ASSESSING THE VIABILITY OF MEDIATED EXERCISE COMPANIONS IN MOTIVATING FUTURE EXERCISE INTENTIONS: AN EXPERIMENTAL INVESTIGATION OF TRADITIONAL AND ADVANCED FORMS OF EXERCISE MEDIA

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ABSTRACT

Research has generally shown that video games can be effective at teaching and persuading individuals engage in certain behaviors and outcomes (e.g., Baranowski, Buday, Thompson, & Baranowski, 2008; Lee, Peng, & Park, 2009). Since 2006, Nintendo Wii has dominated the console video game market, primarily because of its motion-sensing technology. Additionally, the release of Wii has fueled one of the fastest growing trends in the game industry known as exercise gaming (exergaming). The potential for exergames to encourage and promote healthy behavior is promising, but there is little empirical support for such claims. In order to better understand user experiences with exercise video games, this research examined the effects of mediated exercise formats (exercise video game v. exercise video) on a number of different cognitive and affective mechanisms, and users’ future behavioral intentions toward exercise or future use of a particular mediated exercise format. Results indicated that playing an exergame was significantly related to feelings of increased performance feedback, and that performance feedback was significantly related to both feelings of presence and competence. Both presence and competence predicted enjoyment, and enjoyment was related to behavioral intentions for future use of an exergame. Furthermore, exploratory analyses revealed that intentions to use an exergame were related to intentions for future exercise. This study provides an understanding of how specific technologies of exergames contribute to their effectiveness. Theoretical and practical implications of this study are discussed, as well as opportunities for future research in this area.
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Chapter 1

Introduction

Since its initial release in 2006, Nintendo Wii has remained the top-selling video game system in the world, outselling both Xbox 360 and Playstation 3 (PS3) (Walton, 2010). Although Xbox 360 and PS3 are more powerful systems, the success of Wii is heavily attributable to the console’s use of non-traditional game controls (Hartley, 2007). The Nintendo Wii Remote, sometimes referred to as the “Wiimote,” is a wand style motion-sensing controller which allows players to impact the gaming environment through gesture recognition. The Wiimote invites players to perform actual physical movements which are then rendered into the game environment, often creating a feeling that gamers are actually performing real-life activities. Perhaps the best example of how this technology works is most evident in Wii Sports games, which allow players to utilize the motion-sensing capabilities of the controller in order to emulate real-life sports actions, such as swinging a tennis racket or throwing a bowling ball (Berry, 2007).

In July of 2007, Nintendo released the *Wii Fit* video game with a companion controller known as the Wii Balance Board. Much like the Wiimote, the Balance Board utilized motion-sensing technology and was specifically designed for exercise video games. Features of the Balance Board include the ability to measure weight, accurately project balance, and recreate real-life leg movements and activities into the game environment. The technologies of the Wiimote and the Balance Board together exemplify the idea of full body motion control in gaming and have given rise to one of largest growing sectors of the game industry, which are games that promote physical activity (Hobson, 2008).
Over the past 20 years, researchers have learned much about the effects of video games. Although a diversity of questions have been explored, the field itself has been dominated by studies focusing on negative aspects of gaming (Lee, Peng, & Park, 2009). Specifically, investigations into the social and psychological impacts of gaming have shown linkages between playing video games and aggression (Anderson, 2004; Sherry, 2001), addiction (Lee & Peng, 2006), and other anti-social behaviors (Gentile, Lynch, Linder, & Walsh, 2004). Though these questions will likely remain important in the future, the fact is that console versions of serious exercise games have become increasingly popular. At the very least, the rise in popularity of these games should serve as a reminder that pro-social effects of gaming are just as important as the consequences, and are currently in need of research attention.

With the lives of average individuals becoming increasingly inundated with different forms of media (e.g., television, video games, and the Internet), researchers have speculated that media use (a largely sedentary activity) may be causing or exacerbating inactive lifestyles (Vandewater, Shim, & Caplovitz, 2004; Warner, 2004). However, this new wave of video games promises to keep users active, entertained, and healthy. Exercise games (commonly known as “exergames”) are a relatively new type of video game that encourages players to engage in mild to intensive types of physical activity (Bogost, 2007). Although little research has been conducted to examine the effectiveness of these games, their utility in promoting exercise, physical activity, and healthy life outcomes is promising. Despite popular press reports and weight loss success stories reported by exergamers on various internet websites, the potential health benefits of games like “Wii Fit” is an anecdotally strong argument which currently lacks empirical support. While a diversity of research on this topic is starting to emerge, basic
questions regarding user experiences, motivation to play, and the effectiveness of exergames are in need of research attention.

Exergames themselves contain many message characteristics and technological features which should be well-suited for promoting physical activity and healthy lifestyle habits. Immersion, attention-maintaining properties of story, interactivity, tailoring, and goal-setting are some of the key features which make health-related video games successful at bringing about behavioral change (Baranowski, Buday, Thompson, & Baranowski, 2008). Although this list of features is by no means comprehensive, it is prototypical. When investigating the utility of health games, scholars are generally interested in understanding the linear relationship between the playing a video game and some dependent measures which is actual behavior change or something that is akin to that effect (e.g., leaning, behavior intent, and attitudes). However, because games are a sophisticated technology, the playing experience may be best understood by considering individual differences of users along with formal technological features.

The purpose of this research is to expand upon the idea of health gaming in the broader context of media effects research. Drawing on theories of behavioral change (social cognitive theory and theory of reasoned action/planned behavior) and motivation (self-determination theory) as well as research in the areas of enjoyment, technology, and gaming, this investigation is broadly focused on understanding how psychological and technological factors of exergames impact whether these games are effective at keeping players engaged and producing exercise behavior. The literature review will start with discussing the growing problem of obesity and lack of exercise in the United States. After this, video games and their potential impact on learning, attitudes, and behavioral change will be addressed. Finally, prominent theoretical frameworks will be reviewed, and hypotheses and research questions will be offered.
Literature Review

Gaming for Health Purposes

During the mid to late 1990s the first studies focused on the impacts of video games for health-related behavior change began to appear. Even though there has been considerably less research on games and health than any other area of media effects, researchers generally believe that serious games are an effective channel for persuading individuals toward positive health outcomes (Baranowski, et al., 2008; Lee et al., 2009). Playing video games is a fun, engaging, and enjoyment-laden activity which is why researchers have speculated that video games may actually be the most effective channel for bringing about health-related behavior change in certain populations (Lieberman, 2006). In a recent meta-analysis of 27 published articles focusing on the effectiveness of health games, Baranowski et al. (2008) found that most (93%) provided evidence that video games can positively impact learning, behavioral, and attitude changes, and even weight management. Although many studies have been conducted to assess whether games can be effective at teaching and changing behavior, relatively few have been driven by purely theoretical questions (Ritterfeld & Weber, 2006). Instead, the norm has been to design interactive games based on theoretical findings from psychology and other disciplines, and then to subsequently test the game in order see if it effective at facilitating whatever attitude or behavior a particular researcher is interested in (Lieberman, 2006). Although this type of research is informative and important, it provides little insight into user experiences with commercially available video games that focus on improving health.

Video games have been used to teach children how to care for diabetes (Brown, Lieberman, Gemeny, Fan, Wilson, & Pasta, 1997) and have been successful in educating college-aged adults about how to eat healthier (Peng, 2009). In an effort to teach youth hockey
players about concussion symptoms, Goodman, Bradely, Paras, Williamson, and Bizzochi (2006) used a video game called “symptom shock” and found that even though the game contained only implicit messages about concussions, it was effective in educating kids about the risks associated with this injury. These are just a few examples of how video games have been used to teach and shape attitudes in health contexts. Although each of these studies shows that video games can positively impact health-related attitudes, the question of whether games can change actual behavior or behavioral intentions remains tentative at best. Even though treatment groups often show improvement in their knowledge of pressing health issues after playing a video game in clinical settings, deciphering whether that knowledge gain leads to real-life action or performance of behaviors is not as clear cut. In fact, obtaining variability in behavioral measures is often one of the most elusive aspects of health driven video games research (Lee et al., 2009). Whereas most studies on positive aspects of gaming have sought to understand if games can lead to knowledge gain or certain behaviors outside the gaming environment, this study will focus on exergames which require people to exercise in order to engage with the game content. Therefore, the simple action of playing the game may have inherent advantages in encouraging future intentions to engage with the game content on a regular basis or general future intentions to exercise outside of the game environment.

When comparing and contrasting the existing literature on games for health and learning, this difference becomes critical. “Serious games” are often designed with a specific goal in mind. For example, most of the studies referenced earlier in this review were aimed at educating or informing at-risk populations about a certain risk or behavior. According to the conventions outlined in this type of research and most behavioral theory approaches to gaming, the action of playing the game is often what researchers hope will exert influence on some real-world attitude,
behavior, or cognition. Furthermore, researchers hope that this influence will be stable and lasting, even in the absence of the game. For example, researchers have used traditional and virtual reality exposure therapy treatments to see if they had utility in helping to treat post-traumatic stress disorder (PTSD) and found no differences in traditional treatments versus the interactive VR treatments (McLay, McBrien, Wiederhold, & Wiederhold, 2010). Though no differences were found between the two types of treatment, the researchers did not employ a design where soldiers were able to have continued access to the VR treatments. Consequently, there is a possibility that PTSD-affected soldiers would continue to use VR treatments if given the opportunity. Therefore, while simple questions of exposure and behavior change are important, future use of game technology is also something that can be considered significant when looking at how pro-social behaviors are enacted and changed.

Rosser, Lynch, Cuddihy, Gentile, Kloskly, and Merrell (2007) found that surgical residents who were more skilled at video games were actually better at suturing and performing laparoscopic procedures than those who were not as skilled. As evidenced by this study, one behavioral outcome (surgical skill) is influenced by another behavioral outcome (continued use of video games). What separates commercially available exercise games from the video games and simulators mentioned in the previous studies is the fact the playing an exergame contains the behavior (exercise) which is trying to be encouraged. This is an important distinction because future use of video games that foster behavioral improvement in other domains or continued use of a VR therapy or treatment is not necessarily the outcome that is hoping to be achieved. Because playing exergames is itself a healthy outcome, the future use of that particular technology becomes of the utmost importance. Although exergames can potentially foster
positive attitudes toward exercise generally, continued use of an exergame is and of itself a healthy outcome or desired behavior.

The focus of this research is to understand if console video games can be effective at bringing about or sustaining exercise behavior. Thus far, there have been a handful of small-scale experiments and interventions which have shown that interactive technology can impact levels of physical activity and exercise. In one study, researchers found that participants who used a stationary exercise bike with an interactive video game attached reported greater levels of physical fitness than a control group who simply used a bike without a video game (Warburton, Bredin, Horita, Zdogbar, Scott, Esch, & Rhodes, 2007). Fox and Bailenson (2009) used immersive virtual environment technology to experimentally test if mediated representations of reward/punishment and vicarious reinforcement would impact actual propensity to exercise and found that identification with a virtual representation of oneself and reinforcement to be significant determinants of increased exercise behavior. Even though these studies seem to suggest that different aspects of video games have the ability to increase exercise behavior, they are contextually bound because most people do not have access to virtual immersive technology or exercise equipment with video games. Furthermore, these studies do not differentiate between general propensities for future exercise and future use of the technology employed in the experiment.

However, there have been a few studies which have attempted to test the specific utility of console based exercise games. Although not explicitly known as an exercise game, “Dance Dance Revolution” or more simply known as DDR has been widely regarded as one of the first commercially available video games to promote physical activity (Kautiainen, Koivusilta, Lintonen, Virtanen, & Rimpela, 2005). As a result, researchers have tested the utility of this
game in curbing obesity and reducing sedentary screen time. Madsen, Yen, Wlasiuk Newman, and Lustig (2007) conducted a multi-week clinical trial where children played DDR for 30 minutes a day. The researchers found that the participants used the game less as the experiment went on and found no evidence that game was effective at reducing weight.

Although the aforementioned study seems to suggest that actual behavioral effects from playing video games are elusive, there are mixed findings. Driven by the same basic question of whether DDR could make children become more physically active, Maloney, Bethea, Kelsey, Marks, Paez, and Rosenberg (2008) conducted a similar experiment and found that DDR was effective in reducing body mass index and pulse rate, and led to more vigorous physical activity among individuals in the treatment group. Consequently, using almost identical designs, one study found largely negligible effects of DDR (Madsen et al., 2007) while the other showed it to be beneficial to an array of positive health outcomes (Maloney et al., 2008). Because both of these studies were clinical experiments, it is possible that demand characteristics of the design might have influenced the results of the studies instead of the actual game experience.

Thus far, the literature has generally shown that video games can promote learning, elicit attitude change, and result in pro-social behavioral change. However, the process by which these changes result could be explained in a more comprehensive manner. How exactly do video games like “Wii Fit” facilitate exercise? What are some of the theoretical mechanisms which might help explain if exercise games are enjoyable or effective? Before delving into some of the theories which might help answer these questions, it is important to first understand the growing problem of obesity and some of the barriers to real-life exercise.

*Obesity and Motivation to Exercise*
According to the Center for Disease Control (2008), obesity and weight-related illness has increased steadily over the past 20 years. In testimony to a special task force focused on understanding the causes and prevention of obesity, Richard Carmona, now former Surgeon General of the United States, stated that, “nearly two of out of every three Americans are overweight or obese and nearly one out of every eight deaths in the United States is caused by some illness that is directly related to being overweight” (2003, ¶ 5). The causes of obesity and illness related to this condition are numerous and vast. Although it is likely that factors contributing to obesity are unique for each individual, lack of exercise and poor dieting habits have most commonly been identified as the two main reasons that people fail to control their weight (Center for Disease Control, 2008; Hetzel, 2008).

Though poor dieting habits and lifestyle choices directly impact overall health, these choices can be mitigated by physical activity or exercise. According to Whitehead (2008), people are born with the propensity and motivation to perform physical activity and exercise. Furthermore, this internal drive to exercise can be extremely beneficial if it is fostered over the course of one’s life. However, individuals often run into physical and psychological boundaries that prevent them from being active. For example, researchers have found that some of the most common reasons that individuals do not feel good about exercise is because they compare themselves to others at the gym, feel that they lack the competence to exercise, and generally have an amotivational attitude toward exercise (Boiché, Sarrazin, Grouzet, Pelletier, & Chanal, 2007; Vallerand, 2007). These barriers to exercise are external factors which seem to interrupt motivation to exercise. However, in mediated exercise environments, these factors may or may not be as influential. In fact, because exercise games are easy to use and provide dynamic feedback, they could, in theory, increase people’s feelings of competence to exercise.
Researchers have indicated that the motivation to exercise is very much intrinsic in nature (Deci & Ryan, 1987; Whitehead, 2008). In order to fully understand the process of how exercise games can be effective, one must consider individual differences, technological factors, and other theoretically driven mediators to fully explain the exergame experience.

Two theories of behavioral change, social cognitive theory and the theory of reasoned action, have been applied to real-life exercise domains and appear to have utility for investigating exergames. Also, a prominent psychological framework, self-determination theory, has proven to be valuable for studying how intrinsic motivation is linked to health-related behavioral change and the specific domain of exercise behavior. In the follow section, the major assumptions of these three theories will be explicated and discussed in terms of their applicability for studying exergames.

**Social Cognitive Theory**

At the most basic level, social cognitive theory (SCT) suggests that people can learn specific behaviors by watching others (Bandura, 2009). Through a series of studies now classically known as the “bobo doll experiments,” Bandura and colleagues found that children could learn aggressive behavior from simply watching real-life (Bandura, Ross, & Ross, 1961) or film representations of aggressive adults (Bandura, Ross, & Ross, 1963a). Furthermore, these studies detailed that imitative learning was often determined by whether or not the aggressive models were rewarded or punished for their behavior (Bandura, Ross, & Ross, 1963b). This notion, known as vicarious reinforcement, explains that imitative learning and behavioral modeling can often inhibited or disinhibited by valence of outcome and other factors like identification with a model.
Though many different mechanisms have been identified which detail the psychology behind learning and behavior change, the basic causal model of SCT suggests that socio-cognitive determinants (personal, behavioral, and environmental) influence one another bi-directionally to shape how people learn and behave (Bandura, 1986, 2002). Because social cognitive theory places emphasis on human agency, people are seen as having the ability to learn from symbols, to self-regulate, to reflect on information that they encounter, and to model behavior which is vicariously received (Bandura, 2000, 2009). In essence, this means that people have the ability to translate symbols into cognitive plans of action and eventually behavior, regardless of whether they are actually performing a behavior, and even when a symbolic environment does not explicitly match reality.

Advancements in gaming technology and video games themselves have increasingly blurred the lines between symbolic and real environments and contain a wide variety of socio-cognitive determinants that could elicit behavioral change. For example, people bring a wide variety of individual differences into the game playing experience and undoubtedly have different experiences with gaming environments and technologies. Research has shown that individual differences and different control schemes can profoundly shape how people experience identical game content (Limperos, Schmierbach, Kegerise, & Dardis, 2011). In this particular study, the researchers found that people who played a football video game with a traditional controller won more often and experienced greater levels of enjoyment than people who used an advanced motion sensing control scheme. This is essentially an environmental change that affects outcome experiences. In recent years, Bandura (2004) has speculated that interactive technologies may have the ability to individualize and tailor social cognitive inputs in ways that should lead to more effective learning and behavioral change.
Central to SCT is the construct of self-efficacy. According to Bandura (1982), self-efficacy is described as “judgments of how well one can execute courses of action required to deal with prospective situations” (p. 122). Because video games are becoming increasingly interactive and have the ability to provide avenues of symbolic rehearsal, it is possible that they can bolster efficacy toward both in-game and out-of-game activities (Downs & Oliver, 2009). Personal and environmental determinates in the gaming worlds are likely to affect feelings of efficacy which ultimately impact learning and behavioral change. Sources of self-efficacy beliefs include performance accomplishments, social modeling or vicarious experiences, verbal and social persuasion, and affective experiences (McAuley & Elavsky, 2008). With regard to exercise research guided by social cognitive theory, self-efficacy has always been a central construct of interest, and it has consistently been a strong predictor of exercise adherence (McAuley & Blissmer, 2000; Oman & King, 1998).

According to Klimmt and Hartmann (2006), playing video games fulfills a player’s need to feel like they are impacting the game environment (effectance) and thus produces feelings of agency and efficacy. Furthermore, this need for feelings of effectance is inherently tied to both technological features and individual gamer characteristics. This is why exergames could be superior to alternate exercise environments such as a gym or workout video. Although a personal trainer can coach specific movements and an exercise video contains models (trainers) that show how to exercise, exergames, especially those played with motion-sensing technology, provide dynamic on-screen feedback and a host of other factors which could increase self-efficacy for future exercise behavior and continued use of the games themselves. Though self-efficacy is described in social cognitive frameworks as both a motivational factor for exercise and a mechanism which keeps one involved in exercise programs, another prominent behavioral
change theory suggests that attitudes, norms, and perception of control are the best proximate predictors of behavior.

*The Theory or Reasoned Action/Planned Behavior*

The theory of reasoned action (planned behavior) explains that the greatest predictor of voluntary behavior is a person’s own behavioral intention (Fishbein & Ajzen, 1975). Behavioral intentions are believed to emanate from the duality of normative and individual influences (Ajzen, 1985). Much like SCT, this perspective has been applied to many different contexts in order to explain the process of behavioral change. Although the theory of reasoned action (TRA) has mostly been applied to understand the effectiveness of persuasive messages in eliciting behavioral change, it has been applied more generally to understand when people have the highest probability of performing certain behaviors (Hale, Householder, & Greene, 2002).

Various meta-analyses of TRA research have concluded that attitude toward a behavior and subjective normative feelings of that behavior are primary determinants of behavioral intentions (Godin & Kok, 1996). A later extension of TRA known as the theory of planned behavior (TPB) posited perceived behavioral control, or the ability that one has to perform a behavior, to be another proximal predictor of behavioral intentions. The perceived behavioral control construct is much like self-efficacy construct described by Bandura. In essence, control or efficacy can influence which behaviors people choose and can also be contingent upon experiences people have while performing certain activities. Although tenets of TRA/TPB and the guiding framework of social cognitive theory consider slightly different paths toward behavioral change, the experience of perceived behavioral control or self-efficacy is central to understanding behavior. As a result, both theories have been applied to understand exercise behaviors.
Theory of Reasoned Action and Social Cognitive Theory: Implications for Exercise

In an attempt to understand the relationships between intentions to exercise and actual self-reported exercise, Blue, Wilbur, and Marston-Scott (2001) used TRA and hypothesized that people’s intention to exercise, attitudes toward exercise, and subjective norms toward the activity would predict exercise behavior. The researchers found that behavioral intentions to exercise strongly predicted actual exercise behavior. Although this is not surprising, the locus of the study was to identify cognitive predictors of exercise behavior, and the model revealed that attitudes toward exercise and perceived control of exercise behavior were strong predictors of behavior intention, while subjective norms were not (Blue et al., 2001). According to Ajzen and Albarracín (2007), the best proximate predictor of actual behavior is behavioral intention. The implications of these findings seem to suggest that exercise programs that are focused on getting people to work out would be most beneficial if they were able to alleviate negative attitudes and inhibitions about exercise.

Jones, Sinclair, Rhodes, and Courneya (2004) sought to understand the effectiveness of a theoretically integrated message on exercise motivation in a college population by way of the theory of planned behavior (TPB). These researchers hypothesized that subjective norms and perceived control would be impacted by source credibility and message. Instead of designing the message content in accordance with TPB, the researchers merely used the constructs associated with this theory in their analyses. Theoretically, the researchers expected that source and message characteristics would influence perceived behavior control and subjective norms, which would then predict exercise intentions. However, the researchers found no significant effects of the message on intentions to exercise (Jones et al., 2004). The absence of effects was theorized to have occurred because of measurement error and/or limited measurement of constructs. That is,
the researchers may have not measured the correct constructs. Of course, it is entirely possible that no significant differences emerged because this sample population did not accept the exercise intervention message. The implications of this research are that exercise and health professionals should be cautious when designing exercise promotion initiatives and remain cognizant of their audiences’ characteristics.

Another study (Wise & Trunnell, 2001) involving exercise sought to address how different sources of information impact self-efficacy to perform exercise. Premised on SCT, this study specifically focused on the construct of self-efficacy. Ultimately, these researchers were interested in understanding how performance accomplishment and verbal encouragement affected efficacy to bench press. In this experiment, participants were placed in groups that varied by whether they actually got to perform exercise, watch others perform the exercise, or received only verbal instruction. Different types of reinforcement (positive and negative) were also manipulated following the exercise manipulations. Results of the research indicate that participants in groups that actually got to bench press felt more efficacious than those who watched a model bench press, and those who watched the model were more efficacious than those who listened to a verbal message (Wise & Trunnell, 2001). This study also found that performing a behavior followed by positive reinforcement increased efficacy. These findings have powerful implications regarding the potential effectiveness of exercise games. From theoretical perspectives that place value on behavior control and efficacy, it seems that reinforcement or feedback from exercise games might be central to understanding their effectiveness.

Taken at face value, the findings of these real-life exercise studies guided by SCT and TRA/TPB seem to suggest that many social and individual differences (e.g., motivational
climate, feedback, self-efficacy, and behavioral control) are vitally important to increasing
enjoyment of and propensity toward exercise (Blue et al., 2001; Vallerand & Losier, 1999; Wise
& Trunnell, 2001). While it is apparent that an array of different factors can influence the
propensity or motivation of people to exercise, research guided by self-determination theory has
shown that extrinsic happenings in one’s life often undermine their ability to maintain intrinsic
drive. Self-determination theory further elaborates the dichotomy of intrinsic and extrinsic
motivators as they pertain to positive life outcomes and exercise behaviors.

*Self-Determination Theory: A Theoretical Framework for Studying Exercise Games*

Self-determination theory (SDT) is a macro and metatheoretical perspective which is
focused on understanding how different social and contextual factors either facilitate or inhibit
intrinsic and extrinsic motivation (Deci & Ryan, 1985, 2008). Accordingly, intrinsic and
extrinsic motivations are operationally differentiated in terms of the absence or presence of a
reward for performing a behavior. Given any situation, when people receive some type of reward
(e.g., money) or try to avoid some deleterious outcome (e.g., punishment), then their behavior is
thought of as being constrained by extrinsic factors, and is therefore extrinsically motivated
(Deci, 1980). When there are no apparent extrinsic factors influencing one’s behavior or action,
then that person’s behavior is thought to be a result of intrinsically motivated action (Deci &
Ryan, 1985).

Also important to SDT is that different social and contextual factors in a person’s
environment have the ability to bolster that person’s sense of autonomy and competence (Deci &
Ryan, 1980; Ryan & Deci, 2000). These feelings of individuality and achievement are theorized
to support intrinsic motivation, while factors that interfere with these needs are thought to
diminish autonomy or competence, leading to decreased intrinsic motivation (Deci & Ryan,
A recent meta-analysis focused on the effect of extrinsic rewards showed that intrinsic motivation is almost always undermined by extrinsic rewards. Specifically, Deci, Koestner, and Ryan (1999) stated that, “rewards can control behavior which is why they are widely advocated, but the primary negative effects of rewards are that they tend to forestall self-regulation, ultimately undermining people’s ability to motivate or regulate themselves” (p. 659). No matter the context or situation, when people feel like they are not in control of their actions or if their actions are externally motivated, then their overall motivation toward a particular action or behavior can be diminished.

Finally, most SDT research has focused on how well certain actions and behaviors fulfill basic needs. The basic needs component of SDT articulates the interplay between the fulfillment of basic needs and its relationship to social, cognitive, physical, and psychological well-being. Research has shown that when the three basic needs of autonomy, competence, and relatedness are fulfilled, they bolster people’s intrinsic motivations and feelings of self-determined behavior (Deci & Ryan, 1985; Ryan & Deci, 2000). Taken in sum, this review is a snapshot of all the macro-theoretical assumptions of the self-determination theory. Since the current proposal is focused on understanding how the theoretical framework of SDT can be used to study the effectiveness and enjoyment of exergames, it is necessary to review some of the literature from exercise, sport, and video games that has been guided by self-determination theory.

**Self-Determination: Exercise, Sport, and Video Games**

Self-determination theory has been empirically tested across a variety of contexts which include education and learning, health care, political activity, environmental activism, exercise/sport, and intimate relationships (Deci & Ryan, 2000; 2008). Although each of these
areas is important to the larger framework of the theory, the literature involving sport and exercise is most central to this investigation.

Early research involving SDT and sport revealed that people who partake in fitness and athletics do so primarily because they are either motivated intrinsically (e.g., for fun, challenge, or enjoyment) or extrinsically (e.g., winning, prestige, or weight loss) (Deci & Ryan, 1987; Vallerand, 2007). This basic idea has led to an understanding of how different social and environmental factors either increase or decrease the intrinsic motivation of athletes. After conducting an extensive review on sport and SDT literatures, Vallerand and Losier (1999) proposed the following theoretical explanation: “Social factors lead to psychological mediators which then fuel motivation and consequences” (p.161). Essentially, this model incorporates basic needs and intrinsic and extrinsic motivations to explain sport behavior. A social factor (e.g., success or failure, competition or cooperation, or a mentor’s behavior) affects an athlete’s abilities to fulfill basic needs (e.g., autonomy, competence, and relatedness), which then affects motivation and consequences (Vallerand & Losier, 1999). For instance, if an athlete experiences failure, this would negatively impact feelings of competence, ultimately inhibiting motivation. In this view, the social factors are motivating factors which either undermine or facilitate intrinsic motivation. This assertion has been validated and has helped researchers understand the complexities of motivation as it pertains to sport and exercise (Wilson, Rogers, Rodgers, & Wild, 2006).

There are many factors that affect motivation to engage in and enjoyment of exercise. In one study designed to understand the influence of peers on exercise and enjoyment, Murcia and colleagues (2008) found that positive task-involving peer motivational climate predicted fulfillment of the basic psychological needs among non-competitive exercisers. The researchers
found that both competence and relatedness predicted self-determined motivation, while autonomy did not. Research has also shown that social and psychological factors determine the motivational climate of an exercise scenario, which then has a direct impact on exercisers’ intrinsic motivations (Ntoumanis, 2002). Similar to the guiding perspectives of SDT, both social cognitive and reasoned action approaches posit that environmental, social, and psychological factors are important for determining motivation and the propensity to perform behavior. Collectively, these frameworks are well-suited for exploring the determinants of intrinsic motivation and behavioral production across many domains, including exercise.

Although there is not an abundance of research that focuses on how external motivators affect intrinsic motivations in exercise, some barriers (external factors) to enjoyment of exercise have been identified (Boiché et al., 2007; Vallerand, 2007). After reviewing the literature from SCT, TRA/THB, and SDT frameworks, it is apparent that an array of different factors can influence the propensity or motivation of people to exercise. However, each theory only provides explanations of exercise behavior in a specific context. That is, the explanation of motivation that is offered by each part of the theory, as well as what has been found empirically in specific applications of these frameworks, is unique. Therefore, empirically testing whether a mediated exercise environment such as those provided by exergames can actually enhance feelings of self-efficacy, intrinsic motivation, and subsequent propensity to exercise, may be best approached by considering specific constructs from each theoretical perspective.

Emerging research suggests that playing video games is an intrinsically motivating activity (Ryan, Rigby, & Przybylski, 2006, Tamborini, Bowman, Eden, Grizzard, & Organ, 2010). According to Ryan et al. (2006), video game players often feel a sense of autonomy and competence as a result of their playing experience, and these feelings are positively related to
game player enjoyment, preferences for future play, and feelings of overall well being. Furthermore, this relationship is presumed to be moderated by a host of game characteristics. All of these findings are important because they illustrate the complex relationship between technological and game affordances as well as social factors, which then differentially predict fulfillment of self-efficacy, intrinsic motivation, well-being, and enjoyment.

Recently, Tamborini and colleagues (2010) manipulated a game affordance (natural mapping) and a social factor (playing scenario) and found that each of these manipulations explained more than half of the variance in intrinsic motivation and subsequent game player enjoyment. Whether or not one agrees that enjoyment should be understood purely in the terms of intrinsic need fulfillment, these findings along with the evidence from sport and exercise literature suggest that fulfillment of intrinsic needs is central to understanding enjoyment of and propensity to perform certain behaviors. Although mounting evidence in SDT suggests fulfillment of needs is ultimately what impacts a host of positive life behaviors, SCT and TRA/TPB suggest a different set of determinants which influences behavioral intention and actual exercise behavior. Regardless of how each theoretical perspective and its constructs contribute to understanding exercise behavior, one must also consider how the affordances of exergames can potentially contribute to their effectiveness. Therefore, another set of literature that can inform questions regarding the effectiveness of exercise games is that which focuses on the specific impacts of technological affordances on video game play experiences.

Aspects of Exergaming and Technological Affordances

Video games have been described as inherently immersive, engaging, and interactive technologies (Nowak, Krcmar, & Farrar, 2008; Segal & Dietz, 1991). Over the past few years, there has been a lot of speculation as well as empirical work regarding the impact of technology
on affect, behavior, and cognition (Fogg, 2003). Scholars have been conducting mostly variable analytic research in order to understand how graphical enhancements, control schemes, virtual environments, and agents within these environments might be impacting the communication process. To fully understand how specific game characteristics might shape enjoyment, intent to exercise, and future use of a particular game, it’s vital to consider the mechanisms through which that influence might occur.

Video games nicely capture the essence of what is known as technological affordances. Early conceptualizations of technological affordances were rooted in perceptual psychology. The basic notion of affordances as described from this perspective are thought to emanate from the duality of visual stimuli and our cognitions of how we are supposed to interact with them (Gibson, 1977, 1986). For example, the shape of shoe implies that it is to be worn on your foot, and a game controller invites a person to push buttons. However, a more recent conceptualization of affordances is rooted in human computer interaction and proposes that affordances exist, even if we do not perceive they are present (Sundar, 2007). This fundamental distinction is really one of degree. While early conceptualizations were more about perceptions of an affordance, recent definitions see affordances as properties of a medium (Bucy, 2004; Sundar, 2004; Sundar, 2008). Seeing affordances as properties of the medium instead of mere perception, allows researchers to differentiate perceptual cognitions from properties of technology.

The MAIN model (Sundar, 2008) proposes four main classes of medium-driven technological affordances – modality, agency, interactivity, and navigability, and these affordances have been shown to have significant psychological impacts in a variety of mediated contexts. With regard to exercising in a mediated environment (e.g., using an exercise video or playing an exergame), an affordance is essentially anything that mediates the interaction with the
environment and the user. For instance, when using an exercise video, affordances may include the fidelity of television, the format of the workout, and the feedback given by trainers in the video. Exergames are no different. They too provide feedback and can involve different aspects of technological presentation and format, but one of the key differentiating features of these games versus traditional mediated exercise formats involves modality. Both exergames and exercise videos are interactive and encourage movement, but the input devices (Wiimote and Balance Board) afforded by exergames may allow users to experience greater feelings of presence, perhaps signaling a more effective exercise experience. The affordances or controls of exergame technology also dynamically impact the gaming environment by letting the player know if they are performing behaviors correctly. This impact on the gaming environment is essentially equivalent to effectance needs, which Klimmt and Hartmann (2006) suggest are key properties that draw people to video games and ultimately makes them more enjoyable.

Research has consistently shown that specific technological affordances (e.g., agency, interactivity, and modality) increase feelings of presence which then elicit an increase in cognitive, affective, and behavioral outcomes (Rimmer & Krueter, 2006; Skalski & Tamborini, 2007; Tamborini & Skalski, 2006). Although there are many different dimensions of presence, the term is generally used to describe a feeling of being inside of a media environment (Lombard & Ditton, 2001). So collectively, these studies suggest that specific technological factors related to the game environment (e.g., such as having an input modality which dynamically impacts feedback) can increase feelings of presence. Additionally, experiencing heightened feelings of presence have been found to be positively related to enjoyment of game play experiences (Ryan, et al., 2006). Therefore, the link between specific technological features, presence, and enjoyment is important to understanding user experiences with exergames.
Feelings of involvement (Ivory & Kalyanaraman, 2007), presence (Tamborini & Skalski, 2006), natural player movement (Lindley, Le Couteur, & Bianchi-Berthouze, 2008), and simulated player movement (Persky & Blaskovich, 2007) are all variables that have been theorized to differentially impact enjoyment of game play. More generally, ease of use of game technology can also influence whether or not a person will enjoy or continue to play a game (Davis, 1989; Limperos et al., 2011). Since amotivational attitudes or lack of competence have often been identified as barriers to exercise, exergames may be superior because they are intuitive and easy to use. Considering that exergames should, theoretically, provide for a lot of the aforementioned game play experiences, it is plausible to assume that playing an exergame may differently impact aspects of self-efficacy, intrinsic motivation, enjoyment, and presence, ultimately leading to an understanding of what makes exergames effective.

Hypotheses, Research Questions, and Proposed Path Model

If a person wants to exercise in his or her own home (outside of a gym or outdoor activity), their options are rather limited, especially if they do not have the necessary means or space to purchase workout equipment. Exercise videos are a relatively cheap alternative, but exergames, which share qualities with exercise videos, are potentially an even more viable alternative. However, the broad question remains, can these games affect peoples’ exercise behavior, intentions, or motivations for future exercise and/or future use of mediated exercise formats? Since there are many similarities between exercise videos and exercise games, comparing the two would provide a theoretically rich testing ground to address the broad questions of exergame effectiveness. Effectiveness could be gauged in numerous ways. However, in the present investigation, two of the most plausible explanations of effectiveness of exergames could be operationalized in terms of future behavioral intent toward using a particular
exercise medium (game or video) and future behavioral intent/attitudes toward future exercise more generally. Based on theoretical considerations from three applicable frameworks and the review of the literature involving technological affordances, specific hypotheses and research questions were advanced, leading to a theoretically driven mediation model.

Bandura’s (2009) SCT framework accounts for learning and behavioral change through various social and environmental determinants. Furthermore, whether a behavior is actually modeled or vicariously experienced, feedback and reinforcement are thought to affect the experience that a person has in future production of that behavior (Bandura, 2000; Fox & Bailenson, 2009). Finally, feelings of self-efficacy, which can emanate from different social and environmental determinants, are also likely to contribute to future propensity toward a behavior. Sources of self-efficacy beliefs can include performance accomplishments, social modeling or vicarious experiences, verbal and social persuasion, and feelings of emotion (McAuley & Elavsky, 2008). In the present investigation, modality affordances provided by the use of Wiimote and Balance Board are theorized to impact the experience with the mediated exercise environment of exergames. Although an exercise video and an exergame are both effective channels of encouraging physical activity, the modality inputs afforded by the exercise game should be far superior at providing dynamically mapped feedback, and thus should increase participants’ feelings of performance feedback in the exergames relative to exercise videos. Furthermore, perceived feedback should enhance feelings of self-efficacy, and the technology itself should enhance feelings of presence, leading to the following hypotheses:

*H1:* Participants who use motion controllers in an exergame will report greater levels of performance feedback than those who participate in a similar format of an exercise video.
**H2:** Greater perceived performance feedback will be positively associated with feeling of self-efficacy.

**H3a:** Feelings of self-efficacy will be positively associated with behavioral intentions for future use of a particular exercise medium.

**H3b:** Feelings of self-efficacy will be positively associated with behavioral intentions toward future exercise.

**H4:** Participants who use motion controllers in an exergame will report greater levels of presence than those who participate in a similar format of an exercise video.

**H5:** Feelings of presence will be positively associated with behavioral intentions toward future use of a particular exercise medium.

Self-determination theory suggests that an array of factors influence whether or not a person feels a sense of intrinsic motivation, and increases in intrinsic motivation are linked to positive life outcomes (Deci & Ryan, 2008). In both exergame and exercise video formats, a social factor (such as trainer or mentor’s feedback) can affect a person’s ability to be intrinsically motivated (see Vallerand & Losier, 1999). Because exercise games provide feedback which is dynamically linked with a person’s action and performance, they should in theory be easier to use and facilitate more intrinsic motivation relative to mediated exercise video formats, where feedback is relatively static and occurs in the presence or absence of correct performance or action, leading to the following hypothesis:

**H6:** Greater perceived performance feedback will be positively associated with feelings of competence.

**H7a:** Competence will be positively associated with future intention to use a particular exercise medium.
H7b: Competence will be positively associated with future behavioral intention to exercise.

Finally, a key differentiating feature of video games is that they are considered to be a fun and enjoyable pastime. Feelings of involvement (Ivory & Kalyanaraman, 2007), presence (Tamborini & Skalski, 2006), natural player movement (Lindley, Le Couteur, & Bianchi-Berthouze, 2008), and simulated player movement (Persky & Blaskovich, 2007) are all variables that have been theorized to differentially impact enjoyment of game play. Since exergames do provide for dynamic representations of player movement and simulated movement, they should in theory be more enjoyable than formats which do not have these affordances. However, it is possible that advanced technological affordances might be restrictive and not necessarily lead to greater enjoyment (Limperos et al., 2011). Therefore, the following research question is proposed:

RQ1: How do feelings of enjoyment differ by exercise format?

Regardless of which exercise format is enjoyed more, it is likely that that enjoyment should predict the future propensity to use a particular exercise medium. Additionally, enjoyment of a particular exercise experience should predict future intentions to exercise. For instance, if someone enjoys playing an exercise game, then it is likely they would want to continue to play the game in the future. Regardless of exercise format, enjoyment of the experience should also predict future intentions to exercise as well, leading to the following hypotheses:

H8a: Enjoyment will be positively associated with behavioral intention to use a particular exercise medium.

H8b: Enjoyment will be positively associated with behavioral intentions to exercise.
Previous research on video games has shown that both feelings of presence (Ryan et al., 2006) and intrinsic motivation (Tamborini et al., 2010) have been linked to enjoyment of gameplay. Also, research across a variety of situations and activities has shown that the experience of self-efficacy is often accompanied by or leads to positive life feelings (Bandura, 1997; Gecas, 1989). Similarly, the voluminous SDT literature from multiple domains suggests that fulfillment of intrinsic motivation is linked to increasing enjoyment of activities. Therefore, the following hypotheses were proposed:

\( H9 \): Presence will be positively associated with feelings of enjoyment.

\( H10 \): Competence will be positively associated with feelings of enjoyment.

\( H11 \): Self-efficacy will be positively associated with feelings of enjoyment.

Each of aforementioned research questions and hypotheses is offered as a result of the specific literature pertaining to each line of inquiry. Figure 1 summarizes each of these hypotheses and research questions and outlines the theoretical path model.

Figure 1: Proposed Path Model and Summary of Hypotheses and Research Questions
Chapter 2

Methods

The intent of this study was to examine if mediated exercise formats (exergames and exercise videos) could affect peoples’ behavioral intentions toward exercise or behavioral intentions toward the future use of a particular mediated exercise format. A number of different cognitive and psychological mechanisms were hypothesized as being central explanatory mechanisms between the independent and dependent variables. A two-factor between subjects experimental design with pre and post-test self-report questionnaires was used to test the main hypotheses and research questions. The pre-test questionnaire contained questions about gender, class standing, and experiences with video games, television, and exercise. The post-test questionnaire contained items that focused on competence, exercise self-efficacy, presence, enjoyment, performance feedback, and behavioral intentions toward future exercise and future use of exercise media.

Participants

Participants were recruited from a variety of undergraduate communication courses at a large Northeastern university to voluntarily take part in research sessions. A total of 130 students participated in the study. The final sample consisted of 68.5% women \( (n = 89) \) and 31.5% men \( (n = 41) \), and the mean age of the participants was 20.56 years old \( (SD = 1.51) \). Three participants did not provide their age. Most of the participants were senior \( (n = 43) \), junior \( (n = 43) \), and sophomore \( (n = 38) \) level students, but there were also a few freshman \( (n = 6) \) students who participated in this research. Prior to being exposed the stimulus material, participants were asked to report their exposure and experience level with various types of media and exercise. Participants reported playing video games for a little under 2½ hours per week \( (M = 145 \)
minutes), reported watching television for approximately 12 hours per week ($M = 710$ minutes), and reported exercising for approximately 7 hours per week ($M = 417$ minutes). Participants reported slightly above average experience with playing video games on the Nintendo Wii ($M = 3.94$, $SD = 1.72$, 7-point scale) but reported relatively little experience with using exercise video games in general ($M = 2.55$, $SD = 1.85$, 7-point scale). In addition, participants reported moderate experience with using fitness videos or DVDs ($M = 3.24$, $SD = 1.97$, 7-point scale).

Since *The Biggest Loser* series was chosen as the stimulus material for this study, numerous questions were asked to assess participants’ experience level and familiarity with different *The Biggest Loser* media. In all, participants reported slight familiarity with the *The Biggest Loser* TV series ($M = 2.92$, $SD = 1.81$, 7-point scale) and almost no experience with playing *The Biggest Loser* video game ($M = 1.14$, $SD = 0.63$, 7-point scale). Participants were randomly assigned to experimental conditions and received course credit in exchange for their participation.

**Experimental Design**

This study employed a two-level between subjects’ design where participants were randomly assigned to play either an exercise video game or interact with an exercise DVD. This manipulation served as a way of testing how aspects of exergames might be psychologically significant when compared with traditional mediated exercise environments. Playing or interacting with exergames is achieved by using specific technologies that allow users to impact the exercise environment. Traditional formats such as an exercise video do not require or allow users to impact the exercise environment. If the content between the two types of mediated exercise environments is held relatively constant, the only point of departure between the two
types of media would be the technology, and this difference served as the primary experimental manipulation in this study.

Stimulus Material

Participants in this study were randomly assigned to either interact with an exercise DVD (The Biggest Loser Workout Vol. 2) or to play an exercise video game (The Biggest Loser). The primary reason that the Biggest Loser media was selected for this study is because it allowed for the workout content to be nearly identical between experimental conditions. Although the conventions and timing of the DVD and video game were slightly different, the presentation (e.g., the trainer and exercise companions) and types of exercises in the two conditions were similar. Participants in the exergame condition played the game on the Wii console by using both the motion-sensing Wii controller and the Wii Balance Board. For the DVD condition, participants simply followed the trainer and did not hold or interact with any exercise equipment. In both conditions, the exercise media was displayed on a 42” LCD television. For the Wii condition, the motion sensor was placed directly under the TV. In both conditions, participants were approximately 4-5 feet from the television screen while exercising, and the volume of the TV speakers was set at level 25 during the sessions.

The Biggest Loser Vol. 2 workout DVD contained nine different exercise routines which were approximately 10 minutes in length each. Each exercise routine could be selected individually, or multiple routines could be selected and played in succession of one another. The Biggest Loser exercise video game contained different exercise challenges based on the TV series, exercise mini-games, and customizable exercise routines. For this study, the workout routine that was selected from the DVD was the “Cardio Max” routine. This exercise routine contained a series of side-steps, jumping jacks, squat, and plank exercises. In order to ensure that
content was constant across both experimental conditions, the customizable workout option from the video game was utilized to create an exercise routine that mirrored the cardio max routine from the DVD. Both the DVD and video game exercise routines were narrated and guided by trainer Bob Harper (a popular *Biggest Loser* trainer), had a similar exercise companion named Matt Hoover (a former *Biggest Loser* contestant), and were 10 minutes in length.

Although careful consideration was given to ensure that the experimental conditions were similar, there were some slight notable differences. Even though the exercises in both experimental conditions were presented in identical chronological order, there were slight differences in the timing of the exercises. The presentation of the exercises in the DVD condition was relatively fluid and the exercise pace was the same for each session. In the video game condition, participants needed to use different combinations of controllers in order to perform different exercises. For example, a plank exercise (holding oneself upright in the push-up position) performed in the exergame condition required participants to only use the Wii Balance Board (not the Wii controller). Although the routine performed in the exergame condition did not require an excessive amount of setup time between exercises, it is worth noting that the pacing of the exercises was not identical to the DVD condition. Another notable difference between the two conditions was the presentation of on-screen workout companions. The DVD showed a trainer on the screen (Bob Harper) and two workout partners in the background (Maurice and Matt). The exergame contained the trainer (Bob Harper) and only one workout companion in the background (Matt). It is also worth noting that the game showed more animated characters whereas the video provided for a more cinematic experience.

Although these slight differences existed between the two conditions, they did not deviate from what could be expected from using these types of exercise media outside the laboratory,
thus increasing ecological validity. In this study, a strict comparison between the two experimental conditions and subsequent user experiences was possible because the exercise media were fundamentally similar (See Appendix A for screen shots of the stimulus material).

Procedure

Upon arrival to a campus research lab, participants were consented and asked to fill out a short health questionnaire (Physical Activity Readiness Questionnaire; Thomas, Reading, & Shepard, 1992). This questionnaire was used as a screening mechanism to ensure that participants were fit to participate in physical activity. Only one participant was found to be unfit to participate, and this person was thanked for their time and dismissed from the study. After completing the consent form and screening questionnaire, participants were then asked to complete a background questionnaire meant to assess basic demographic information and level of experience with various types of media and exercise.

Following the completion of the consent, screening, and pre-experiment questionnaire, participants were then asked to join the researcher in a separate room in order to interact with the exercise media. Between each research session, the researcher set up the room so that it was ready for each experimental condition. Therefore, participants in the study were blind the other condition. Upon entering the room with the exercise media, participants were told that they would be exercising along with some media for approximately 10 - 12 minutes. For the exercise video condition, participants were shown a short preview or portion of a warm-up exercise routine and instructed to do “the best they could” to follow the trainer and keep up with the exercise. The investigator asked the participant if there were any questions and then cued up the “Cardio Max” exercise routine and exited the room. After the researcher left the room, the participant then hit the play button on the DVD player remote and began exercising. For the
exergame condition, participants were again instructed to do their best and were given specific instructions about how to interact with the game using both the Wiimote and the Wii Balance Board. Participants were then given an opportunity to play a short demo (2 minutes) in order to ensure that they were comfortable and understood how to play the game. After the tutorial, the researcher then cued up the “Cardio Max” customized exercise routine and excited the room. The participant then hit the “start” button on the Wii controller and began exercising.

Regardless of which experimental condition the participant was assigned to, the researcher periodically checked (through an observation window) to see if participants were in fact exercising. Though there were no specific recorded observations of each session, this method of checking ensured that each participant was exercising as they had been told to. Upon completion of playing the game or interacting with the exercise video, the researcher reentered the room and informed the participant that the exercise session was complete. The participant was then led back out of the room to the hallway and given a questionnaire containing the dependent measures. The participants were instructed to read each set of instructions and told to answer the questions to the best of their abilities. After completing the final questionnaire, participants were thanked for participating, told they would receive course credit and dismissed. In all, the entire study lasted between 35 – 50 minutes. This range was based on the rate in which each participant read and answered the questionnaires. The exercise portion of the study was standardized so each participant exercised for the same amount of time (10 – 12 minutes). In almost all instances, the exercise portion of the exergame condition took slightly longer than the exercise experience in the DVD condition. As noted earlier, the exergame required some setup on the part of the user between certain exercises. Once the exercise video was started, the users only stopped when instructed to by the on-screen trainer.
Construction of Dependent Measures

The dependent measures used in this study mainly consisted of adapted versions of previously validated scales and some measures that were created specifically for the purpose of this study. The scales which have been used successfully in previous research were checked for reliability before the final scales were computed. Those measures which were created for the specific purpose of this research and those which were adapted from previously validated scales were factor analyzed using principal components extraction with varimax rotation. Retention of items was determined using the 60/40 rule for factor loadings and only factors with eigenvalues greater than one were considered sufficient (McCroskey & Young, 1979; Morrison, 2009). Finally, the scales which resulted from exploratory factor analyses were checked for internal consistency and face validity. For scales that have not been previously validated in other research, these criteria were used to guide the construction of the final scales. All of the scales had a Cronbach’s Alpha of at least .70 or greater and were considered acceptable for further analyses (Kline, 2005).

Perceived performance feedback. One of the distinguishing features of exergames is that they let users know when they are exercising correctly by providing on-screen representations of their physical movements accompanied by verbal encouragement. Exercise videos also provide verbal encourage and feedback while people are using them to exercise. Therefore, a measure of performance feedback was constructed in order to tap for user’s perceptions of performance feedback during their exercise experience. Participants read and responded to 5 statements measured on 7-point scales (1 = not at all, 7 = very much). The following 5 items were used to measure performance feedback: (1) The feedback I received from the exercise medium let me know I was exercising correctly; (2) The exercise medium provided me with feedback based on
my exercise behavior; (3) The exercise medium provided me with feedback related to my exercise performance; (4) The encouragement I received from the system while exercising was valuable; (5) The exercise medium took my performance into account and offered me feedback based on that performance. Because these items were created for the specific purpose of this study, they were submitted to exploratory factor analyses and checked for validity. The analysis indicated a single factor and all other criteria were met. The final scale containing all 5 items was reliable (Cronbach α = .88).

*Enjoyment.* Enjoyment was measured using an adaptation of McAuley, Duncan, and Tammen’s (1989) and Deci, Eghrari, Partick, and Leone’s (1994) measures of enjoyment of sport. Enjoyment was measured with 7 point scales (1 = *strongly disagree*, 7 = *strongly agree*). The following items were used to assess enjoyment of the exercise experience: (1) I found exercising to be very boring (reverse coded item); (2) While I was exercising, I was thinking about how much I enjoyed it; (3) I thought exercising was very enjoyable; (4) I would describe my exercise experience as pleasant and enjoyable; (5) Exercising was very fun; (6) I was disappointed with the exercise experience I had today (reverse coded item). Although this scale had been reliably used in previous research (Limperos, Schmierbach, Kegerise, & Dardis, 2011), it was checked using exploratory factor analysis and checked for validity. These 6 items were reliable (Cronbach α = .90).

*Exercise self-efficacy.* Self-efficacy has been measured across a variety of different contexts. Conceptually, self-efficacy is defined as, “judgments of how well one can execute courses of action required to deal with prospective situations” (Bandura, 1982, p. 122). Although most measures of self-efficacy can be created to suit whichever domain or behavior is being investigated (Bandura, 1986), there have been previously validated scales of exercise self-
efficacy. For this study, an adaptation of McAuley’s (1992; 1993) scales was used to measure exercise efficacy. Exercise efficacy was measured with 7-point scales (1 = strongly disagree, 7 = strongly agree) and following items were included in this measure: (1) I feel confident that I could participate in exercise regularly; (2) I feel confident that I am good at exercising; (3) I feel confident that I could exercise on my own; (4) I am confident that I could exercise multiple times in a week; (5) I am confident that I could maintain a regular exercise program; (6) I am confident that I could exercise well in a gym. Even though these measures have been reliably used in previous research, exploratory factor analysis was employed and indicated a single factor. These 6 items were found to be reliable (Cronbach α = .89).

Presence. Presence was measured by using Nowak and Biocca’s (2003) general scale of presence. Although presence generally has separate dimensions (e.g., self-presence, spatial presence, etc.), the dimensions that were most central to the focus of this study were immersion and engagement. Presence is generally defined as, “the perceptual illusion of nonmediation” (Lombard & Ditton, 2001). Accordingly, presence was measured with 7-point scales (1 = not at all, 7 = very much) and the following items were employed: (1) How intense was the experience? (2) How involving was the exercise experience? (3) To what extent did you feel as if you were inside the exercise environment? (4) To what extent did you feel like you were immersed in the exercise environment? (5) Did you feel surrounded or engaged with the exercise environment? These 5 items were found to be reliable (Cronbach α = .85).

Competence. Although intrinsic motivation is often measured in terms of three concepts (autonomy, competence, and relatedness), this study did not involve any manipulations or questions concerned with the relatedness or autonomy dimensions of intrinsic motivation and instead focused on competence. Intrinsic motivation has been measured across a variety of
different domains. For this study, a battery of measurement items meant to tap for competence in previous studies (Deci et al., 1994; McAuley et al., 1989) was adapted and measured with 7-point scales ranging from 1 (Not At All) to 7 (Very Much). The items were factor analyzed and 7 (out of 10) of the items were deemed acceptable and retained for scale construction. The 7 items used to measure competence were: (1) I felt as if I had mastery of the exercises; (2) The exercise environment kept me on my toes but did not overwhelm me; (3) I felt as if I had mastery of the exercise media; (4) I felt capable and competent in my abilities while using this exercise media; (5) I did not feel comfortable or proficient while exercising (reverse coded); (6) I did not feel comfortable or proficient while using this exercise media (reverse coded); (7) I felt capable and competent in my abilities to exercise. The Cronbach alpha reliability of these 7 items was .86.

Behavioral intentions toward future exercise. Traditionally, behavioral intentions have been defined and measured as outcome expectancies related to attitudes, perceived behavioral control, and subjective norms (Ajzen, 1985). For previous studies in which future intention to exercise has been measured, operational measures have ranged from single to multiple items and have been used to tap the propensity that one would have towards future exercise behavior, given a particular health intervention or experience (Rhodes & Courneya, 2005; Wurtele & Maddux, 1987). This approach to measuring behavioral intentions toward future exercise was used in the current study. Participants indicated their agreement with 6 items measured with 7-point scales (1 = strongly disagree, 7 = strongly agree). The following items were included in the scale: (1) The experience I had today made me want to start exercising regularly; (2) Based on my experience today, I would consider exercising regularly in the future; (3) At the next available opportunity, I intend to participate in some form of exercise; (4) Within the next few weeks I plan to start exercising regularly; (5) I am not planning to exercise regularly in the future (reverse
(6) During the next 30 days, I intend to exercise. The factor analysis of these items indicated a single factor and the final scale had acceptable reliability (Cronbach $\alpha = .76$).

Behavioral intentions toward future use of exercise technology. Behavioral intentions toward future technology use have often been measured as outcome expectancies of particular experiences with technology (Davis, 1989; Venketesh & Davis, 2000). These operationalizations share similarities with the way that behavioral intentions have been measured in reasoned action studies, but are connected to specific properties of a medium instead of attitudes, norms, and behavioral control. For this study, future intentions to use exercise media (exercise game or video) was measured by using previously validated scales of future technology use (Venketesh & Davis, 2000). The items were adapted to suit the purpose of the study and participants were asked to indicate their agreement with the following 6 statements ($1 = \text{strongly disagree}, 7 = \text{strongly agree}$): (1) I would use this particular exercise media to exercise in the future; (2) If I had access to this particular exercise media, I would use it to exercise regularly in the future; (3) If I owned this particular exercise medium, I would use it to exercise regularly; (4) If given the opportunity, I would purchase and use this exercise technology again; (5) Given the experience and opportunity to use this exercise media in the future, I would definitely do it. All of the items loaded on a single factor and the final scale had good reliability (Cronbach $\alpha = .95$).

Control Measures

In addition to the dependent measures, measures of experience with exercise and different types of exercise media were also taken. As reported earlier, participants in this study had slightly above average experience with playing video games on the Nintendo Wii, relatively little experience with using exergames in general, and slightly below average experience with using fitness DVDs or videos. The net amount of time spent with video games and the amount of
time spent exercising were also both recorded. The previous experience measures were used in order to account for individual differences that may have impacted the relationships between the independent and dependent variables. Gender was also included as a control variable in this study. All of the aforementioned variables were controlled for in this study given the relative importance of individual differences in users’ perceptions and experiences with media (Oliver & Krakowiak, 2009).

*Experience with the Biggest Loser Series.* Since *The Biggest Loser* series of products has a strong national following, it is possible that participants’ individual experiences with *Biggest Loser* could impact their feelings toward the stimulus material. Even though there are many forms of *Biggest Loser* media, the TV show is by far the most widely distributed and accessible type of media. A single item measure was used to access previous experience with the *Biggest Loser* show accordingly. Participants reported slightly below average experience with the TV series ($M = 2.92, SD = 1.81$, 7-point scale).

*Exercise experience.* As mentioned previously, participants were asked to report how much time they spent exercising during a typical week and weekend. The responses to these items were summed and average to create a metric of weekly exercise activity. Participants reported exercising approximately 7 hours per week ($M = 417$ minutes, $SD = 246$ minutes).

*Experience with exercise media.* Participants were also asked to indicate their experience level with different types of exercise media such as exercise video games, exercise TV shows, and exercise DVDs or videos. Since this study involved having participants use either an exergame or DVD, responses to two single item measures on 7 point scale (1 = *no experience*, 7 = *very experienced*) were used to measure previous experience with these types of media. Participants reported little experience with using exercise video games ($M = 2.55, SD = 1.85$, 7-
point scale) and relatively moderate experience with using fitness videos or DVDs ($M = 3.24, SD = 1.97, 7$-point scale). (See Appendix B for complete measurement instrument).

**Statistical Analyses**

Mean responses for each statement from the different items for each measure were calculated. The items for each dependent measure were used to create scales to test the proposed hypotheses and research questions. In order to test the research questions and hypotheses of interest, correlation analyses and path analysis were used. Prior to running these analyses, the descriptive statistics for all dependent variables were examined for normality (See Table 1).

**Table 1: Descriptive Statistics for Dependent Variables**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>MIN</th>
<th>MAX</th>
<th>Skew</th>
<th>Kurt</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Feedback</td>
<td>4.08</td>
<td>1.53</td>
<td>1.00</td>
<td>7.00</td>
<td>-0.12</td>
<td>-0.89</td>
<td>0.88</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>5.06</td>
<td>1.06</td>
<td>1.67</td>
<td>7.00</td>
<td>-0.64</td>
<td>0.71</td>
<td>0.90</td>
</tr>
<tr>
<td>Exercise Self-Efficacy</td>
<td>6.16</td>
<td>0.87</td>
<td>3.33</td>
<td>7.00</td>
<td>-0.94</td>
<td>-0.01</td>
<td>0.89</td>
</tr>
<tr>
<td>Presence</td>
<td>4.51</td>
<td>1.16</td>
<td>1.40</td>
<td>7.00</td>
<td>-0.31</td>
<td>-0.02</td>
<td>0.85</td>
</tr>
<tr>
<td>Competence</td>
<td>5.69</td>
<td>0.90</td>
<td>3.14</td>
<td>7.00</td>
<td>-0.57</td>
<td>-0.09</td>
<td>0.86</td>
</tr>
<tr>
<td>Behavioral Intention (Exercise)</td>
<td>5.61</td>
<td>0.93</td>
<td>3.17</td>
<td>7.00</td>
<td>-0.37</td>
<td>-0.32</td>
<td>0.76</td>
</tr>
<tr>
<td>Behavioral Intention (Media)</td>
<td>4.54</td>
<td>1.67</td>
<td>1.00</td>
<td>7.00</td>
<td>-0.29</td>
<td>-0.82</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Means and standard deviations appeared acceptable. For most variables, minimum and maximum values indicated that participants had a wide range of experiences during this study. However, three variables (exercise self-efficacy, competence, and behavioral intention toward future exercise) had a more limited range of possibilities signaling that they may not be suitable for further analysis. PASW Statistics 19 was used to check multiple criteria to determine whether
the data were suitable for the analysis. The skewness values for all variables were deemed acceptable (> -1, < 1). The data were also checked for outliers and multivariate normality using Mahalanobis’ distance and z-score criteria (± 3.29) (Kline, 2005; Tabachnick & Fidell, 2001) and the data were deemed acceptable for univariate and multivariate analyses. Although there were only two conditions in this study, descriptive statistics for each condition were examined to ensure that there was no noticeable irregularity with the data. The measured control variables between the two conditions were relatively similar and all of the dependent variables appeared to be acceptable. Table 2 provides a summary of these descriptive statistics.

Checks and Considerations for the Theoretical Path Model

After checking for outliers, skewness, and kurtosis, the data were found to be multivariate normal and deemed acceptable for path modeling. Data were imputed in PASW Statistics 19 with AMOS in order to conduct the path analysis. Before testing a final path model, the bivariate correlations were examined to check for multicollinearity and to determine if the hypothesized paths in the proposed model were significant and directionally appropriate (See Table 3). Amongst the predictor variables, there were no significant correlations greater than .60 indicating a low likelihood of multicollinearity with these data (Kline, 2005). Accordingly, none of the predictor variables were modified before running the final path analysis.

There were a total of fourteen hypothesized relationships in the proposed path model. Although the correlations indicated that a majority of the hypothesized relationships were directionally appropriate and significant, there were five such instances where this was not the case. For H2, H3a, H6, H7a, and H11, the proposed relationships between the variables were directionally appropriate but failed to research significance as predicted, indicating that these particular relationships would need to be reconsidered or possibly dropped from the final path
model. In addition to these concerns, the bivariate correlations also showed that gender, experience with exercise media, experience with exercise generally, and experience with biggest loser media to be correlated with some of the key predictor and dependent variables of interest. Therefore, they were used as control variables in the final path analysis.

Table 2: Descriptive Statistics for Each Dependent Variable by Condition

<table>
<thead>
<tr>
<th>Experimental Condition</th>
<th>Video Game</th>
<th>DVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Feedback</td>
<td>4.85 (1.24)</td>
<td>3.30 (1.39)</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>5.27 (1.06)</td>
<td>4.86 (1.02)</td>
</tr>
<tr>
<td>Exercise Self-Efficacy</td>
<td>6.17 (0.86)</td>
<td>6.15 (0.89)</td>
</tr>
<tr>
<td>Presence</td>
<td>4.74 (1.06)</td>
<td>4.29 (1.21)</td>
</tr>
<tr>
<td>Competence</td>
<td>5.66 (0.85)</td>
<td>5.72 (0.95)</td>
</tr>
<tr>
<td>Behavioral Intention (Exercise)</td>
<td>5.61 (0.92)</td>
<td>5.61 (0.96)</td>
</tr>
<tr>
<td>Behavioral Intention (Media)</td>
<td>5.06 (1.72)</td>
<td>4.02 (1.46)</td>
</tr>
<tr>
<td>Experience with Biggest Loser TV</td>
<td>3.31 (1.99)</td>
<td>2.52 (1.52)</td>
</tr>
<tr>
<td>Experience with Exercise Videos</td>
<td>3.42 (2.07)</td>
<td>3.06 (1.86)</td>
</tr>
<tr>
<td>Experience with Exergames</td>
<td>2.48 (1.73)</td>
<td>2.62 (1.97)</td>
</tr>
<tr>
<td>Weekly Exercise</td>
<td>6.70 (3.82)</td>
<td>7.21 (4.40)</td>
</tr>
</tbody>
</table>

Note. Means listed first followed by standard deviations in parentheses. Weekly exercise was the only variable not measured on a 7-point scale.
Table 3: Bivariate Correlations for All Variables Considered in the Proposed Path Model.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exercise Format</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Gender</td>
<td>-0.08</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Experience with Biggest Loser TV show</td>
<td>0.22*</td>
<td>0.24**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Experience with exercise videos</td>
<td>0.09</td>
<td>0.26**</td>
<td>0.44**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Experience with exergames</td>
<td>-0.04</td>
<td>-0.03</td>
<td>0.19*</td>
<td>0.40**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Weekly exercise</td>
<td>-0.06</td>
<td>-0.14*</td>
<td>0.02</td>
<td>0.16</td>
<td>0.03</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Performance feedback</td>
<td>0.51**</td>
<td>0.05</td>
<td>0.06</td>
<td>-0.07</td>
<td>0.02</td>
<td>-0.05</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Enjoyment</td>
<td>0.19*</td>
<td>0.22*</td>
<td>0.17*</td>
<td>0.15</td>
<td>0.01</td>
<td>0.03</td>
<td>0.36**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Exercise self-efficacy</td>
<td>0.02</td>
<td>0.10</td>
<td>0.21*</td>
<td>0.34**</td>
<td>0.10</td>
<td>0.57**</td>
<td>-0.02</td>
<td>0.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Presence</td>
<td>0.20*</td>
<td>-0.04</td>
<td>0.01</td>
<td>-0.02</td>
<td>0.08</td>
<td>-0.06</td>
<td>0.47**</td>
<td>0.49**</td>
<td>0.01</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Competence</td>
<td>-0.03</td>
<td>0.08</td>
<td>0.16</td>
<td>0.25**</td>
<td>0.13</td>
<td>0.34**</td>
<td>0.17</td>
<td>0.29**</td>
<td>0.51**</td>
<td>0.10</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Behavioral intentions to exercise</td>
<td>0.00</td>
<td>0.15</td>
<td>0.12</td>
<td>0.17</td>
<td>0.09</td>
<td>0.20*</td>
<td>0.26**</td>
<td>0.33**</td>
<td>0.43**</td>
<td>0.33**</td>
<td>0.32**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>13. Behavioral intentions to use exercise media</td>
<td>0.31**</td>
<td>0.25**</td>
<td>0.18*</td>
<td>0.13</td>
<td>-0.02</td>
<td>-0.14</td>
<td>0.39**</td>
<td>0.64**</td>
<td>-0.06</td>
<td>0.54**</td>
<td>0.12</td>
<td>0.35**</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: * p < .05, ** p < .01
Exercise Format was coded as a dichotomous variable: 0 = exercise video, 1 = exergame.
Gender was coded as a dichotomous variable: 0 = males, 1 = female
Chapter 3

Results

In this study, a total of 14 different hypotheses and one research question were proposed. These hypotheses and research questions (advanced in terms of theoretical model) dictated the data collection and analytical strategy that was used. This study was concerned with understanding how mediated exercise formats (exergames and exercise videos) impact a number of different cognitive mechanisms, and users’ future behavioral intentions toward exercise or future use of a particular mediated exercise format. Various path analysis models were conducted in order to test individual hypotheses, research questions, and model fit. Also, bootstrapping procedures were employed to further explain and explore the data. The findings and results of the study are reported according to the hypotheses and research questions. All modifications, supplemental analyses, and details regarding the path models are also discussed.

Test of the Hypothesized Model

To test the hypotheses and paths advanced in the model, data were imported into AMOS v. 19 in order to run path analysis. Although random assignment to experimental procedures should have eliminated the influence of participant characteristics on any of the results, the bivariate correlations (Table 3) indicated that some of the control and predictor variables were related. Therefore, before the path analysis was conducted, gender, experience with exercise videos and exercise games, time spent exercising each week, and experience with Biggest Loser media were employed as control variables.

In order to control for these five variables in the final path model, the residuals of the predictor variable and each of the endogenous variables (errors) were obtained by running eight separate regression analyses in SPSS. Each of the variables in the model was regressed on the
five control variables and the residual values or errors were retained for use in subsequent path models. This procedure has been used previously in order to control for confounding influences or third variable explanations in path analysis (Gunther, Bolt, Borzekowski, Liebhart, & Dillard, 2006). In addition to the controls, latent composite variables were constructed in order to account for measurement error in the model (McDonald, 1996). The error variance for each endogenous variable was set to $\sigma^2 \times (1 - \alpha)$. After preparing the data by accounting for the control variables and measurement error, path analysis with maximum likelihood estimation was performed. The significance of each path was examined in order to answer the proposed hypotheses and research question. Fit statistics were also examined to determine how well the model fit the data. Figure 2 shows all significant and non-significant paths in the hypothesized model.

The first hypothesis (H1) predicted that participants who used motion controllers in the exercise game condition would report greater perceived performance feedback than those who interacted with the exercise video. The path analysis revealed that participants in the exergame condition perceived greater perceptions of performance feedback than those in the exercise video condition ($\beta = .55, p < .001$), thus indicating support for the first hypothesis. Research question one (RQ1) asked how participants’ enjoyment of the exercise experience differed by exercise format. Results of the path analysis indicated that there were no significant differences in feelings of enjoyment by exercise format ($\beta = .05, p = .53$). Although the positive relationship suggests that participants in the exergame condition did enjoy their exercise experience slightly more than those who used the exercise video, these difference failed to reach significance. So in response to RQ1, there were no differences in enjoyment by exercise format. Hypothesis 2 (H2) predicted that perceived performance feedback would be positively associated with feelings of
self-efficacy. This hypothesis was not supported, as the path between performance feedback and self-efficacy was not significant ($\beta = .02, p = .82$).

The third set of hypotheses (H3a & H3b) predicted that feelings of self-efficacy would be positively related to behavioral intentions to use exercise media and intentions to exercise. H3a was not supported, as the relationship between self-efficacy and future intentions to use exercise media was significant, but was not directionally appropriate ($\beta = -.13, p < .05$). However, the path between self-efficacy and future intentions to exercise was significant and positive ($\beta = .39, p < .001$), indicating that H3b was supported. It makes sense that self-efficacy would be related to behavioral intentions to exercise, but this relationship did not appear to be a result of whether or not a person interacted with a particular exercise format.

Hypothesis 4 (H4) predicted that participants in the exergame condition would experience greater feelings of presence than those in the exercise video condition. The relationship between the exercise format and feelings of presence was significant and positive, indicating that participants who played the exergame experienced greater feelings of presence than those who interacted with the exercise video ($\beta = .24, p < .01$). Therefore, hypothesis four was supported. Hypothesis 5 (H5) predicted that feelings of presence would be positively associated with behavioral intentions toward future use of a particular exercise medium. This hypothesis was also supported, as the path between presence and behavioral intentions to use exercise media was significant and positive ($\beta = .36, p < .001$).

Hypothesis 6 (H6) predicted that performance feedback would be positively associated with greater feelings of competence. The path between these two variables was significant and positive ($\beta = .22, p < .05$), indicating that perceived performance feedback was positively related to feelings of competence, thus confirming the original hypothesis. The seventh set of
hypotheses (H7a & H7b) predicted that feelings of competence would be positively related to behavioral intentions to use exercise media and future intentions to exercise. Neither the relationship between competence and intentions to use exercise media was significant ($\beta = .01, p = .90$), nor the path between competence and intentions for future exercise ($\beta = .04, p = .73$) was statistically significant. Therefore, neither of these hypotheses received support.

The next set of hypotheses (H8a & H8b) predicted that enjoyment would be positively associated with behavioral intentions to use exercise media and future intentions to exercise. The paths between enjoyment and behavioral intentions to use exercise media ($\beta = .47, p < .001$) and enjoyment and behavioral intentions to exercise ($\beta = .36, p < .001$) were positive and significant. Therefore, both H8a and H8b were supported. Hypothesis 9 (H9) predicted that feelings of presence would be positively associated with enjoyment. This hypothesis was supported, as the path between presence and enjoyment was positive and significant ($\beta = .57, p < .001$). The next hypothesis (H10) predicted that competence would be positively associated with enjoyment. This hypothesis received support, as the path between competence and enjoyment was positive and significant ($\beta = .26, p < .01$). The final hypothesis (H11) predicted that self-efficacy would be positively related to enjoyment. This hypothesis did not receive support, as the relationship between self-efficacy and enjoyment was not significant ($\beta = -.04, p = .60$). Out of the 14 possible hypothesized relationships, H2, H3a, H7a, H7b, and H11 were not supported. Figure 2 summarizes the path model.

The overall model fit was assessed with the chi-square goodness-of-fit test, root mean square error of approximation (RMSEA) test, the comparative fit index (CFI), and the standardized root mean square residual (SRMR). Because the chi-square test is known to be sensitive to sample size, the additional fit statistics were included to ensure that the fit of the
model was interpreted correctly (Kline, 2005). The overall fit statistics indicated that the model did not fit the data particularly well, $\chi^2 = 77.99, df = 13, p < .001; \text{RMSEA} = .20 \ (90\% \text{ confidence interval} = .17 \text{ to } .24); \ CFI = .76, \ SRMR = .13$.

Figure 2: Original Path Model and Hypothesis Tests

Note. * $p < .05, ** p < .01, *** p < .001$
Numbers appearing in parentheses indicate variance explained by each path.
Exercise Format was coded as a dichotomous variable: 0 = exercise video, 1 = exergame. The endogenous variables in the model reflect residual variables which control for gender, experience with exergames and videos, time spent exercising per week, and experience with Biggest Loser. Measurement error was also accounted for in this model.

There are numerous reasons why the model may have not fit the data, but perhaps the most notable was the model complexity. Therefore, reducing complexity and increasing parsimony was considered as the primary way to improve model fit. As a first step toward increasing model parsimony, the non-significant paths were examined with regard to their theoretical importance and contribution in the original model. Therefore, both theoretical and
empirical modifications were considered in order to improve the model fit. The next section details the decisions that were made to modify the path model.

*Modifications and Supplemental Analysis of the Path Model*

Two of the most common ways to modify a path model is by trimming or adding paths (Kline, 2005). Before looking at the modification indices in order to determine which paths to add, model trimming was first employed to simplify the model and increase its parsimony. Segrin and Nabi (2002) have suggested “trimming” or dropping variables and their associated paths when they are not significant at the .05 level. This criterion has been used in order to improve model fit in other media research (Oliver, Kalyanaraman, Mahood, & Ramasubramanian, 2007). After examining the non-significant paths in light of both theoretical and empirical contributions to the model, the decision to drop specific paths and variables was undertaken in order to improve the fit of the model.

In this study, one of the key moderating variables, self-efficacy, was significantly related to behavioral intentions to exercise. However, self-efficacy did not vary as a result of the experimental manipulation and was not predicted by perceived feedback as originally hypothesized. Therefore, self-efficacy and its associated paths were dropped from the path model. Although competence was theorized to impact both behavioral intentions to use exercise media and to exercise, the model indicated that there was no relationship between these variables. However, because perceived feedback predicted competence, and competence was significantly related to enjoyment, only the two non-significant paths between competence and the behavioral intention measures were dropped from further analyses. A similar decision was made to eliminate the path between exercise format and enjoyment because it was not significant.
The modification indices from the original path model suggested adding a path between perceived performance feedback and presence. Although this relationship was not originally hypothesized, it did make theoretical sense given literature which has shown that specific attributes of a system or mediated interface can increase feeling of presence (Lee, 2004; Lombard & Ditton, 2001). After completing all of these model revisions and re-running the path analysis, model fit improved significantly, $\chi^2 = 27.43$, $df = 12$, $p < .01$; RMSEA = .10 (90% confidence interval = .05 to .15); CFI = .93, SRMR = .07.

The interpretation of significant paths showed that people who played the exergame experienced greater perceived feedback ($\beta = .55$, $p < .001$) than those who used the exercise video. However, there were no significant differences between experimental conditions in feelings of presence ($\beta = -.08$, $p = .44$). In the previous models, there was a significant positive relationship between playing an exergame and experiencing greater feelings of presence. In this model, the path that was added between perceived feedback and presence was positive and significant ($\beta = .60$, $p < .001$), suggesting that feelings of presence are a product of greater perceived feedback from playing the exergame. Perceived feedback was also positively related to feelings of competence ($\beta = .22$, $p < .05$), and feelings of competence were positively related to enjoyment of the exercise experience ($\beta = .23$, $p < .01$). Presence was positively associated with both enjoyment ($\beta = .59$, $p < .001$) of the exercise experience and future intentions use the exercise media ($\beta = .45$, $p < .001$). Enjoyment was positively associated with both intentions to use exercise media ($\beta = .45$, $p < .001$) and future intentions to exercise ($\beta = .40$, $p < .001$). Figure 3 summarizes these findings.

Bootstrapping of the indirect effects of exercise format on the mediating and dependent variables revealed significant total indirect effects of exercise format of feelings of presence ($\beta =
.33, \( p < .001 \)), competence (\( \beta = .12, p < .05 \)), enjoyment (\( \beta = .17, p < .01 \)), behavioral intentions to use exercise media (\( \beta = .17, p < .01 \)), and behavioral intentions to exercise (\( \beta = .07, p < .01 \)). These findings suggest that those who used the exercise video game experienced greater feelings of presence, competence, enjoyment, and behavioral intentions to use the exercise media and exercise than those who participated in the exercise video condition.

*Figure 3: Revised Path Model with Control Variables*

Note. * \( p < .05 \), ** \( p < .01 \), *** \( p < .001 \)
Numbers appearing in parentheses indicate variance explained by each path.
Exercise Format was coded as a dichotomous variable: 0 = exercise video, 1 = exergame.
Model reflects control variables and correction for measurement error. The dotted-line represents a significant unpredicted relationship.

Further bootstrapping analyses showed significant total indirect effects of perceived performance feedback on feelings of enjoyment (\( \beta = .40, p < .01 \)), behavioral intentions to exercise (\( \beta = .16, p < .001 \)), and behavioral intentions to use exercise media (\( \beta = .40, p < .001 \)). These results suggest that experiencing greater performance feedback is associated with greater enjoyment and behavioral intentions toward exercise. Also, presence had a significant indirect
effect on behavioral intentions to exercise ($\beta = .23, p < .001$), and behavioral intentions to use exercise media ($\beta = .27, p < .001$). Based on these results, presence also appears to indirectly influence behavioral intentions toward future use of exercise media and exercise in general. Finally, competence was indirectly related to both behavioral intentions to exercise ($\beta = .09, p < .05$), and behavioral intentions to use exercise media ($\beta = .10, p < .05$). Taken in sum, these results suggest that these variables (performance feedback, presence, and competence) indirectly influence the outcome variables along with enjoyment which directly predicts future intent to use exercise media and exercise in general.

Overall, the results indicate that people who used the exercise video game tended to perceive greater feedback than those who interacted with an exercise video. Greater perceived performance feedback was directly related to feelings of competence and presence, and both of these variables were related to enjoyment of the exercise experience. Both presence and enjoyment predicted future intentions to use an exergame in the future, and enjoyment also predicted future propensity for exercise. Although the revised model fit well and all of the relationships made theoretical sense, another alternative model was computed in order to explore the possibility that intentions to use exergames could predict or motivate behavioral intentions to exercise in general.

*Exploratory Model to Assess the Effectiveness of Exergames*

Many research studies have focused on understanding what predicts exercise program adherence and general motivations to sustain exercise behavior. Research in this area has consistently shown that enjoyment of exercise experience is one of the strongest determinants of exercise behavior (Hagberg, Lindahl, Nyberg, & Hellénius, 2009; Wankel, 1993). Furthermore, research has shown that initial decisions to participate in exercise are driven by many different
personal (e.g., past participation in exercise, mood, and age) and environmental (e.g., social reinforcement and access to exercise equipment) determinants (Dishman, Sallis, & Orenstein, 1985). Based on the aforementioned results of this study, it is clear that playing an exergame elicits greater feelings of perceived feedback, presence, and competence than exercise videos, and that these feelings are related to enjoyment and the subsequent likelihood that individuals will use an exergame in the future. The experience of enjoyment is specifically tied to the use of an exergame and experiences which emanate from using that game. Therefore, it is both theoretically and practically significant to consider that experiences with certain types of exercise media such as exergames could predict future intentions to exercise per se.

Using the logic that previous exercise experience and environmental differences can impact enjoyment and subsequent exercise behavior, it is plausible to think that there could be a relationship where behavioral intentions to exercise predict future intentions to use an exergame. However, if someone intends to exercise, they can seek out many different activities in order to meet this demand. So intending to exercise does not mean that someone would necessarily seek out an exergame.

To test whether behavioral intentions to use an exergame could predict general behavioral intentions to exercise, another revised model was constructed (similar to Figure 3) with slight modifications. First, the non-significant path between exercise format and presence was deleted. Second, a new path between behavioral intentions to use exercise media and intentions to exercise was drawn. The fit statistics indicated that this model fit the data well, $\chi^2 = 22.95, df = 12, p < .05$; RMSEA = .08 (90% confidence interval = .03 to .14); CFI = .95, SRMR = .06. However, the path between enjoyment and behavioral intentions to exercise became non-significant ($\beta = .16, p = .25$), while the path between behavioral intent to use an exergame and
intentions to exercise was significant ($\beta = .32, p < .05$). Once again, bootstrapping showed that exercise format has significant indirect effects on the mediating and dependent variables. Similar to the previous model (Figure 3), exercise format had a total indirect effect on feelings of presence ($\beta = .30, p < .01$), competence ($\beta = .12, p < .05$), enjoyment ($\beta = .20, p < .01$), behavioral intentions to use exercise media ($\beta = .20, p < .01$), and behavioral intentions to exercise ($\beta = .01, p < .05$).

*Figure 4: Exploratory Revised Path Model with Control Variables*

![Diagram of exploratory revised path model with control variables](image)

*Note.* *p* < .05, **p** < .01, ***p** < .001

Numbers appearing in parentheses indicate variance explained by each path. Exercise Format was coded as a dichotomous variable: 0 = exercise video, 1 = exergame. Measurement error was corrected and all variables mentioned previously were also controlled for.

These findings suggest that playing the exercise video game led to greater feelings of presence, competence, and enjoyment. Furthermore, participants reported that they would be more likely to use an exergame, and that using an exergame was related to future behavioral intentions to exercise. To test for an alternative explanation of the relationship between the behavioral intentions variables, an additional model was computed. In this alternative rival...
model, the path between intentions to use exercise media and intentions to exercise was reversed so that behavioral intent to exercise predicted intent to use exercise media. This model fit was almost identical to the first exploratory model, $\chi^2 = 26.14$, $df = 12$, $p < .01$; RMSEA = .10 (90% confidence interval = .05 to .15); CFI = .93, SRMR = .07, however, the path between intention to exercise and intentions to use exercise media was not significant ($\beta = .12$, $p = .17$). All of the other paths in the model were significant. Although both the first and second alternative path models were somewhat exploratory in nature, the first alternative model (Figure 4) was determined to be more theoretically and empirically appropriate than the second model.

*Summary of Results*

To conclude, each of the revised models (Figure 3 and Figure 4) show that playing an exergame is significantly related to feelings of increased performance feedback. Performance feedback is related to feelings of presence with the exercise media and general competence to exercise. Both presence and competence predict enjoyment, and enjoyment is related to behavioral intentions for continued use of an exergame. Presence impacted intentions for continued use of the game directly and through enjoyment. In the final model, behavioral intentions for continued use of an exercise game was related to general behavioral intentions toward future exercise. These findings are theoretically and practically interesting, especially given the recent rise and use of commercially available exergames. The significance of these findings and the key contributions of this study will be expanded upon in the discussion section.
Chapter 4
Discussion

This study examined the utility, processes, and effects of using mediated exercise formats. Premised on theories of behavioral change, persuasion, and new technology, the purpose of this study was to examine how technological differences in mediated exercise formats impacted various user experiences and subsequent intentions to use such exercise technology or intentions to exercise in general. Because exergames are a new and promising type of exercise technology, the results of this study provide a good starting point for understanding how specific characteristics of these games impact specific user experiences. Though the proposed theoretical model had numerous shortcomings, the final revised path model provided much insight into what really drives users to want to use exergames, and highlighted some key variables of interest for future research in this area. This section discusses the results of each of the specific hypotheses, general implications, limitations, contributions, and suggestions for future research.

Overview and Explanation of Hypotheses/Research Question

In testing the first hypotheses, a significant main effect of the type of exercise format on feelings of perceived performance feedback emerged, with individuals experiencing greater perceived performance feedback while playing an exergame versus interacting with an exercise video. This finding is not that surprising given the fact that exergames dynamically link a player’s performance with certain types of feedback. For example, while a player is performing exercises during the game, they are also receiving visual on-screen feedback that is directly linked to their performance, as well as verbal encouragement from the trainer. In contrast, exercise videos mainly provide auditory feedback. Even though both types of exercise media provide positively-valenced feedback, the difference in perceptions of feedback that users
experienced was most likely due to technological affordances. Exergames provide for multiple modalities of input and output. Research from other media domains has shown that multimodal media can provide users with experiences that are superior to similar media that do not have such affordances (Sundar, 2007, 2008). The support for the first hypothesis is consistent with the idea that the exergame was perceived as more interactive and engaging than the similar mediated exercise format.

The second hypotheses predicted that perceived performance feedback would be positively associated with exercise self-efficacy. However, this hypothesis did not receive support. There are a number of potential reasons why this relationship may have been non-significant. Generally, participants who took part in this research reported very high feelings of self-efficacy regardless of which experimental condition they were assigned to. One possible explanation of this could be that the sample population felt efficacious about exercising in general. Even though this may have been the case, there is also a potential theoretical explanation for this non-significant finding. Bandura (1982, 2009) suggests that self-efficacy can be bolstered by simply modeling certain types of behavior. Even though participants felt that they were receiving more feedback from the game than the video, both types of media still allowed for enactive rehearsal of specific exercise behaviors. Therefore, this similarity alone could explain why participants did not differ in their self-efficacy toward exercise.

The third set of hypotheses (H3a & H3b), predicted a relationship between self-efficacy and the two primary dependent variables, behavioral intentions to exercise and intentions to use specific exercise media. Although significant, the results indicated that self-efficacy was negatively related to future use of exercise technology, so this part of the third hypothesis was not supported. The fact that there was a negative relationship between self-efficacy and future
use of technology suggests a few things. Since feelings of self-efficacy across the sample population were generally high, the exercise routines that participants were exposed to may have not been challenging or varied enough for them to feel that future use of that technology would be beneficial. If self-efficacy had varied as a result of the experimental manipulation, then the hypothesized relationship should have emerged. Therefore, this unexpected finding could be explained by both the characteristics of the sample population and their interactions with the stimulus material. In response to the second part of the third hypothesis, self-efficacy was strongly associated with future behavioral intentions to exercise. This finding makes intuitive sense and does not deviate from what the larger body of literature involving social cognitive theory would predict. Nevertheless, it is important to note that self-efficacy did not vary as a result of the experimental manipulation and was dropped from the final path model.

The fourth and fifth hypotheses received support. In recent years, research has consistently shown that interactive and virtually immersive technologies increase feelings of presence and other cognitive outcomes (Rimmer & Krueter, 2006; Skalski & Tamborini, 2007; Tamborini & Skalski, 2006). Even though exergames are not virtually immersive, they do provide players with the ability to impact the game environment. In theory, the exergame should have been more presence-inducing than the exercise video, but this assertion could not be verified without empirical support. The results of this study showed that participants who played the exergame did feel more present in the mediated environment than those who used a similar exercise video. In support of the fifth hypothesis, there was also a relationship between presence and future intentions to use exergames. Theoretically, these findings make sense. Presence has been known to increase positive perceptions of media content across many domains, and exergames do not appear to be any different.
The sixth hypothesis predicted that perceived performance feedback would be related to feelings of competence. This hypothesis supported. Once again, even though participants in both experimental conditions experienced some form of feedback, the feedback given in the exergame was multimodal and dynamically linked to user actions. In the context of sport and leisure, research has shown that verbal feedback and encouragement can influence the motivational climate and subsequent feelings of intrinsic motivation (Ntoumanis, 2002; Vallerand & Losier, 1999). Even though this study does not shed light on the specific aspects of feedback that could be enhancing feelings of competence, it is clear that different characteristics or technologies associated with exergame are superior to that of the exercise video. Despite the fact that increases in intrinsic motivation have been found to globally impact the propensity toward certain behaviors which are fulfilling (Deci & Ryan, 1985; Ryan & Deci, 2000), neither of the hypotheses which linked competence to behavioral intentions (H7a & H7b) received support. So although the exergame appeared to be more intrinsically motivating than its similar mediated counterpart, feelings of competence did not directly influence intentions for future use of exercise technology or intentions to exercise in general.

Research question one and both parts of the eighth hypothesis were focused on understanding how enjoyment differed by exercise format and if enjoyment could increase the propensity for intentions to exercise and to use exercise media. This question was proposed because research has shown that more sophisticated technologies do not always lead to greater experiences with media content (Bucy, 2004; Limperos et al., 2011). Results indicated that enjoyment did not differ by exercise format. However, in support of both parts of H8, enjoyment predicted both intentions to exercise and intentions to use exercise technology. Although there was no main effect of exercise format on enjoyment, the total indirect effects suggest that user
perceptions contribute to enjoyment of the exercise experience which is ultimately linked to future intentions to use exercise media and exercise in general.

The final three hypotheses (H9, H10, and H11) all focused on specific relationships between enjoyment and the other mediating variables. Results indicated that presence and competence were positively related to enjoyment, while self-efficacy was not. Previous research focusing on video games has indicated that presence, as well as autonomy and competence can contribute to game player experiences such as enjoyment (Tamborini et al., 2010; Ryan et al., 2006). Even though self-efficacy was hypothesized to predict enjoyment, this hypothesis was not supported. This non-significant finding could again be symptomatic of the fact that the measure of self-efficacy had little variance. Even though one would expect efficacy to be related to enjoyment, it is plausible for someone to be efficacious about a particular behavior without actually enjoying the performance of that behavior.

Revised Path Model and Theoretical Implications

The original path model which included all of the variables and proposed relationships did not fit the data well. Therefore, the original model was revised and the modified path model appears to provide a good picture of specific mechanisms and effects of the exercise format in this study. One of the first and most important conclusions that we can draw from the final model is that playing an exergame is significantly different than using an exercise video, mainly in terms of the user experiences of feedback and presence. Simply put, people felt that they were receiving more feedback (based on their performance and actions) when they used the exergame relative to an exercise video. While exercise format did not directly impact many of the dependant variables, the significant indirect effects in the model operated through performance feedback, underlying its theoretical and practical significance for researchers, health
professionals, and game designers alike. From a health or exercise standpoint, both exercise videos and exergames might have utility in getting people to move, but this research suggests that exergames are more effective because they dynamically link users movement with feedback. This feedback emanating from the use of exergames predicted feelings of presence, competence, and enjoyment which were ultimately related to future use of exergames and exercise in general. Therefore, when considering what ultimately contributes to the effectiveness of exergames, both designers and health professionals alike should be concerned with creating or using games which cue perceptions of feedback. For game designers, it would be ideal to include specific features or technological affordances which enhance feedback experiences, as this would likely contribute to the overall effectiveness of exercise video games.

Even though the experience of performance feedback was a key difference by exercise format, another interesting aspect of this research is that enjoyment appears to be a key predictor of whether people intend to use an exergame or exercise generally in the future. Even though there was no direct effect of exercise format on enjoyment in the model, the total indirect effect of enjoyment was primarily driven by the combination of perceived feedback, presence, and feelings of competence. In trying to answer the general question of why exergames are effective, the revised model sheds light on how specific interactions with the gaming technology, impact user experiences, and ultimately the likelihood that people would consider using an exergame in the future.

Further revisions to the path model suggest that future intention to use exergames can actually predict future intentions to exercise. This finding is important because it shows that experiences of playing an exergame can not only promote future use of that game, but can potentially motivate people to exercise outside of the gaming environment. Since this finding
was confirmed in light of a non-significant path in an alternative model, it is by no means a causal claim and should be interpreted with caution. While there is much debate about whether exergames are generally viable at helping people achieve weight loss or exercise in general, this research suggests that the effectiveness of any mediated exercise format is dependent on the ability of that medium to provide feedback and to cue feelings of good will and enjoyment. Even though there is growing body of research which suggests that technology can sometimes inhibit or interfere with the transmission or reception of certain content (Bucy, 2004; Limperos et al., 2011; Vorderer & Klimmt, 2006), this research suggests that having a technologically advanced exercise format is far superior to that of a more traditional format.

Despite the hypothesized path model needing revisions, the general relationships of the variables still trended in the direction of what was originally proposed. Although the variables in the research model were not rooted in one unifying theory, the results are theoretically interesting and they lend support to different aspects of the theory of reasoned action, self-determination theory, socio-cognitive theory, and the effects of technologies on user experiences. Given the fact that the technology was the main point of departure between the two types of mediated exercise environments in this research, the MAIN model (Sundar, 2008) is perhaps one theoretical perspective in which these findings can be contextualized. This is largely because specific modality based technological affordances had a significant impact on user perceptions and outcomes that were linked to those affordances.

Finally, it cannot be understated that performance feedback contributed to enhanced feelings of presence and competence which ultimately predicted enjoyment and future intent to use an exergame. This finding is consistent with the idea that enjoyment is a key construct for understanding experiences with entertainment media (Vorderer, Klimmt, & Ritterfeld, 2004).
Research indicates that there are numerous ways to explain media and enjoyment and this often varies by the type by media content and domain (Oliver & Bartsch, 2010). So in the absence of any single unifying theory of enjoyment, one the main theoretical contributions of this research is that it highlights the specific experience of performance feedback with configurations of variables associated with enjoyment of exergames. Although it is debatable whether exercise media can be considered as “entertainment” media, this study suggests that exergaming is an inherently entertaining and enjoyable activity.

Practical Implications

The commercial scale proliferation of exercise video games which started with the introduction of Nintendo’s Wii Fit in 2007 has continued to grow in recent years. This research suggests that exergames may be more viable for encouraging actual exercise then exercise videos. Though this study does not tell us how well exergames work at encouraging weight loss or curbing inactive lifestyles, the results suggest that the technological features of exergames can motivate (though experiences of feedback, competence, presence) and shape peoples’ intentions to use and reuse them to exercise in the future. Furthermore, the exploratory analysis showed that intent to use exergames was linked to future intent to exercise. In the absence of actual measures of exercise behavior or longitudinal data, these data suggest that even a short-exposure to an exergame can encourage people to want to revisit and use this type of media in the future.

Even though this study does not examine the net health benefits of exergames, it does show that interactive exercise can be an enjoyable experience. People who normally find exercising to be very boring or cumbersome can potentially find a fun, enjoyable, and intrinsically fulfilling alternative in the form of exergaming. Although it appears that exergames have much promise as an exercise companion, it is important to note that intentions do not
always predict behavior. For example, someone could buy an exergame with the intentions of using it regularly to exercise; however, it is unknown whether a person would continue to use that technology or if the technology could promote general exercise behavior over an extended period of time. In other words, it is possible that someone could buy the necessary technology in order play an exergame, but fail to continue to use that technology to exercise. Even though this research suggests that intentions to use an exergame are related to general propensities for exercise, this finding should be interpreted with caution, as there are numerous factors that could impact the ability to continue or sustain the motivation to exercise.

Limitations and Future Research

As is the case with a majority of studies, the results of this research can only be generalized to the sample population. According to the Entertainment Software Association (2011), the typical gamer in the United State is approximately 34 years old. It would be beneficial to see future research focus on other populations, specifically those who are not at the peak of their physical condition (as is often the case with college students). Because participants in this study reported exercising for a little over 7 hours per week, there were some variables (such as self-efficacy) that did not work out in the hypothesized model. It makes sense that self-efficacy for exercise was generally high across the sample population because participants reported that they spent a lot of time exercising per week. This is yet another reason that future research would benefit from a more diverse sample population.

Even though a very popular and recognizable exercise series (Biggest Loser) was used for this research, it is always a possibility that different games and videos could lead to results that differ from those reported in this study. Since the exergame catalogue is already rather large and continues to grow, it will remain important for future studies to look at other popular fitness
games. Even though using the *Biggest Loser* media could be regarded as a limitation, it did allow for a strict comparison because the game and video were so similar.

Another limitation of this research was the design of the study. Video game studies (especially those in the realm of health promotion) are often plagued with not being able to answer if effects are short or long-term. Even though participants reported that they intended to use the exergame more so than the exercise video, there is no way to tell whether these intentions would translate into actual behavior or if they could be sustained over a long period of time. Once participants leave the lab, there is no guarantee that they would ever seek this type of technology again or what the impact of repeated use of such technology might be. Therefore, it is important for future research to assess the impact of exercise technology in a longitudinal manner. Furthermore, while performance feedback seemed to be the main difference between the exergame and the exercise video, there is no way to tell whether this difference would be enduring over time. With regard to the exergame used in this study and for most exergames in general, the feedback provided by the exercise medium becomes increasingly repetitive with repeated play. So while participants reported that they perceived greater feedback from the exercise media after a one time exposure, there is a possibility that the feelings of perceived performance feedback and the experiences emanating from it could diminish over time with repeated exergame use. Therefore, future research should focus on this limitation to rule out the possibility that the relationships reported in this study are not due to novelty.

Yet another limitation was the small number of social, psychological, and technological constructs that were manipulated and measured in this study. In fact, emergent research on exergaming suggests that other technological features such as use of an avatar can have significant impacts on user experiences of exergames (Song, Peng, & Lee, 2011). Therefore,
future research should focus more broadly on understanding how a variety of individual characteristics, technological features, and responses to that technology help shape outcomes of the exergaming experience. While competence was found to be a central explanatory mechanism in this research, it is only one dimension of intrinsic motivation. Future research should explore the potential relationship between specific technological features and gameplay scenarios afforded by exergames and the other dimensions of intrinsic motivation, autonomy and relatedness. Perceived performance feedback differed significantly between both the exergame and exercise video. Although this measure essentially tapped perceived feedback from the system, future research would benefit by expanding, differentiating, and further explaining exactly what aspects of feedback are linked with specific user experiences. Also, it may be theoretically interesting to manipulate the type and valence of the feedback in future research studies. Such a pursuit is likely to help further disaggregate and link features of technology with specific outcomes of the playing experience.

In light of new motion sensing technology in the video game industry, there are additional limitations to this research. While Nintendo introduced commercial exergaming with its motion-sensing controls and balance board, new control systems introduced by Microsoft now allow users to impact exergame environments without using controllers. Microsoft’s X-Box Kinect is a camera which can sense player motion and recreate it in the gaming environment. So while it appears that using the Nintendo Wii creates more presence and elicits greater feelings of enjoyment than a traditional exercise video format, this new system might be even better than Wii because it allows users to interact without controls. Also, the technology acceptance model (TAM) predicts that future use of any technology is largely predicted by how easy it is to use that technology (Davis, 1989). Although “ease of use” was not measured in the current study, this
variable will be important for future research efforts, especially in light of competing and innovative technological formats. Even though any findings which show that exergaming is viable avenue for encouraging exercise behavior are important, it will remain vital to continually theorize and understand how the evolution of gaming technology is impacting the processes and effects of exergames.

Summary and Conclusions

The results of this study indicated that participants who used an interactive exergame experienced heightened feelings of performance feedback, presence, competence, and enjoyment. These experiences, specifically enjoyment and presence, predicted future intentions to use exergames and to exercise in general. While we are just starting to learn about how much specific features of video games are beneficial in health intervention and clinical outcomes, this research suggests that commercially available exercise games might be just as effective in encouraging and motivating exercise behavior and healthy lifestyles as the games that were being used to teach children to care about diabetes in the late 1990s.

As the home exercise and video game industries continue to develop and offer more avenues and opportunities for individuals to exercise, the findings of this research suggest that content of particular exercise formats in largely inconsequential. Instead, it is the technology and technological features which really impact the experiences that individuals have with particular exercise media. While this is only one study and many important questions remain, this research does shed light on both the theoretical and technological linkages that underlie the cognitive processes associated with the use and future use of exergames. Although the findings reported in this study are merely one small piece of a complex puzzle, they do serve to highlight some key variables which are likely to be both relevant and applicable for future research which attempts
to understand how exergames motivate people toward healthy lifestyles and behavioral outcomes.
References:


Appendix A
Screen Shots of *the Biggest Loser* Exercise Media

*Example of lateral lunges in exercise video condition*

*Example of lateral lunges in exercise video game condition*
Example of jumping jacks in exercise video condition

Example of jumping jacks in the video game condition
PAR-Q (Physical Activity Readiness Questionnaire)

Regular physical activity is fun, healthy, and enjoyable. However, there are certain instances where people need to consult with a doctor before partaking in physical activity. This questionnaire will tell you if you are fit for physical activity and do not have any risk factors which would require medical consultation.

**Directions:** Please read each of the questions carefully and answer each of them as honestly as possible. Circle “Yes” or “No.”

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
   - Yes or No

2. Do you feel pain in your chest when doing physical activity?
   - Yes or No

3. In the past month, have you had chest pain when doing physical activity?
   - Yes or No

4. Do you lose your balance because of dizziness or do you ever lose consciousness?
   - Yes or No

5. Do you have a bone or joint problem (e.g., knee, back, hip) that could be made worse by a change in your physical activity?
   - Yes or No

6. Is your doctor currently prescribing drugs (e.g., water pills) for your blood pressure or heart condition?
   - Yes or No

7. Do you know any other reason that you should not participate in physical activity?
   - Yes or No
Questionnaire 1

*Please read the instructions for each section and answer the corresponding questions as honestly and as best as you can.*

Indicate your biological sex (gender) by circling one of the following choices:

Male                    Female

Please indicate your age: _______

Academic Standing:

- Freshman____
- Sophomore____
- Junior____
- Senior (+)____

To the best of your abilities, please indicate how much time you spend playing video games during a typical week (Monday through Friday).

I play video games for _____ hours and _____ minutes during a typical week.

To the best of your abilities, please indicate how much time you spend playing video games during a typical weekend (Saturday through Sunday).

I play video games for _____ hours and _____ minutes during a typical weekend.

The following questions ask you to rate your experience with specific video game systems. Please circle the number which best represents your experience each game console:

**Nintendo Game Cube**

- No experience
- Very Experienced

1------2------3------4------5------6------7

**Nintendo Wii**

- No experience
- Very Experienced

1------2------3------4------5------6------7

**Sony Playstation 2**

- No experience
- Very Experienced

1------2------3------4------5------6------7

**Sony Playstation 3**

- No experience
- Very Experienced

1------2------3------4------5------6------7
The following questions ask you to rate your experience with specific video games. Please circle the number which best represents your experience each of these particular video games:

**Microsoft Xbox**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

**Microsoft Xbox 360**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

**Nintendo Wii Fit (Wii Fit Plus)**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

**Dance-Dance Revolution**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

**EA Sports Active Trainer**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

**Wii Personal Trainer**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

**The Biggest Loser**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

**Your Shape Fitness Evolved**
- No experience
- Very Experienced
  
  1------2------3------4------5------6------7

To the best of your abilities, please indicate how much time you spend watching TV during a typical week (Monday through Friday).

I watch TV for _____ hours and _____ minutes during a typical week.
To the best of your abilities, please indicate how much time you spend watching TV during a typical weekend (Saturday through Sunday).

I watch TV for _____ hours and _____ minutes during a typical weekend.

The following questions ask you to rate your experience with specific TV shows. Please circle the number which best represents how much you have watched or experienced each of these particular TV shows.

The Biggest Loser
No experience (never watched) Very Experienced (Have watched a lot)
1------2------3------4------5------6------7

Celebrity Fit Club
No experience (never watched) Very Experienced (Have watched a lot)
1------2------3------4------5------6------7

FitTV
No experience (never watched) Very Experienced (Have watched a lot)
1------2------3------4------5------6------7

Losing It with Jillian Michaels!
No experience (never watched) Very Experienced (Have watched a lot)
1------2------3------4------5------6------7

Work Out (on Bravo)
No experience (never watched) Very Experienced (Have watched a lot)
1------2------3------4------5------6------7

Gilad’s Bodies in Motion
No experience (never watched) Very Experienced (Have watched a lot)
1------2------3------4------5------6------7

To the best of your abilities, please indicate how much time you spend exercising (e.g., at home, in a gym, playing sports) during a typical week (Monday through Friday).

I exercise for _____ hours and _____ minutes during a typical week.

To the best of your abilities, please indicate how much time you spend exercising (e.g., at home, in a gym, playing sports) during a typical weekend (Saturday through Sunday).

I exercise for _____ hours and _____ minutes during a typical weekend.
The next set of questions asks you to rate different experiences that you have with exercise. Please circle the number which best represents your different experiences with these different types of exercise.

**Exercising in a gym**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Playing sports**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Exercising at home**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Exercising with a video or DVD**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Participating in outdoor activities**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Exercising with a video game**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Jogging or Running**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Power walking or taking long walks**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Exercising along with a TV program**
- No experience
- Very Experienced
  1------2------3------4------5------6------7

**Cycling**
- No experience
- Very Experienced
  1------2------3------4------5------6------7
Yoga or Pilates

No experience

1------2------3------4------5------6------7

Very Experienced

Other (please write and indicate level of experience): ________________________________

No experience

1------2------3------4------5------6------7

Very Experienced
Questionnaire 2

The following questions are based on the exercise experience you just had. Please answer each section of questions as honestly and as best as you can.

Please rate the following items in regard to how much you enjoyed your exercise experience.

While I was exercising, I was thinking about how much I enjoyed it.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Neutral</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I found exercising with to be very boring.

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<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I thought exercising was very enjoyable.

<table>
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<th>5</th>
<th>6</th>
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</tr>
</thead>
<tbody>
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<td>Neutral</td>
<td>Strongly Agree</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

I would describe my exercise experience as pleasant and enjoyable.

<table>
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</tbody>
</table>

This particular way of exercising was very fun.

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</tr>
</tbody>
</table>

I was disappointed with the exercise experience I had today.

<table>
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Recall the experience you just had with the Biggest Loser exercise media. Please rate the following items with regard to how competent and motivated you felt at the end of your experience?

I felt as if I had mastery of the exercises.

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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The exercise environment kept me on my toes but did not overwhelm me.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

I felt as if I had mastery of the exercise media.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

I felt capable and competent in my abilities while using the exercise media.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

I did not feel comfortable or proficient while exercising.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

My skill and the challenges presented in the exercise environment were equal.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

I did not feel comfortable or proficient while using the exercise media.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

The exercises challenged me, but did not overwhelm me.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

I felt capable and competent in my ability to exercise.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

My fitness level and exercise challenge were equal.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree
I felt controlled and pressured by the exercise challenge.

1------------2------------3------------4------------5------------6------------7
Strongly Disagree       Neutral       Strongly Agree

The exercises that I did were what I wanted to do.

1------------2------------3------------4------------5------------6------------7
Strongly Disagree       Neutral       Strongly Agree

I felt a sense of freedom while exercising.

1------------2------------3------------4------------5------------6------------7
Strongly Disagree       Neutral       Strongly Agree

My sense of independence was bolstered by exercising.

1------------2------------3------------4------------5------------6------------7
Strongly Disagree       Neutral       Strongly Agree

The exercise environment allowed me to do what I wanted to do.

1------------2------------3------------4------------5------------6------------7
Strongly Disagree       Neutral       Strongly Agree

I felt a sense of freedom while using this exercise media.

1------------2------------3------------4------------5------------6------------7
Strongly Disagree       Neutral       Strongly Agree

My sense of independence was bolstered by using this exercise media.

1------------2------------3------------4------------5------------6------------7
Strongly Disagree       Neutral       Strongly Agree

Reflecting on the experience you just had, please rate how involved you were with mediated exercise format.

How intense was the experience?

1------------2------------3------------4------------5------------6------------7
Not At All       Neutral       Very Much

How involving was the exercise experience?

1------------2------------3------------4------------5------------6------------7
Not At All       Neutral       Very Much
To what extent did you feel as if you were inside the exercise environment?

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much

To what extent did you feel like you were immersed in the exercise environment?

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much

To what extent did you feel like there was a technological boundary between you and the exercise environment?

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much

To what extent did you experience a sense of reality?

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much

Did you feel surrounded or engaged with the exercise environment?

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much

How completely were your senses engaged?

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much

How engaging was the exercise experience?

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much

To what extent did you feel a sense of “being there” in the exercise environment.

1------------2-----------3-------------4-------------5-------------6-------------7
Not At All                Neutral                Very Much
Please answer by circling the appropriate number for the following questions in regards to your perceived ability, beginning with the phrase:

“I am confident that…”

I could participate in exercise regularly.

1--------------2------------3------------4------------5------------6------------7

Strongly Disagree Neutral Strongly Agree

I am good at exercising.

1--------------2------------3------------4------------5------------6------------7

Strongly Disagree Neutral Strongly Agree

I could exercise on my own.

1--------------2------------3------------4------------5------------6------------7

Strongly Disagree Neutral Strongly Agree

I could exercise multiple times in a week.

1--------------2------------3------------4------------5------------6------------7

Strongly Disagree Neutral Strongly Agree

I could maintain a regular exercise program.

1--------------2------------3------------4------------5------------6------------7

Strongly Disagree Neutral Strongly Agree

I could exercise well in a gym.

1--------------2------------3------------4------------5------------6------------7

Strongly Disagree Neutral Strongly Agree

The following questions pertain to your perceptions of feedback in the exercise environment and from the exercise medium (Biggest Loser).

The feedback I received from the exercise media let me know I was exercising correctly.

1--------------2------------3------------4------------5------------6------------7

Strongly Disagree Neutral Strongly Agree
The exercise medium provided me with feedback based on my exercise behavior.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

The exercise medium provided me with feedback related to my exercise performance.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

The encouragement I received from the system while exercising was valuable.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

The exercise medium took my performance into account and offered me feedback based on that performance.

1--------------2------------3------------4------------5------------6------------7
Strongly Disagree     Neutral       Strongly Agree

This set of questions asks you to rate how interactive your exercise experience was. Please answer as best as you can.

My experience with this exercise format was interactive.

1--------------2------------3------------4------------5------------6------------7
Not At All                 Neutral         Very Much

The exercise media was responsive to my actions.

1--------------2------------3------------4------------5------------6------------7
Not At All                 Neutral         Very Much

The exercise media adapted and changed based on my input.

1--------------2------------3------------4------------5------------6------------7
Not At All                 Neutral         Very Much

My actions had an impact on the exercise experience that I had.

1--------------2------------3------------4------------5------------6------------7
Not At All                 Neutral         Very Much
This set of questions asks you to think about your exercise experience today and indicate how much you would like to exercise in general or use a particular type of media to exercise in the future.

The experience I had today made me want to start exercising regularly.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree

Based on my experience today, I would consider exercising regularly in the future.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree

At the next available opportunity, I intend to participate in some form of exercise.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree

Within the next few weeks I plan to start exercising regularly.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree

I am not planning to exercise regularly in the future.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree

During the next 30 days, I intend to exercise.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree

I would use this particular media to exercise in the future.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree

If I had access to this particular exercise media, I would use it to exercise regularly in the future.

1------------2----------3-----------4----------5---------6----------7
Strongly Disagree   Neutral   Strongly Agree
If I owned this particular exercise media, I would use it to exercise regularly.

1------------2-----------3-----------4-----------5-----------6-----------7
Strongly Disagree   Neutral   Strongly Agree

If given the opportunity, I would purchase and use this exercise technology again.

1------------2-----------3-----------4-----------5-----------6-----------7
Strongly Disagree   Neutral   Strongly Agree

Given the experience and opportunity to use this exercise media in the future, I would definitely do it.

1------------2-----------3-----------4-----------5-----------6-----------7
Strongly Disagree   Neutral   Strongly Agree

The researchers that conducted this study are planning similar studies in the forthcoming semesters at Penn State University. Please answer the following two questions.

If you had the opportunity, would you be willing to participate in a study that is similar to this one in the future?

_____ YES

_____ NO

How likely or unlikely would you be to participate in a similar study?

1------------2-----------3-----------4-----------5-----------6-----------7
Not Likely   Neutral   Very Like
Anthony Michael Limperos  
*Curriculum Vitae*

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**Ph. D.**  
College of Communications  
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Dissertation chairs: Drs. Mary Beth Oliver and S. Shyam Sundar  
Committee: Drs. S. Shyam Sundar, Michael Schmierbach, Ed Yoder

**M. A.**  
School of Communication Studies  
Kent State University, 2006  
Major cognate: Media Studies & Media Effects  
Thesis chair: Dr. Paul Haridakis  
Committee: Drs. Stanley Wearden, Gracie Lawson-Borders

**B. A.**  
School of Communication Studies  
Kent State University, 2004  
Major cognate: Interpersonal & Public Communication  
Minor: Computer Information Systems

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- Pro-social effects of serious video games and gaming technology  
- Media, motivation, and cognition  
- Social and psychological impacts of video games  
- Uses, gratifications, and effects of new communication technology  
- Computer-mediated communication and the effects of online social media

**Publications**
