size of the bike and the space needed to house a bike of this size. Some parents suggested that the equipment was very large and that there was not enough room in their house to have equipment this size there past the six week period. Below are two quotes highlighting the games and bike as barriers.

> *I found it a little difficult to use. Um, I found that it just took a while to, um, for the bike to relate to the game, and um, and that actually probably discouraged me from using it because it wasn't as easy to use as I thought it was gonna be.*

> *For the kids the pedals were, their legs are too short, even with the blocks, their feet would slip off the blocks. Um, so they ended up having somebody pedal for them and they'd steer.*

As was listed as a limitation to this study, the weather and season was noted as a barrier to use of the GameBike by participants. Data collection for this trial occurred during summer months when Victoria was having exceptionally good weather. Participants noted that they were enjoying being outside and that when it was nice out they would prefer to perform activities as a family that were outside. Parents did however note that had it been winter or rainier, they believed that they would have used the equipment more. Below is a quote highlighting the seasonal factor related to GameBike usage.

> *I think it would be more beneficial probably in the fall or winter more, when it's rainy and cold and going outside isn't as preferable.*

The final subtheme of PBC is benefits associated with GameBike use. Some parents commented that having the GameBike in their home was convenient, providing the opportunity to use it whenever they'd like. Below is a quote to highlight this point.

> *It's definitely nice to have exercise equipment in the home in a comfortable spot and, just to have it at your fingertips and to have it there to use is definitely nice. Because you can just jump on it whenever you want.*

Chapter 5: Discussion

The purpose of this research was to perform a pilot that built upon previous studies by examining the motivation underlying the use of a GameBike in comparison to a traditional stationary bike placed in front of the television among parents and children in the home-setting. It addressed these differences by focusing on physical activity cognitions represented through constructs of the TPB among parents and by tracking usage of the equipment among all family members. This study also performed belief elicitation procedures for GameBike use based on the TPB. This study was the first of its kind to examine GameBike usage among families outside of a laboratory-setting. Due to this study acting as a pilot, the emphasis throughout analysis was on effect size, therefore aiding to determine whether significance would be reached should the sample size be increased. Overall, results were in favour of the GameBike group for both usage and social cognitive constructs.

This study addressed a number of hypotheses related to GameBike usage within the home-setting. The discussion chapter has been organized according to each of those hypotheses including usage, PBC and intention, affective attitude, prediction of intention and behaviour, and elicited beliefs. It then concludes with the limitations to this research and future direction.

Equipment Usage

The GameBike group and control group were analyzed across the course of the six weeks to measure trends in usage. It was found that while families of the control group initially had higher usage of the bike, it decreased rapidly below the level of the

GameBike group around the third week. It appears that this trend would continue downward if the study had continued. On the other hand, the GameBike group started at a lower usage rate than the control, but increased above the control group and levelled off after week three. The trend of the GameBike group appeared to be steady in the last three weeks whereas the control continued to decline. The effect size for the decrease in the control group was large (d = .89) whereas it was small for the GameBike group (d = .32).

Usage was also analyzed on a weekly basis with participants broken into separate groups (e.g. mothers, fathers and children by age). Overall, weekly results all supported the general trends stated above. Many of these effects sizes were classified as medium and large, which suggest that if larger scale trials were performed these findings may reach significance.

The decline in usage is consistent with the hypothesis of this study and is supported in previous research where stationary bikes with an interactive component were found to yield significantly higher adherence rates than members of the control groups who used traditional stationary bikes (Annesi and Mazas 1997; Warburton, Bredin et al., 2007; Rhodes, Warburton, et al., in press). In terms of adherence to structured exercise programs, Dishman and Buckworth (1996) suggest that of individuals who start an exercise program, half of them will abandon it within the first six months. There are currently no studies using interactive gaming equipment that have lasted six months in order to test these statistics in relation to adherence rates, however, Annesi and Mazas found that adherence rates were approximately 25% higher for the virtual-reality exercise bike group than those using either a traditional upright or recumbent bike. As well, Warburton, Bredin et al. and Rhodes et al. found that GameBike users attended

approximately 30% more sessions than those individuals in the control group. Therefore, these studies as well as the current research suggest that interactive stationary bikes may be supportive of greater adherence rates than traditional exercise equipment despite general declines in both across time.

This study differs from past GameBike studies in that the control group had higher use initially. Qualitative comments provide possible reasoning behind these findings. Some families noted that it took them a while to get used to the GameBike and figure out how all of the controls worked. As well, during the first few weeks parents were trying to make the bike work for some of the smaller children and they may have realized that the children were not going to be able to use it. This differs from the control group because a traditional stationary bike is a piece of equipment that most individuals already know how to use and it requires very little learning. The notion of a greater priming period for GameBike users is one that may be prudent for future research. Participants were only given approximately ten minutes per person to learn how to use the GameBike under supervision of the researcher. The degree to which they can absorb this information may be dependent on gaming history. For example, individuals with gaming experience may only need to learn to use the bike to control the game whereas someone without much gaming experience must also learn how to use the Playstation system as well as become accustomed to video games. The sample used in the study by Rhodes, Warburton et al. (in press) all self-reported a history of video gaming which may suggest why GameBike usage was always higher than the control group, as there was less need for this priming period. Future studies may wish to examine whether gaming

history plays a role in usage by assigning individuals to groups based on their personal gaming history.

At the time of orientation, families were given a copy of Health Canada's Physical Activity Guidelines for both adults and children and told to use this as a resource in terms of usage. While usage results were primarily in favour of the GameBike group over those receiving the traditional stationary bike, overall (e.g., the absolute value of) usage was still quite low. This can be seen by studying the physical activity recall (as measured through a modified Godin Leisure-Time Exercise Questionnaire (Godin et al., 1986)) of parents to see the proportion of adults meeting Health Canada's Guidelines for Physical Activity such that they were achieving a minimum of four bouts of moderate to strenuous activity for at least half an hour per week (Health Canada, 2002). At time one, 33.33% of parents in the GameBike group and 33.3% of parents in the control group were meeting guidelines, whereas at follow-up, 66.66% of parents in the GameBike group and 41.67% of parents in the control group were meeting guidelines. This difference between groups at follow-up equates to a medium effect size (h = .51) as classified by Cohen (1992). Overall, usage analysis has shown that while actual use may be low, the GameBike may still be effective at adding an extra bout of activity weekly. It is not believed that usage of the GameBike alone would be enough for parents to meet the physical activity recommendations of Health Canada; however, it may act as an alternative method to augment current initiatives.

While the increases in overall physical activity levels among parents may seem somewhat high between time one and follow-up, actual bike usage was still low which suggests that parents increased their physical activity participation (other than the

GameBike) throughout the time of the intervention. Qualitative findings from this study propose a number of different reasons as to why participants' usage of the equipment was low. One fundamental reason for minimal usage among children was the bike itself. While adjustments were provided to help children fit the bike (e.g. smaller seat and blocks for the pedals), there were some children who were too small and found the equipment uncomfortable and unable to be properly controlled. As well, parents and children indicated that there were features of the bike that made it difficult to use. This included that participants experienced a delay between the bike and the game, where individuals would pedal at a high intensity and the game did not respond accordingly for a few seconds.

Perceived Behavioural Control and Intention

When comparing PBC between groups, time one yielded a medium effect in favour of the GameBike group ($\eta^2 = .10$), and at time two the effect was the same ($\eta^2 = .10$), however, in favour of the control condition. Across time, PBC decreased for both groups, yielding a large effect for the GameBike group ($d = 1.43$), and a medium effect for the control ($d = .58$). Perceived barriers which could have contributed to the decrease in PBC among participants of the GameBike group were discussed in the focus groups. The two most listed barriers were time and fatigue which are consistent with previously elicited barriers to physical activity as outlined by Symons Downs and Hausenblas (2005a).

Laboratory-based data collection settings lack ecological validity, and participants may be more likely to comply with training recommendations because their usage was being tracked by a research assistant at each session or simply because of the Hawthorne

Effect where individuals change their behaviour in response to having it measured (Roethlisberger & Dickson, 1939). College participants of previous studies were likely already on campus when they attended the session which may have contributed to fewer barriers such as childcare and household responsibilities, among others. However, when participants' data is collected in their own home, and there is no monitoring throughout the six week period, participants may be more likely to experience barriers to use. As well, while the equipment is more accessible to participants when they are in their home rather than when students are on campus, individuals may have a number of other activities (e.g. spending time with kids, watching TV, sleeping) that they would rather do and are easily accessible. Parents may also feel that they have certain household responsibilities which need to be performed while they are in the home-setting (e.g. meal preparation, laundry, cleaning) which may take away from time that they have to perform the activity. Therefore, these new barriers which are experienced in the home-setting rather than the laboratory-setting may contribute to the decreased usage at home as a result of competing intentions to use the bike (Rhodes & Blanchard, 2008; Rhodes et al., 2008).

In regards to intention, time one yielded a small effect in favour of the GameBike condition ($\eta^2 = .03$), whereas time two yielded the same effect ($\eta^2 = .03$), as well in favour of the control condition. Over the six weeks, intention decreased for both groups yielding a small effect for both the GameBike group ($d = .47$), and the control group ($d = .40$). This supports what has been suggested by Rhodes and Plotnikoff (2006) that the translation of intention to behaviour may decrease over time. Another interesting point regarding intention is the lack of translation between intention and behaviour which has

been labelled the intention-behaviour gap (Sheeran, 2002). After receiving the equipment, participants' intention was high for both groups. However, this intention to use the equipment was not always translated into behaviour. In the qualitative component, participants in the GameBike group indicated that they had intended to use the bike much more in the beginning, however by the end of the six weeks, they were hardly using it. Action planning has been shown in some cases to increase behaviour when intentions are high (Rhodes et al., 2008; Scholz et al., 2008), however, in this case where participants were busy parents who had named many barriers to using the bike, planning may not have taken place. Research in action control or the translation of intentions into behaviour (Rhodes & Plotnikoff, 2006) has looked at personality characteristics as well as social cognitive constructs to determine the predictors of successful and unsuccessful intenders (e.g. Fishbein, Hennessy, Yzer, & Douglas, 2003; Rhodes, Courneya, & Jones, 2003; Rhodes & Plotnikoff). Rhodes et al. and de Bruijn and Rhodes (in press) found affective attitude to be a construct of action control suggesting that it can predict successful intenders from unsuccessful intenders. Efficacy is also thought to play an important role in action control (Rhodes & Plotnikoff) which reinforces the need for parents to understand how to use the equipment as well as feel comfortable using it. Therefore, future studies may wish to include a planning and efficacy-building component for individuals to help translate intentions into actual behaviour, as well as measure intentions across the span of the intervention rather than just at time one and again at follow-up.

Affective Attitude

This study hypothesized that affective attitude would be higher for the GameBike condition over those receiving the traditional stationary bike. Affective attitude yielded a very large effect size ($\eta^2 = .23$) in favour of the GameBike condition at time one suggesting that individuals of the GameBike group expected their experience with the equipment over the following six weeks to be more enjoyable than those receiving a traditional stationary bike. This finding is consistent with Rhodes, Warburton et al. (in press), where the effect size for affective attitude was classified as large in favour of the GameBike group and affective attitude was found to be the only TPB variable that was significantly different between groups at time one.

Affective attitude is thought to be an important factor related to exercise motivation and behaviour (Rhodes et al., 2006) because it is the immediate evaluation that individuals make while performing a specific behaviour. As well, the power of affective beliefs on behaviour is illustrated in a study by Lawton, Conner, and McEachan (2009), where affective attitude was shown to be a significantly better predictor of physical activity and exercise behaviours than instrumental attitude and that affect could predict these behaviours independent of intention. The results in this study were similar to those found by Rhodes, Warburton and colleagues (in press) where affective attitude was the only social cognitive construct that significantly differed between groups at time one yielding a very large effect (d =1.55). Intention for both groups decreased over time, however the difference between the two groups at both time one and two resulted in only small effects. It may therefore be suggested from this study that regardless of intention, affective attitude may be able to predict this type of behaviour as has also been suggested

in four other studies (Lawton et al.; Lowe et al., 2002; Rhodes et al., 2006; Rhodes, Courneya, & Jones, 2005). These findings challenge the structure of the TPB, suggesting perhaps that intentions can waver depending on immediate circumstances or the possibility of performing other more desired behaviours by illustrating that individuals lean towards affectively pleasing behaviour choices regardless of initial intention.

Rhodes, Fiala, and Conner (in press) suggest that studies which manipulate affective attitude in behavioural interventions are extremely scarce in the literature. The current study adds to the limited literature by measuring the role of affective attitude in a RCT in the physical activity domain using the GameBike which has been shown to contribute to affective expectancies. As well, the importance of basing physical activity interventions on affectively pleasing factors is reinforced.

Another hypothesis of this study was that affective attitude would decrease over the course of the six weeks. This was found to have support for both the GameBike and control groups. Again, this finding is consistent with that of Rhodes, Warburton, and colleagues (in press). It is believed that participants receiving new types of home exercise equipment initially experience enjoyment and excitement about using this equipment over the following six weeks. However, as time passes, the novel effect of this equipment begins to wear off and participants may see the equipment as being less enjoyable to use. Participants suggested that having more options for the types of games to be played may have helped, as they were only provided with three and some participants believed them to become boring with time.

Prediction of Intention and Behaviour

Two types of regression analysis were performed. The first which predicted intention from affective attitude, instrumental attitude, injunctive and descriptive norm and PBC yielded an extremely high R^2 of .66, primarily from the contributions of affective attitude and PBC. This level of explained variance is high in comparison to other studies (e.g. Rhodes et al., 2006; Lowe et al., 2002), however may be due to sampling error. While the level of variance explained from these variables is extremely high for intention, the prediction of behaviour from PBC, intention and affective attitude was relatively poor. While participants had high intentions at time one, these intentions were not translated into behaviour. One speculation as to why this may have occurred has to due to the novel nature of the equipment. Using the new equipment may have created a sense of excitement which may have translated into high intentions. These intentions had only been made for a relatively short period of time which makes them temporally unstable (Rhodes**,** de Bruijn, & Matheson, in press) and susceptible to change depending on other factors such as the weather and family events among others.

Theory of Planned Behaviour Belief Elicitation

Qualitative focus groups with each family of the GameBike group provided insight into the beliefs that these individuals held about using the GameBike. Many elicited beliefs were similar to those found by Symons Downs and Hausenblas (2005a) in a systematic review of elicited beliefs pertaining to exercise. Other beliefs listed by participants were exclusive to GameBike usage.

Behavioural beliefs were fairly consistent with those often elicited in regards to regular physical activity (Symons Downs & Hausenblas, 2005a). In terms of positive

affect, these included that the GameBike was fun and enjoyable and also contributed to stress relief. Behavioural beliefs elicited that were not also listed by Symons Downs and Hausenblas had to do with the distraction that the GameBike provided from the actual work being performed. This finding is consistent with work done with non-elite runners which suggest that by distracting oneself or tuning out, less attention is paid to physical effort, pain and fatigue (Silva & Appelbaum 1989). In relation to negative affect, similar beliefs were that it was tiring, required too much energy and was too hard. One novel belief that arose in this study was that using the equipment was frustrating. Lastly, the instrumental beliefs that were stated included that it was good for them in terms of health. This belief is similar to Symons Downs and Hausenblas. New beliefs which were elicited in relation to the GameBike and instrumental attitude had to do with the combination of video games and exercise and how it was a good way to maximize screen time. Of the behavioural beliefs elicited, 80% of them were affective in nature, while only 20% were instrumental. Traditionally, behavioural beliefs elicited are mostly instrumental, commenting on the benefits to physical and psychological health (Symons Downs & Hausenblas; French et al., 2005). This highlights the affective component of the GameBike, as even the negative beliefs (e.g. it is frustrating) were affective in nature.

There were some similarities in the common barriers and facilitators elicited in this study to those listed by Symons Downs and Hausenblas (2005a). The primary facilitating factor listed was convenience. No other facilitating factors were listed. In terms of barriers, traditional barriers similar to findings by Symons Downs and Hausenblas were found such as lack of time, fatigue, laziness and other commitments such as childcare. Because the GameBike is a novel experience for all individuals

interviewed, a number of beliefs exclusive to the GameBike were raised. For children, the primary barrier was the size of the bike. This was a major barrier to children as it almost completely inhibited them from using the equipment. Also in relation to the bike, participants stated that the level of the handlebars should be adjustable to help with the sizing issue. It was also noted that the bike itself was awkward and cumbersome to move and for those families with less space in their home, it stuck out like a sore thumb in the living room. Other barriers related to the bike were lack of game variety, and the experience of a delay between the bike and the game which made it so that the individual playing was almost always last in the races. Another interestingly unique barrier listed was good weather. While Symons Downs and Hausenblas state that poor weather is a barrier and good weather is a facilitator to exercise, participants in this study noted that they used the bike fewer times because of the good weather during the data collection period. Further GameBike studies may wish to use these beliefs to aid in questionnaire construction as they are specific to the behaviour being researched. See Table 8.

Table 8

Elicited Beliefs by GameBike Participants

Theme	Subtheme	Elicited belief
Attitude	Positive affect	It is fun.
		It is enjoyable.
		Helps with stress relief.
		It provides distraction from the work being performed.
	Negative affect	It is tiring.
		It requires too much energy.
		It is too hard.
		It is frustrating.
	Instrumental attitude	It is good for my health.
		It is a good combination of video games and exercise.
PBC	General barriers	Lack of time.
		Fatigue.
		Laziness.
		I have other commitments around the house and with children.
	Bike as a barrier	It is too big for children.
		The level of the handlebars should be adjustable.
		The bike is cumbersome to move.
		The bike takes up a lot of space.
		Lack of game variety.
		Delay between the bike and game.
	Weather	The weather was good.
	Benefits	It is convenient.

Limitations

As with all studies, this study has its own set of limitations. First, the majority of data collection occurred in the late spring and summer when there was exceptionally beautiful weather and a record amount of sunshine (Bell, 2009). As a result, usage may have been decreased because families were spending more time outside. Random assignment of participants made it so that both groups were equal at time one; however, because usage was low, there was little variability in behaviour which may have made it difficult to detect any differences between groups. In the qualitative findings, participants suggested that when they did have time for activity, that they would rather perform it as a family outside, rather than ride the bike indoors. Although qualitative findings were not obtained from the control group, it may be a fair assumption that those families receiving a traditional stationary bike would also have spent more time outdoors as was suggested in the focus groups with the GameBike group. Participants suggested that they would likely use the equipment more during the fall and winter when there was more inclement weather. Future studies should collect data in the fall and winter, which can be assumed, would increase time indoors and ultimately usage. As a result, variability would increase and differences between groups would be easier to detect.

A second limitation was the equipment itself. The age group targeted within this study was too young, as some children were not able to use the bike because they were too small. Even some of the children who fit the bike were not able to produce enough power in their cycling efforts in order to influence the game. As well, as can be seen in the equipment usage logs, parents were always present in the room when the children were using the equipment. This suggests, and is supported by comments from the

participants that the children could not use the equipment unsupervised, as they often needed help both setting up and using it. Another comment from participants about the bike was the delay between the bike and the game on the television. They became frustrated because they were working so hard and the game took a few seconds to respond, which made it nearly impossible to win any of the races. Even after adjusting the sensitivity controls on the bike's controller, they stated that the problem still was not fixed.

Thirdly, usage of the equipment was made through self-report. At the time that follow-up measures were performed and the equipment was collected, some participants commented that they sometimes forgot to write down certain bouts of usage. Because of this, usage of the equipment could be underreported which could alter the results of the study, depending on how many bouts were forgotten about. Despite this, other more objective means of measuring physical activity may not be suitable, as pedometers are not valid on bicycles and while accelerometers are, it would be impossible to distinguish bike use from other daily activities without the participant keeping a log. The only better method may be direct observation as was used by Warburton, Bredin et al. (2007) as well as Rhodes, Warburton et al. (in press) which found similar results as this study's logs. This suggests the equipment usage log may be a validated as a measurement tool.

Another limitation to this study surrounds the time-frame for data collection. Data collection from each family lasted for six weeks, which is the same duration of all other GameBike studies. Annesi and Mazas (1997) measured participants' usage across fourteen weeks in a private fitness centre. Lengthening the data collection period in the

home-setting may be beneficial to understanding if adherence changes in the longer-term as families become more accustomed to having equipment at home.

Social cognitive measures in this study were only administered to the parents in the study. Measuring children's cognitions toward this type of exercise equipment would be beneficial in terms of assessing affective attitude, as well as intention to predict behaviour. That being said, the wording of these measures would need to be altered and piloted with children in the targeted age range to ensure that they fully understand the questions being asked. A researcher would also likely need to go through the questionnaire with the child while they are completing it.

Lastly, data in this study was analyzed treating each individual as a separate case. However, in reality, participants were part of families and therefore, some bias may be created by analyzing each individual separately. Correlations between parents and children for usage were low and insignificant (r = .25 for the GameBike group, r = -.32 for the control group) which can be added to the inconclusive findings in this area as found by Gustafson and Rhodes (2006). However, correlations between mothers and fathers for affective attitude were high when the entire sample was analyzed together (r = .72, p = .01), although it differed when the two groups were analyzed separately (r = .08, p =.88 for the GameBike group; r = .87, p= .03 for the control group). Because of these inconclusive findings, further research may wish to analyze families using cluster analysis and hierarchical linear modeling to predict behaviour.

Conclusions and Future Direction

The aim of this study was to extend the literature surrounding interactive stationary bikes by testing a new population and data collection setting. By transferring

the data collection setting to the home, the ecological validity of GameBike use was tested. As well, the control condition was extended from previous GameBike studies where rather than self-selecting music to listen to while biking, participants used the control bike while watching television.

The findings of this study were fairly consistent with the previous findings of other GameBike studies (Warburton, Bredin et al., 2007; Rhodes, Warburton et al., in press). As with these studies, GameBike usage was found to be higher than control conditions, and also decreased far less than the control condition over the course of the intervention. Overall physical activity levels of the GameBike group participants increased through the six weeks yielding a small effect. Because of these findings as well as the findings which suggest that usage of the GameBike in the latter portion of the intervention was higher and the novelty decreased less over six weeks, it may be concluded that the GameBike is an effective piece of home exercise equipment. As well, affective attitude was also the only construct of the TPB that was significantly different across the two groups which highlights the importance of enjoyment in the creation of physical activity interventions.

Cateye, the manufacturer of the GameBike has two other models of the GameBike which may be more enjoyable for individuals to use. The first is a recumbent bike and the second is a pro version of the bike which was given to participants in this study. These bikes have a computer screen which allows the individual to make a program for their usage (e.g. hills or intervals) and receive output including heart rate. These bikes may be more comfortable to use as well, because they are more

technologically advanced than the model used in this study, and the delay between the bike and the games may be resolved.

Future studies in the area of interactive video games should examine usage of the GameBike among other age groups within the family (e.g. adolescents and teenagers) as the age group of the children in this study were clearly too young as some of them were not able to properly make use of the equipment. Individuals between the ages of eight and sixteen may have greater success using the bike as they are more size appropriate and have the strength to pedal the bike to control the game. As well, individuals of this age group are target users for video games and may therefore be interested in the equipment. Other studies should provide seasonal comparisons for home usage which may determine whether data collection in the summer months was a real limitation to this study. Use of the newer models of the GameBike in research may be beneficial in terms of the technological advancement and comfort of these new bikes. As well, a large proportion of the effect sizes in this study were in the medium to large range, which would suggest that significance may be found if the sample size was increased. This emphasizes the need to conduct larger scale trials in this area of research.

To conclude, this study has extended the emerging research surrounding interactive video games. From the results, it can be concluded that while the equipment may not be suitable for young children, it still may successful with parents in the home. The GameBike has been shown to have greater levels of affective attitude as well as create a lesser decline in usage than traditional equipment. Having extended the research setting to the home, these results indicate that interactive video games may be viable for health promotion initiatives within the community.

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Appendix A: CONSORT Statement Checklist

Table 9

CONSORT Checklist

Paper section and topic	Item	Descriptor	Reported on page #
Title and Abstract	1	How participants were allocated to interventions (*e.g.*, "random allocation", "randomized", or "randomly assigned").	iii
Introduction (Background)	2	Scientific background and explanation of rationale.	1-8
Methods			
Participants	3	Eligibility criteria for participants and the settings and locations where the data were collected.	24
Interventions	4	Precise details of the interventions intended for each group and how and when they were actually administered.	25-26
Objectives	5	Specific objectives and hypotheses.	6-7
Outcomes	6	Clearly defined primary and secondary outcome measures and, when applicable, any methods used to enhance the quality of measurements (*e.g.*, multiple observations, training of assessors).	6
Sample Size	7	How sample size was determined and, when applicable, explanation of any interim analyses and stopping rules.	25
Randomization (Sequence generation)	8	Method used to generate the random allocation sequence, including details of any restrictions (*e.g.*, blocking, stratification)	26-27
Randomization (Allocation concealment)	9	Method used to implement the random allocation sequence (*e.g.*, numbered containers or central telephone), clarifying whether the sequence was concealed until interventions were assigned.	-
Randomization (Implementation)	10	Who generated the allocation sequence, who enrolled participants, and who assigned participants to their groups.	-
Blinding (Masking)	11	Whether or not participants, those administering the interventions, and those assessing the outcomes were blinded to group assignment. If done, how the success of blinding was	-

		evaluated.	
Statistical methods	12	Statistical methods used to compare groups for primary outcome(s); Methods for additional analyses, such as subgroup analyses and adjusted analyses.	31-36
Results			
Participant flow	13	Flow of participants through each stage (a diagram is strongly recommended). Specifically, for each group report the numbers of participants randomly assigned, receiving intended treatment, completing the study protocol, and analyzed for the primary outcome. Describe protocol deviations from study as planned, together with reasons.	38
Recruitment	14	Dates defining the periods of recruitment and follow-up.	24-25
Baseline data	15	Baseline demographic and clinical characteristics of each group.	41
Numbers analyzed	16	Number of participants (denominator) in each group included in each analysis and whether the analysis was by "intention-to-treat". State the results in absolute numbers when feasible (*e.g.*, 10/20, not 50%).	37
Outcomes and estimation	17	For each primary and secondary outcome, a summary of results for each group, and the estimated effect size and its precision (*e.g.*, 95% confidence interval).	44-59
Ancillary analyses	18	Address multiplicity by reporting any other analyses performed, including subgroup analyses and adjusted analyses, indicating those pre-specified and those exploratory.	51-53
Adverse events	19	All important adverse events or side effects in each intervention group.	-
Discussion			
Interpretation	20	Interpretation of the results, taking into account study hypotheses, sources of potential bias or imprecision and the dangers associated with multiplicity of analyses and outcomes.	60-72
Generalizability	21	Generalizability (external validity) of the trial findings.	75-77
Overall evidence	22	General interpretation of the results in the context of current evidence.	77

(Moher, Schulz, & Altman, 2001)

Appendix B: Timeline

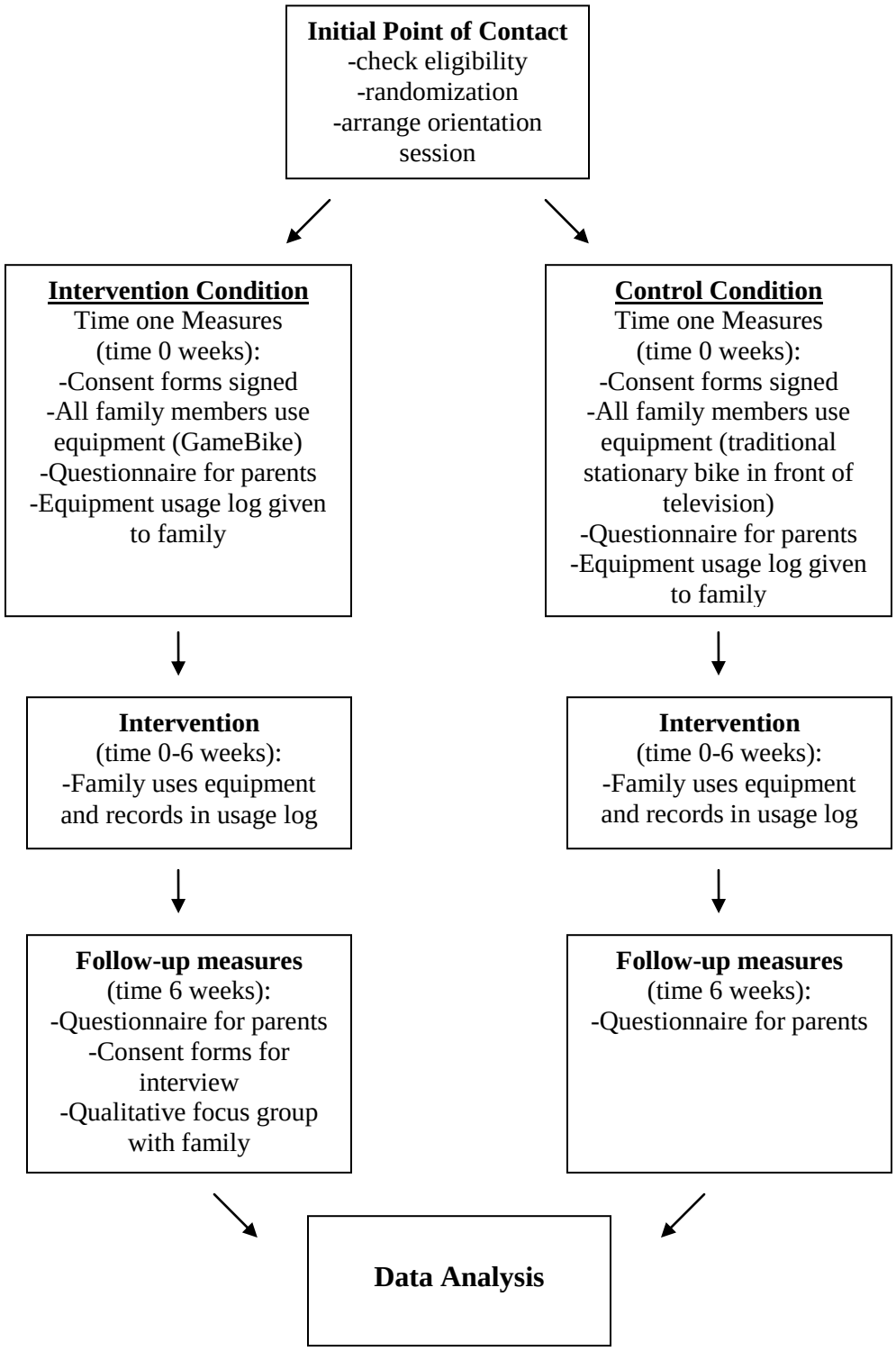

Figure 7. Timeline for study.

Appendix C: Notice of Research

Notice of Research

"Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: A Pilot Study"

My name is Rachel Mark and I am a Master's candidate in the School of Exercise Science, Physical and Health Education at the University of Victoria. As a graduate student, I am required to conduct a research study as part of my degree program requirements. The research study that I am conducting is entitled "Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: A Pilot Study." I am looking for families who would like to help test the effectiveness of using interactive video game equipment for physical activity. Potential participants must be over 18 years old, in a married or common-law relationship and have at least one child between the ages of four and six. Participants will be entered into a draw to win a family membership at Commonwealth Place. As well, please note that families do not need to own a gaming console to participate.

Your involvement in this research is very important, since despite the known benefits of physical activity for both adults and children, over half of Canadians are not active enough to reap these benefits. Current physical activity interventions have had only small successes and current research suggests that physical activity opportunities should be enjoyable, physically pleasant and convenient. Research using interactive gaming equipment is minimal, but studies do show positive health benefits and increased enjoyment over traditional exercise equipment. This research builds upon past research by providing equipment use for the entire family in the home-setting, thereby providing convenient ways for the entire family to increase physical activity.

If you volunteer to participate in this research, you will be randomized to one of two conditions. In one group you will receive a GameBike, which is a stationary bike which links into a Playstation. The second group will receive a traditional stationary bike, which you will place in front of a television. The researcher will schedule an orientation session with you and your family, where the equipment will be brought to your house, set up and you and your family will be shown how to use it. We will review the consent forms and I will answer any questions. After all family members have had a chance to use the equipment you and your partner will each complete a brief questionnaire. The equipment will remain in your home for six weeks, and I ask that you complete the usage log you will be given each time that every family member uses it. After six weeks, I will perform a brief interview with each family member about your experience using the equipment and each parent will complete a follow-up questionnaire.

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 472-5488 or rsmark@uvic.ca or my supervisor, Dr. Ryan Rhodes, at 721-8384 for further information.

Appendix D: Phone Scripts

Phone Script for Point of Contact & Screening:

Thank you for your interest in our study. My name is Rachel Mark and I am a graduate student here at the University of Victoria. This research study is required of me in order to complete my degree program for a Master's in Exercise Science, Physical and Health Education. 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 families into one of two conditions: the first will receive an interactive GameBike which is a stationary bike linking into a Playstation, and the second will receive a traditional stationary bike to be placed in front of the television. Before I go on there are a few questions I must ask you to ensure that you are eligible to participate in the study.

1) Are you currently in a partnered relationship (such as common-law or married)?
   -Must answer yes
2) Are you and your partner over the age of 18?
   -Must answer yes
3) Do you have any children?
   -Must have at least one child between the ages of four and six.
4) Are you currently accumulating approximately 4 bouts of moderate to vigorous intensity physical activity each week?
   -Must answer no

<u>If the participant meets all of the above inclusion criteria:</u>
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 two groups. In one group you will receive a GameBike, which is a stationary bike which links into a Playstation. Cycling on the equipment propels the characters of the game which you are playing. If you are randomized to the second group, you will receive a traditional stationary bike, which I will ask that you place in front of a television.

I will schedule an orientation session with you, where I will bring the equipment to your house, set it up and show you and your family members how to use it. At this time we will review the consent forms and I can answer any questions that you have. After all family members have had a chance to try using the equipment, I will ask that you and your partner complete a questionnaire which will take approximately 10-15 minutes. The equipment will remain in your home for six weeks, and I ask that you complete the usage log you will be given each time that every family member uses it. After the six weeks, I will return to your home and perform a brief interview with each family member if you were in the GameBike group about your experience using the equipment. At this time, I will also ask that both parents complete a follow-up questionnaire.

May we please set up an orientation when all family members are available? May I please have your address so that I can bring the equipment at the orientation session? As well, may I get your phone number and email 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 does not meet the inclusion criteria: Unfortunately it is important that all participants meet these four inclusion criteria, and ___ means that I can't include you in the study at this time. 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 Withdraw Form

University of Victoria | British Columbia Canada

Participant Consent Form
Adults

"Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: A Pilot Study"

You are being invited to participate in a study entitled "Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: A Pilot Study" that is being conducted by Rachel Mark. As a Graduate student, I am required to conduct research as part of the requirements for a Master's degree in Exercise Science, Physical and Health Education. 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 of this study is to build upon previous research by examining the motivation underlying the use of interactive exercise equipment in comparison to a traditional stationary bike placed in front of the television. It will look at these differences among parents, and will track usage of the equipment of the entire family.

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 is associated with improvements in numerous other disease states, such as cardiovascular disease, cancer, type 2 diabetes mellitus, depression, and overall quality of life but recent Canadian statistics indicate that less than half of Canadians are active enough to get these benefits. Current physical activity interventions have had only small successes and current research suggests that physical activity opportunities should be enjoyable, physically pleasant and convenient. Research using interactive gaming equipment is minimal, but studies do show positive health benefits and increased enjoyment over traditional exercise equipment. This research builds upon past research by providing equipment use for the entire family in the home-setting, thereby providing convenient ways for the entire family to increase physical activity.

WHAT DO PARTICIPANTS HAVE TO DO? If you volunteer to participate in this research, you will be randomized to one of two conditions. One group you will receive a GameBike, which is a stationary bike which links into a Playstation. The second group will receive a traditional stationary bike, which you will place in front of a television. The researcher will schedule an orientation session with you and your family, where I will bring the equipment to your house, set it up and show you and your family members how to use it. After all family members have had a chance to use the equipment; you will complete a brief questionnaire. The equipment will remain in your home for six weeks, and I ask that you complete the usage log you will be given each time that every family member uses it. After six weeks, I will perform a brief interview with each family member about your experience using the equipment and each parent will complete a follow-up questionnaire.

WHAT ARE THE BENEFITS OF PARTICIPATING? This is an exciting research project because very little research has been conducted in the past which looks at this topic. As a participant, you will be given a piece of exercise equipment to use in your home for six weeks

providing a convenient and enjoyable means of physical activity. All families will also be entered into a draw to win a one year family membership at Commonwealth place.

WHAT WILL HAPPEN WITH MY DATA? All information will be kept confidential, and data will be stored in a secure and locked location at the University of Victoria. All results produced will be from group data, and no individuals will be identified. Interviews will be audio taped and transcribed, however all names and identifying characteristics will be withdrawn from the transcripts. The transcripts will be analyzed for common themes and will kept as group information. No individual's transcript will be separated from the rest of the group. **Participants may withdraw without explanation or consequence at any time during the study.**

You can request further information regarding this study by contacting Rachel Mark at 472-5488 or rsmark@uvic.ca or Dr. Ryan Rhodes at rhodes@uvic.ca 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 researcher.

Name of Participant	Signature	Date

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

University of Victoria | British Columbia Canada

Verbal Consent Form script for children

"Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: A Pilot Study"

You are being invited to participate in a study entitled "Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: A Pilot Study."

If you participate in this study, I will be looking at how much you use this exercise equipment and if you enjoy using it. If you and your family participate in this study, you will receive a new piece of exercise equipment in your home for you and your family to use. After I bring the equipment to your house and show you how to use it, it will stay there for six weeks. While it is there I ask that you or your parents fill out the usage log each time that you use the equipment. After six weeks, I will sit down with you and talk briefly about your experience with the equipment.

Everything that you tell me will be kept confidential, which means that no one else will be told what you say. If you don't want to participate anymore, you do not have to and I will not ask you why you don't want to anymore.

Do you understand everything that I have said? Do you have any questions? Do you agree to participate?

University of Victoria | British Columbia Canada

Participant Consent Form
Interviews

Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: A Pilot Study

FOCUS GROUP CONSENT FORM

WHAT WILL HAPPEN WITH MY DATA? All information will be kept confidential. Focus groups will be audio taped and transcribed, however all names and identifying characteristics will be withdrawn from the transcripts. The transcripts will be analyzed for common themes and will kept as group information. No individual's transcript will be separated from the rest of the group. **Participants may withdraw without explanation or consequence at any time during the study**. Because all names and identifying characteristics will be removed from the transcripts, it is logistically impossible to remove individual data from the transcript if you should choose to withdraw. However, should you choose to withdraw, your personal data will never be associated with your name and personal identity.

CONFIDENTIALITY: The information you contribute for this study will be kept anonymous. Anything shared of a personal nature within the focus group is to be maintained confidential by the researcher. Your information will be kept private, however, because we will be meeting in person for the focus group your responses will not be anonymous to the researcher or your family members.

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

Consent For Use of Data Following Participant Withdrawal:

I agree to allow Rachel Mark, the principle investigator of in the "**Testing the Effectiveness of Interactive Game Bikes on Physical Activity Motivation among Parents and Young Children in the Home: 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 my thesis and scholarly journals.

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

Appendix F: Questionnaires, Equipment Usage Log, & Interview Questions

Participant Number:_____

Date:_____

"Testing the Effectiveness of Interactive Game Bikes on Parents and Young Children in the Home: A Pilot Study"

Stationary Exercise Bike 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:

Rachel Mark, 472-5488, rsmark@uvic.ca

Dr. Ryan Rhodes (supervisor), 721-8384, rhodes@uvic.ca

Demographics

1) 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 occupation? _____

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

$_____ per year

8) Height: _____m _____cm **OR** _____feet _____inches

9) Weight: _____ kg **OR** _____lbs

Health Status

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

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

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

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 □

Gaming History

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

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

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

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

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

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

Stationary Bike Usage

The following questions ask you to rate how you feel about exercising using a stationary bike in front of the television over the next 6 weeks at home. We define regular exercise on the bike as accumulating at least 30 minutes of activity, at least at a moderate level of intensity (i.e., slight perspiration), 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 about exercising on a stationary bike in front of the television over the next 6 weeks.

For me, exercising on a stationary bike in front of the television over the next 6 weeks at home would be:

1.	1	2	3	4	5	6	7
	extremely enjoyable	moderately enjoyable	slightly enjoyable	neutral	slightly unenjoyable	moderately unenjoyable	extremely unenjoyable
2.	1	2	3	4	5	6	7
	extremely useful	moderately useful	slightly useful	neutral	slightly useless	moderately useless	extremely useless
3.	1	2	3	4	5	6	7
	extremely pleasant	moderately pleasant	slightly pleasant	neutral	slightly unpleasant	moderately unpleasant	extremely unpleasant
4.	1	2	3	4	5	6	7
	extremely wise	moderately wise	slightly wise	neutral	slightly unwise	moderately unwise	extremely unwise
5.	1	2	3	4	5	6	7
	extremely exciting	moderately exciting	slightly exciting	neutral	slightly boring	moderately boring	extremely boring
6.	1	2	3	4	5	6	7
	extremely beneficial	moderately beneficial	slightly beneficial	neutral	slightly harmful	moderately harmful	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 using stationary bike in front of the television over the next 6 weeks at home. 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 <u>your</u> social network.

1. Most people who are important to me would want me to engage in regular exercise on a stationary bike in front of the television over the next 6 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 on a stationary bike in front of the television over the next 6 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 on a stationary bike in front of the television over the next 6 weeks themselves.

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

The following questions concern how much control you believe you have over engaging in regular exercise on a stationary bike in front of the television at home over the next 6 weeks. Remember, we define regular exercise on the bike <u>as accumulating at least 30 minutes of activity, at least at a moderate level of intensity (i.e., slight perspiration), 4 times per week.</u> Please read the questions carefully and circle the number that best represents your beliefs.

1. Exercising on a stationary bike in front of the television over the next 6 weeks is under my control <u>if I really wanted to do so</u>.

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 on a stationary bike in front of the television over the next 6 weeks if you really wanted to?

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

3. Engaging in regular exercise on a stationary bike in front of the television over the next 6 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 on a stationary bike in front of the television at home over the next 6 weeks. Please circle the answer that best represents you.

1. I plan to engage in regular exercise on a stationary bike in front of the television over the next 6 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 on a stationary bike in front of the television over the next 6 weeks.

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

Leisure Time

1. Outside of work and my household obligations, on my typical day, I have an average of _____ hours of leisure time.

Personal and Family-Based Leisure Time Physical Activity

This part of the questionnaire addresses your own leisure time physical activity habits. How many times on average per week do you do physical activity and what is the duration of these activities?

When answering these questions please:

⇒ Only count physical activity that was done during free time (e.g. not occupation or housework).
⇒ Note that the main difference between the three categories is the intensity of the physical activity.
⇒ Please write the average frequency on the first line and the average duration on the second line.

	Times Per Week	Average Duration Per Session (min)
STRENUOUS PHYSICAL ACTIVITY (Heart beats rapidly, sweating) e.g. sports, running, jogging, hockey, squash, basketball, judo, vigorous swimming	_____	_____
MODERATE PHYSICAL ACTIVITY (Not exhausting, light perspiration) e.g. baseball, tennis, bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing, brisk walk	_____	_____
MILD PHYSICAL ACTIVITY (Minimal effort, no perspiration) e.g. tai chi, yoga, bowling, casual walk	_____	_____

How many times on average per week did you do family based physical activity and what was the duration of these activities?

	Times Per Week	Average Duration Per Session (min)
FORMAL OR STRUCTURED ACTIVITY e.g. swimming class, gymnastics, kinder-gym, skating, soccer etc.	_____	_____
INFORMAL OR UNSTRUCTURED ACTIVITY family walk, family bike ride, playing in the park, kicking a ball around in the backyard etc.	_____	_____

Thank you for completing this questionnaire!!

Participant Number:_____

Date:_____

"Testing the Effectiveness of Interactive Game Bikes on Parents and Young Children in the Home: A Pilot Study"

GameBike 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:

Rachel Mark, 472-5488, rsmark@uvic.ca

Dr. Ryan Rhodes (supervisor), 721-8384, rhodes@uvic.ca

Demographics

1) 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 occupation? _____

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

$_____ per year

8) Height: _____m _____cm **OR** _____feet _____inches

9) Weight: _____ kg **OR** _____lbs

Health Status

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

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

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

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 □

Gaming History

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

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

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

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

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

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

GameBike Usage

The following questions ask you to rate how you feel about exercising using an interactive video GameBike over the next 6 weeks at home. We define regular exercise on the bike as accumulating at least 30 minutes of activity, at least at a moderate level of intensity (i.e., slight perspiration), 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 about exercising on the GameBike over the next 6 weeks.

For me, exercising on a GameBike over the next 6 weeks at home would be:

1.	1	2	3	4	5	6	7
	extremely enjoyable	moderately enjoyable	slightly enjoyable	neutral	slightly unenjoyable	moderately unenjoyable	extremely unenjoyable
2.	1	2	3	4	5	6	7
	extremely useful	moderately useful	slightly useful	neutral	slightly useless	moderately useless	extremely useless
3.	1	2	3	4	5	6	7
	extremely pleasant	moderately pleasant	slightly pleasant	neutral	slightly unpleasant	moderately unpleasant	extremely unpleasant
4.	1	2	3	4	5	6	7
	extremely wise	moderately wise	slightly wise	neutral	slightly unwise	moderately unwise	extremely unwise
5.	1	2	3	4	5	6	7
	extremely exciting	moderately exciting	slightly exciting	neutral	slightly boring	moderately boring	extremely boring
6.	1	2	3	4	5	6	7
	extremely beneficial	moderately beneficial	slightly beneficial	neutral	slightly harmful	moderately harmful	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 using an interactive video GameBike over the next 6 weeks at home. 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 <u>your</u> social network.

1. Most people who are important to me would want me to engage in regular exercise on a GameBike over the next 6 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 on a GameBike over the next 6 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 on a GameBike over the next 6 weeks themselves.

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

The following questions concern how much control you believe you have over engaging in regular exercise on a GameBike at home over the next 6 weeks. Remember, we define regular exercise on the bike <u>as accumulating at least 30 minutes of activity, at least at a moderate level of intensity (i.e., slight perspiration), 4 times per week.</u> Please read the questions carefully and circle the number that best represents your beliefs.

2. Exercising on a GameBike over the next 6 weeks is under my control <u>if I really wanted to do so</u>.

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 on a GameBike over the next 6 weeks if you really wanted to?

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

3. Engaging in regular exercise on a GameBike over the next 6 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 on a GameBike at home over the next 6 weeks. Please circle the answer that best represents you.

3. I plan to engage in regular exercise on a GameBike over the next 6 weeks.

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

4. I intend to engage in regular exercise on a GameBike over the next 6 weeks.

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

Leisure Time

1. Outside of work and my household obligations, on my typical day, I have an average of _____ hours of leisure time.

Personal and Family-Based Leisure Time Physical Activity

This part of the questionnaire addresses your own leisure time physical activity habits. How many times on average per week do you do physical activity and what is the duration of these activities?

When answering these questions please:

⇒ Only count physical activity that was done during free time (e.g. not occupation or housework).

⇒ Note that the main difference between the three categories is the intensity of the physical activity.

⇒ Please write the average frequency on the first line and the average duration on the second line.

	Times Per Week	Average Duration Per Session (min)
STRENUOUS PHYSICAL ACTIVITY (Heart beats rapidly, sweating) e.g. sports, running, jogging, hockey, squash, basketball, judo, vigorous swimming	_____	_____
MODERATE PHYSICAL ACTIVITY (Not exhausting, light perspiration) e.g. baseball, tennis, bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing, brisk walk	_____	_____
MILD PHYSICAL ACTIVITY (Minimal effort, no perspiration) e.g. tai chi, yoga, bowling, casual walk	_____	_____

How many times on average per week did you do family based physical activity and what was the duration of these activities?

	Times Per Week	Average Duration Per Session (min)
FORMAL OR STRUCTURED ACTIVITY e.g. swimming class, gymnastics, kinder-gym, skating, soccer etc.	_____	_____
INFORMAL OR UNSTRUCTURED ACTIVITY family walk, family bike ride, playing in the park, kicking a ball around in the backyard etc.	_____	_____

Thank you for completing this questionnaire!!

Example page from the equipment usage log

Name of bike user	Date	Time	Duration of Equipment Usage	Who was in the house while using equipment?	Who was in the room while using equipment?	Comments

Interview Questions for GameBike Group

1) What do you feel are the benefits of using the GameBike?
   Probes:
   -Was it enjoyable to use?
   -What would have made it more enjoyable?
   -How did you find the intensity of the bike while using the games?

2) How often did you use the GameBike over the past six weeks?

3) What do you perceive as barriers to using the GameBike?
   Probes:
   -What didn't you like?
   -What would have made you use it more?

4) Do you feel that some family members used the GameBike more than others?

5) Do you think that the GameBike is a valuable piece of home exercise equipment?

6) Is there anything else that you would like to add that you feel we have missed?