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A Comparison of Recreation Therapy Intervention using Nintendo Wii™ Bowling with Participation in a Tai Chi Program on Balance, Enjoyment, and Leisure Competence of Older Adults in a Community Based Setting

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A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Parks, Recreation, and Tourism Management

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by
Hollie E. Summey
December 2009

Accepted by:
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Dr. Jeffrey Hallo

ABSTRACT

Many older adults experience a decrease in physical activity, which often leads to decreases in functioning. Older adults have been shown to have the lowest levels of physical activity for all age groups. This lack of physical activity has been shown to lead to decreases in performance of activities of daily living (ADLs), independence, quality of life, and increases in number of falls, chance of institutionalization, morbidity, and mortality. Physical activity programs in community settings help to restore or maintain physical function and lessen the level of dependence so that individuals will be able to reach the highest level of functioning possible. In recent years, virtual reality (VR) has been incorporated into both programming for older adults and functional improvement through rehabilitation. VR provides three key elements for functional improvement and rehabilitation: repetition, feedback, and motivation. Research has shown that interventions incorporating VR result in improvements in upper extremity and hand function, lower extremity function, balance, fall reduction, and improved ability to perform ADLs. Following the development of the Nintendo Wii™, many community-based, long term care, and rehabilitation facilities have begun incorporating its use in their programs. Currently there is very limited existing research on the use of the Nintendo Wii™ in rehabilitation, community-based, or other long term care settings. This study examined the effects of an intervention using the Nintendo Wii™ on physical functioning in older adults in a community-based setting.

Results indicate that the Nintendo Wii™ would be beneficial in increasing balance, leisure skills competence, and potentially provide an optimal flow experience for

older adults in a community setting. Visual analysis of the data indicated that participants in both groups experienced a mean decrease in Timed Up an Go (TUG) times, mean decrease in balance confidence, and a mean increase in leisure skills competence. While both groups demonstrated a decrease in mean TUG times and Leisure Skills Subscale of the Leisure Competence Measure (LSS LCM) scores, the intervention group experienced a larger decrease than the control group. Although both groups demonstrated a mean decrease in balance confidence, 5 of the intervention group participants and 2 of the control group participants experienced an increase in Activities-Based Balance Confidence (ABC) scores. Split-middle calculation estimates indicated that both groups demonstrated a decelerating trend in mean balance confidence and a mean accelerating trend in leisure skills competence. The intervention group experienced a decelerating trend in TUG times, while the control group experienced an accelerating trend.

ACKNOWLEDGEMENT

I would like to thank all of the individuals involved in the completion of this study. First, I would like to acknowledge all of the participants, members, and staff of Pickens County Seniors Unlimited who allowed me the opportunity to work with them. I truly enjoyed working with such wonderful people. Secondly, I would like to thank my wonderful committee, Dr. Lynne Cory, Dr. Fran McGuire, and Dr. Jeffrey Hallo for seeing me through all of the successes and setbacks that came along with this study. Your guidance, support, and words of encouragement helped me to make it through even the most discouraging moments. I could not go without thanking my wonderful family and friends who provided unending support and encouragement, especially my amazing parents, Mom, Dad, and Jeff, and wonderful husband, Travis. I could not have accomplished this without the support of all of you, and for all of your support I am truly thankful.

Finally, I would like to take a moment to acknowledge Dr. Judith Voelkl for instilling in me her love and passion for working with older adults. In the short time I had to work with her, I came to realize the importance of working to bring opportunities for meaningful engagement to the lives of the older adults I worked with and will work with in the future. The knowledge I gained through her instruction and her work will remain with me throughout my career in the therapeutic recreation field and allow me to bring a higher quality of life to those I serve.

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CHAPTER ONE

INTRODUCTION

Introduction

The population of older adults is rapidly increasing with the number of individuals over the age of 60 doubling to 1.2 billion from 2000 to 2005 (World Health Organization, 2002). Of these individuals, the population of those 80 years of age or older will likely increase from 88 million to 402 million from 2005 to 2050 (Population Division of the Department of Economic and Social Affairs DESA of the United Nations Secretariat, 2007). Many older adults remain physically inactive even though it has been shown to improve well-being, balance, strength, endurance, and the ability to perform activities of daily living (ADLs) (Shephard, 1994). Physical inactivity is highest among individuals aged 65 and older (CDC, 1999). By increasing physical activity among older adults in a community based setting, the physical functioning of these individuals may also increase, leading to increases in the ability to maintain performance of ADLs, decreases in the number of falls, increased independence, increased quality of life, decreased chance of institutionalization, and lower mortality risk (Yeom, Keller, & Fleury, 2009).

Maintenance and Restoration of Functional Abilities

Physical Activity

Physical activity was listed as the number one initiative of Healthy People 2010 for all age groups (US Department of Health and Human Services, 2006). Approximately half of the changes related to physical functioning associated with aging

have been linked to inactivity or disuse (O'Brien-Cousins, 1998). Decline in physical function, in addition to increases in the prevalence of sedentary behavior, is a primary concern for older adults (Nelson et al., 2007). Although benefits such as cardiovascular health, strength, functional capacity, and psychosocial well-being are recognized, these low levels of participation in physical activity continue (O'Brien-Cousins, 1998). The US Department of Health and Human Services reported that in 2005, 47% of adults age 65 to 74 years reported no leisure-time activity, while 60% of adults age 75 years and older reported no leisure time activity (US Department of Health and Human Services, 2006). There is a need for engaging physical activity programs that are both appropriate to the age and ability of older adults (World Health Organization, 2002)

Physical Function

Decreased physical functioning can lead to changes in the type of care needed (Waters, 1994), quality of life (Ettinger, et al., 1997; Jirovec & Maxwell, 1993; Kaplan, et al., 1993; Mulrow, Chiodo, Gerety, Lee, Basu, & Nelsone, 1996; Oleson, Heading, McGlynn, Bistodeau, 1994), and an increased risk of developing secondary conditions (Ouslander, Osterweil, Morley, 1991). By increasing or maintaining physical functioning through physical activity, these negative changes may be prevented or postponed and the quality of life of individuals may increase. Impairments in mobility have been reported in 44% of older adults in community-settings (Iezzoni, McCarthy, Davis, & Siebens, 2000; Shumway-Cook, Ciol, Yorkston, Hoffman, & Chan, 2005). This study focuses on the balance, enjoyment, and leisure competence of older adults in a community based setting.

Balance and Fall Prevention

Balance and fall prevention are two key concerns among older adults (Powell & Meyers, 1995; Myers, Fletcher, Myers, & Sherk, 1998; Li, et al, 2008). As a considerable public health issue in the US, falls among older adults lead to significant secondary morbidities (Li, et al, 2008; Nnodim, et al., 2006). Balance impairments, low balance confidence, and falls can not only lead to physical injury and illness, but also psychological consequences which can limit participation in meaningful activity (Myers, Fletcher, Myers, Sherk, 1998; Powell & Myers, 1995). An effective approach to improving balance and preventing falls in older adults have been interventions aimed at increasing physical activity. Studies have demonstrated improvements in balance and number of falls through the implementation of programs aimed at increasing the amount of physical activity among older adults (Costello & Edelstein, 2008; Nnodim, et al., 2006; Shephard, 1994; Yeom, Keller, & Fleurg, 2009). Although effective in improving balance and number of falls, many physical activity programs lack elements of enjoyment and motivation that are essential in maintaining participation (Alpert, et al., 2009). Recreation-based physical activity programs offer a means of improving balance thorough increased physical activity in a format that is motivating and enjoyable.

Functional Improvement and Virtual Reality

Three key elements often present in physical rehabilitation include repetition, feedback, and motivation (Holden, 2005). Motor development and improvement are accomplished through repeatedly practicing an exercise or activity. Feedback in the form of success should be associated with the exercise or activity. An essential element to

implementing repetition of an activity is motivation. Virtual reality (VR) and video games offer all three of these characteristics to an individual. VR systems provide individuals with repetitive, motivating, and safe exercises which offer continuous feedback (Flynn, Palma, & Bender, 2007). This "real-time feedback" provided by VR interactive environments is presented in a form that is understandable to the individual (Holden, 2005). Video game systems, such as the Nintendo Wii™, present an interactive game that could offer each of these aspects by providing an individual with the opportunity to perform beneficial repetitive movements in a motivating and engaging format that offers feedback in the form of success.

Nintendo Wii™

The Nintendo Wii™ is a recently released gaming system that features a motion sensing remote controller. The controller responds to a player's body movements and players can participate in games by interacting with onscreen environments and objects using their own body movements. Popular sports such as tennis, baseball, golf, bowling, and boxing are games offered by the Nintendo Wii™ game system. Gaming systems are becoming increasingly popular among elders in long-term care facilities (Coveart, 2008). While there has been research on the use of VR in healthcare, including rehabilitation, with both high tech systems and low-cost systems such as the X-Box™ and Sony Playstation 2™, there is a lack of research on the use of the Nintendo Wii™ (Flynn, Palma, Bender, 2007; Morrow, Docan, Burdea, & Merians, 2006). The Nintendo Wii™ provides a system where individuals can interact with multiple environments without needing any additional equipment as needed with the previous gaming systems

researched and can be successfully played with limited instruction. The Wii™ offers multiple interactive games, which provide players with more choice and opportunity to select games according to their preferences. The purpose of this proposed study is to examine the effects of an intervention using the Nintendo Wii™ on balance in older adults in a community setting.

Conceptual Framework

Csikszentmihalyi's (1975) theory of flow has been used as a theoretical framework for motivation in video games and VR use (Reid, 2004; Ryan, Rigby, & Przybylski, 2006). Flow has been described as a state of mind in which a person experiences feelings of competence, motivation and enjoyment (Moneta & Csikszentmihalyi, 1996). Optimal experience, a characteristic of flow, is described as one in which a person is so engaged in an activity that outside matters seem to be lessened or disappear altogether. Flow theory states that when the "flow channel" (Moneta & Csikszentmihalyi, 1996), which is the balance between a person's skill level and the challenges of a task or activity, is equal a person has an optimal experience and is in a state of complete engagement in an activity. To remain in the "flow channel" a person must believe that the demands of the activity increase as their skills and abilities improve (Csikszentmihalyi, 1975). The experience of flow provides an activity that offers pleasure and enjoyment which leads to continued involvement in the activity (Csikszentmihalyi, 1975, 1990). Conditions that allow for flow and an optimal experience include clear goals and immediate feedback, sense of control, loss of self-consciousness, challenge, and enjoyment (Csikszentmihalyi, 1990). Positive feedback

received during participation in an activity can also lead to increased competence and in turn increased motivation (Deci & Ryan, 2000). When an individual experiences positive feelings related to participation in an activity their likelihood of continued adherence to the activity will be positively influenced (Csikszentmihalyi & Csikszentmihalyi, 1988; Wankel, 1993). Theory of flow offers a framework for video game use in rehabilitation and programming for physical function in older adults by providing a foundation on how video games can promote key elements of functional improvement, such as motivation and feedback, by providing the opportunity for activities that support feelings of competence, motivation and enjoyment and continued participation in activities.

Purpose of Study

The purpose of this study was to compare the effects of an intervention using the Nintendo Wii™ with a Tai Chi intervention on balance, enjoyment, and leisure competence in older adults in a community setting. A RT intervention is presented that provides opportunities for physical activity through game play using an interactive bowling game on the Nintendo Wii™, a home-based VR game system. The study addresses (a) balance, (b) enjoyment, and (c) leisure competence.

Research Questions

(1) What are the effects of a recreation therapy intervention using the Nintendo Wii™ as compared to a Tai Chi activity on balance in older adults in a community setting?

(2) What are the effects of a recreation therapy intervention using the Nintendo Wii™ as compared to a Tai Chi activity on enjoyment in older adults in a community setting?

(3) What are the effects of a recreation therapy intervention using the Nintendo Wii™ as compared to a Tai Chi activity on leisure competence of in older adults in a community setting?

Definition of Terms

Virtual Reality (VR) - A simulated environment created by a computer or software in which an individual can interact as if it were a "real world" experience and actively participate with the images displayed (Riva, 2008).

Gait- The pattern of walking a person displays.

Flow- A state of mind in which a person experiences feelings of competence, motivation and enjoyment (Moneta & Csikszentmihalyi, 1996).

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

The use of video game systems in rehabilitation and functional improvement within clinical and community-based settings is relatively new. Household game systems are becoming more common on rehabilitation units in hospitals, skilled nursing facilities, long term care facilities, private practice facilities, and community-based settings. Research related to the use of these systems in health care and community-based settings for rehabilitation and improvement of physical functioning includes studies on VR involving immersion, computer-based systems, and home based gaming systems. VR uses various types of equipment including helmet mounted displays, devices equipped with sensors, computerized displays, virtual environments, and gaming systems.

Balance and Fall Prevention

Balance impairments and falls in older adults present a substantial challenge with regard to both rehabilitation and prevention. Of individuals over the age of 65, 30-50% experience a fall each year (Powell & Myers, 1995). Along with physical injuries, individuals may also experience psychological consequences related to falls in the form of fear of falling. In addition to preventing falls to avoid physical injury, it is also important to recognize the impact fear of falling has on older adults, especially when it comes to participation in activities. Many older adults who have experienced a fall, as well as those who may be at risk for falling, limit their participation in activities due to fear of falling (Powell & Myers, 1995). Individuals who identify with being fearful also

show lower scores on balance tests (Powell & Myers, 1995). Fear of falling may also indicate a decline in functioning, frailty, decreased participation in activities and socialization, depression, and low life satisfaction (Myers, Fletcher, Myers, & Sherk, 1998). Avoidance of participation in activities can also advance a decline in balance functioning (Myers, Fletcher, Myers, & Sherk, 1998). Fear of falling should be addressed in therapeutic interventions along with balance training (Myers, Fletcher, Myers, & Sherk, 1998). Physical activity as been shown to be a major contributor to improving and maintaining balance and preventing falls (Shephard, 1994; Yeom, Keller, & Fleurg, 2009). Interventions have focused on improving balance and fall prevention by providing seniors with programs that provide opportunity for increased physical activity and improvements in mobility.

The majority of interventions focused on improving balance and preventing falls focus on balance training, exercise programs, walking programs, aerobic exercise, resistance training, balance training, treadmill training, flexibility activities, and strengthening (Costello & Edelstein, 2008; Nnodim, Strasburg, Nabozny, Nyquist, Galecki, Chen, & Alexander, 2006; Yeom, Keller, Fleury, 2009). One study using exercise demonstrated a 10% decrease in fall risk while a related balance training exercise demonstrated a 17% decrease (Province, Hadley, & Hornbrook, 1995). A program using balance, exercise, and walking resulted in a 35% decrease in falls and injuries related to falls in older adults living in the community (Robertson, Cambell, Gardner, 2002). A study utilizing a cobblestone mat for a walking intervention showed improvements in balance and walking speed (Li, Fisher, & Harmer, 2005). Group-based

physical activity sessions have shown a positive impact on mobility, especially for older adults participating in community-based exercise programs (Kammerlind, Hakansson, Skogsberg, 2001; King, Pruitt, Phillips, Oka, Rodenburg, & Haskell, 2000; King, Whipple, Gruman, Judge, Schmdt, & Wolfson, 2002).

Recreation-based physical activity programs have also been used as a therapeutic intervention for improving balance, mobility, and fall prevention in older adults and may provide a more motivating means of improving physical functioning. The majority of recreation-based interventions have been dance and Tai Chi programs. Dance has been shown to motivate health promotion and motivate adherence in physical activity (Jeon & Hio, 1996; Lee, 2000; Song, June, Kim, & Jeon, 2004). A study of older adults in the community using modified jazz dance showed significant improvements in balance, through increases in Sensory Organization Test (SOT) scores which measured vision, proprioception, and motor reception, throughout the course of the program (Alpert, et al., 2009). Other studies incorporating social, aerobic and jazz dance demonstrated improvements in one-leg standing, reach, balance, locomotion, agility, sit to stand tests, and lower-extremity function, which was related to decreased fear of falling and improved stability (Cao, Meada, Shima, Kurata, & Nishizomo, 2007; Liu-Ambrose, Khan, Eng, Lord, & McKay, 2004; Shigematsu, Chang, Yabushita, Sakai, Nakagaichi, Nho, 2002; Verghese, 2006).

Tai Chi offers participants a means of improving functioning through slow, rotating movements and shifting weight. One study on the use of Tai Chi in preventing falls demonstrated a 48% reduction in fall risk in older adults in the community (Wolf,

Barnhart, Kutner, 1996). Another study using a Tai Chi intervention showed significant improvements in functional reach, Timed Up and Go (TUG) times, rising and sitting from a chair, the 50-foot speed walk, and mental health (Li, Harmer, Glasgow, Mack, Sleet, Fisher, Kohn, Millet, Mead, Xu, Lin, Yang, Sutton, & Tompkins, 2008). Other trials using Tai Chi have shown improvements in balance, mobility, muscle strength, and flexibility (Taggart, 2002; Taylor-Piliae, Haskell, Stotts, Froelicher, 2006; Yang, Verkuilen, Rosengren, Grubisich, Reed, & Hsiao-Wecksler, 2007).

While these interventions have been effective in improving balance, mobility, and physical functioning, limited research exists on the use of other recreation activities such as video games and virtual reality in balance and physical activity programming for older adults. As recreation based activities have been shown to be a motivating means of physical activity leading to improvements in balance, mobility, and physical function, interventions using video games and virtual reality may be a beneficial means of functional improvement by providing a fun, motivating means of physical activity that is relatively simple to implement.

Participation and Enjoyment

Increased physical activity among older adults has been shown to improve well-being, balance, strength, endurance, and the ability to perform ADLs (Shephard, 1994). While many studies have been conducted on the use of physical activity programs to improve physical functioning in older adults, many are focused on programs such as aerobic exercise, resistance training, balance training, walking, and treadmill training (Yeom, Keller, Fleury, 2009). While these programs have been beneficial, maintaining

participation may be challenging at times. Older adults have reported quitting physical activity programs due to boredom, stating that having fun was the main reason for continuing a physical activity program. Enjoyment in the program is an important part of maintaining participation, providing motivation for older adults to continue physical activity (Alpert, et al., 2009). Recreation-based physical activity programs may provide a more motivating means of improving physical functioning in older adults. Few studies have been conducted using leisure and recreation based activities as a basis for physical activity programs aimed at improving and maintaining functioning in older adults. Of those studies focusing on recreation activities, the majority are Tai Chi and dance programs (Alpert, et al., 2009; Jeon & Chio, 1996; Lee, 2000; Kin, 1998; Song, June, Kim, & Jeon, 2004; Yeom, Keller, & Fleury, 2009; Nnodim, Strasburg, Nabozny, Nyquist, Galecki, Chen, Alexander, 2006; Li, Harmer, Glasgow, Mack, Sleet, Fisher, Kohn, Millet, Mead, Xu, Lin, Yang, Sutton, & Tompkins, 2008), with there being a lack of research on the use of video game and VR based physical activity programs. Virtual environments can provide opportunities to improve functional independence through improving and maintaining functional and ADL performance (Riva, et al., 1999).

In existing VR intervention studies, participants have reported experiencing conditions present in a flow experience including enjoyment, loss of self-consciousness, immersion in the game environment, and control over the experience (Miller & Reid, 2003). Video games and VR provide an environment in which there is increased potential for an individual to be in a state of flow and experience increased motivation, enjoyment, and utilize their abilities (Reid, 2004). One study on virtual fitness that examined immersion

in the environment, motivation, and presence showed that the more present and immersed in the environment an individual felt the higher their motivation, competence, and enjoyment was related to the activity (Ijsselsteijn, De Kort, Westerink, J., De Jager, Bonants, 2006). In addition to increased motivation, competence, and enjoyment, individuals also demonstrated high levels of physical activity related to the activity (Ijsselsteijn, De Kort, Westerink, De Jager, Bonants, 2006). VR allows for increased enjoyment by allowing an individual to focus less on their effort and more on their interaction with the virtual environment (Reid, 2002). Enjoyment received through participation in virtual environments can increase participation levels and positive feedback from VR can lead to increased self esteem and empowerment in the activity (Cattaneo & Cardini, 2001; Kizony, Raz, Katz, Weingarden, & Weiss, 2003). Video games, such as the Nintendo Wii™, provide both a virtual environment as well as a recreation-based means of physical activity. Therefore opportunity exists for recreation therapy (RT) interventions utilizing video games and VR to improve functional outcomes as well as provide a sense of enjoyment during participation for individuals in community settings.

Leisure Competence

A primary goal of recreation therapy is to allow individuals to live and participate in life as independently as possible by helping them to develop, improve upon, or maintain skills, knowledge, and behaviors. The Leisure Skills Subscale of the Leisure Competence Measure (LSS LCM) relates to the skills required to be involved in an individual's chosen leisure activity. A person's ability to independently participate in

and be engaged in meaningful activities is dependent upon the skills, knowledge, behaviors, and attitude they have in regard to those activities (Kloseck & Crilly, 1997).

"At the core of one's psychological functioning is the belief that he/she is able to undertake various tasks and activities and is capable of performing them successfully" (Iso-Ahola, 1984, p.115). The ability to successfully attempt and complete activities is the biggest promoter of independent living and well-being (Searle, Mahon, Iso-Ahola, Sdrolias, & Van Dyck, 1995). Declines in competence and control are critical issues among older adults. Decreased physical function, skills, and abilities, are precursors to decreases in competence and control (Baltes & Baltes, 1990). If an individual has a low sense of competence and control, their desire to live independently is diminished (Searle, Mahon, Iso-Ahola, Sdrolias, & Van Dyck, 1995). The importance of leisure in the lives of older adults allows participation in leisure activities to be used as a means of increasing control and competence in older adults. This increased competence and control in relation to leisure participation, may then be expanded to other areas of life, leading to improved ability to live independently (Searle, Mahon, Iso-Ahola, Sdrolias, & Van Dyck, 1995). Because perceived competence and success in an activity is a primary motivator for continued participation, and low perceived competence in leisure skills may restrict or limit the amount an older adult participates in leisure activities these issues must be addressed when developing physical activity programs for older adults to ensure adherence and continued participation in the activity (Nour, Desrosiers, Gauthrer, Caarbonneau, 2002; Searle, Mahon, Iso-Ahola, Sdrolias, & Van Dyck, 1998). It is important to develop programs for older adults that promote improvements in control and

competence to increase the opportunity for independent living, especially for those older adults who have experienced a decrease in their sense of independence due to factors associated with aging (Searle, Mahon, Iso-Ahola, Sdrolias, & Van Dyck, 1998).

Leisure provides purpose to the lives of older adults by providing them with a means of demonstrating their abilities, control over their environment, and identification of important aspects of life. To provide these aspects leisure activities for older adults should provide challenge and stimulation, while at the same time coinciding with their abilities and leisure skills (Janssen, 2004). An increased sense of control that comes with the successful participation in leisure activities has been shown to promote better health and lower morbidity (Coleman & Iso-Ahola, 1993; Deci & Ryan, 1987). Important factors in life satisfaction for older adults are the leisure skills and interests they develop and carry with them through life (Roberts, 1999). Leisure participation serves to promote recovery and development of skills and social bonds. The development of these leisure skills in older adults can lead to increased levels of physical activity, which in combination leads to higher life satisfaction. Skill and satisfaction in leisure activities brings an added "richness" to the lives of older adults (Roberts, 1999). Low perceived competence in leisure skills may restrict or limit the amount an older adult participates in leisure activities (Nour, Desrosiers, Gauthrer, Caarbonneau, 2002). Increased competence in leisure skills is related to decreased levels of boredom and leads to a higher sense of independence (Searle, Mahon, Iso-Ahola, Sdrolias, & Van Dyck, 1995). Experiences offering physical activity that focus on interaction and skill development can be used as a means of promoting enjoyment and satisfaction in the leisure lifestyles of

older adults by increasing competence in leisure skills related to participation in leisure activities (Thurston and Green, 2004).

Video game play has been shown to promote feelings of competence (Ryan, et al., 2006). Feelings of competence provided during video game play through choice of actions performed and feelings of accomplishment have been shown to have an impact on gaming motivations, enjoyment during game play, and preference for future game play (Ryan, et al., 2006).

VR in Healthcare

VR systems have been used in the healthcare field to promote health improvement due to injuries, illnesses, conditions and situations. Computer games have been shown to improve arm movements in a child with Erb's Palsy, as well as increasing a child's motivation to succeed, which is an important aspect in rehabilitation (Krichevets, Sirotkina, Yevsevicheve, & Seldin, 1995). Pediatric oncology patients with access to video games after chemotherapy sessions have demonstrated reduced (a) anticipatory symptoms, (b) distress following treatment, and (c) negative side effects (Kolko & Rickard-Figueroa, 1985). Video games have been shown to motivate children who have experienced burns by involving them in the rehabilitation process and performing exercises (Adriaenssens, Eggermont, & Pyck, 1988).

The SMARTWheels VR system has been successful in demonstrating increases in physiological response in patients with paraplegia and multiple sclerosis (O'Conner, Fitzgerald, Cooper, Thorman, & Boninger, 2002). The SMARTWheels system delivers kinetic information from the wheels of a wheelchair to a computer. Patients in this study

also reported an enjoyable experience with the video game system. Patients also noted that the game could help them to exercise more frequently and for longer periods of time. This system demostrated the possibility for increasing cardiovascular health in people using manual wheelchairs (O'Conner, et al., 2002).

Betker (2006, 2007) studied the use of video games to treat patients with traumatic brain injuries. Patients demonstrated improvements in volume and attention span during exercise along with improved dynamic sitting balance using a center of pressure (COP)-controlled video game, pressure mat, and force-sensitive applications. Patients noted that the games were fun and challenging and they preferred the video games over traditional exercises. Similar outcomes using the COP-controlled video game system were demonstrated in patients with spina bifida, paraplegia with transfemoral amputation and cerebellar tumors (Betker, Desai, Nett, Kapadia, & Szturm, 2007; Betker, Szturm, Moussavi, & Nett, 2006). While studies have shown improvements in many areas of healthcare, much of the research on VR in healthcare has focused on stroke rehabilitation.

Stroke occurs when brain cells in part of the brain are deprived of oxygen and nutrients due to an interruption or reduction of the blood supply (Mayo Clinic, 2009). When the right side of the brain is damaged due to a lack of oxygen and nutrients, problems with functioning of the left side of the body are experienced. Stroke results in many physical functional impairments which can include weakness or paralysis of the affected side of the body, muscle stiffness and spasms, trouble swallowing, problems with balance and coordination, pain, numbness, unusual sensations, lack of awareness of

body movements and sensations, and difficulty with daily tasks (National Institute of Neurological Disorders and Stroke, 2008).

Although this study does not focus on stroke rehabilitation specifically, many of the older adults who participated have expereinced stroke and/or have functional limitatitions similar to individuals who have had strokes. The area of funtional improvement after a stroke has shown promising advances using VR. The majority of VR systems researched alongside stroke rehabilitation have been complex and higher priced systems. These studies include research on a number of physical functional outcomes including upper extremity and hand function (Adamovich, et al., 2003; Broeren, Rydmark, & Sunnerhagen, 2004; Holden & Dyar, 2002; Jack, et al., 2001; Taylor & Berry 1998), lower extremity function (Deutsch, Merians, Adamovich, Poizner, & Burdea, 2004), balance (Betker, et al., 2006), fall reduction (Betker, et al., 2006), dexterity (Broeren, et al., 2004), gait (Jaffe, Brown, Pierson-Carey, Buckley, & Lew, 2004), brain and motor recovery (Jang, et al., 2005), ROM (Adamovich, et al., 2003; Gaggilio, Menegini, Morganti, Alcaniz, & Riva, 2006; Holden & Dyar, 2002; Jack, et al., 2001), grip strength (Adamovich, et al., 2003; Broeren, et al., 2004; Holden & Dyar, 2002; Jack, et al., 2001), pain (Holden & Dyar, 2002), and improved ability to perform daily tasks (Broeren, et al., 2004; Jack, et al., 2001; Jang, et al., 2005; Rand, Katx, & Weiss, 2007).

Gait, Balance, and Falls

Improvements in gait, balance, and reduction in number of falls have been demonstrated as outcomes associated with the use of VR in rehabilitation. The Rutgers

Ankle Device, which applies force and provides feedback to the user in a virtual environment, has shown potential for improving lower extremity function in people who have had a stroke (Deutsch, et al., 2004). Evidence suggests that VR interventions can be as effective as similar real-world interventions in rehabilitating patients who have walking as an outcome measure. Similar improvements in walking and gait have been demonstrated in both virtual and real-world interventions. One VR system had the benefit of being a safe alternative to the real-world intervention and aided in documentation (Jaffe, et al., 2004). A COP-controlled video game-based exercise system using a pressure mat and laptop computer demonstrated a reduction in the number of falls experienced and improved balance (Betker, et al., 2006).

Upper Extremity and Hand Function

Increased upper extremity and hand functioning are widely demonstrated outcomes of stroke rehabilitation using VR (Broeren, et al., 2004; Adamovich, et al., 2003; Jack, et al., 2001; Taylor & Berry 1998; Holden & Dyar, 2002). A number of studies examined the feasibility and effect of these systems on upper extremity and hand function. Researchers used a VR system to assess time, speed and movement of the upper right extremity in three patients with left hemisphere damage resulting from chronic stroke (Broeren, Bjorkdahl, Pascher, & Rydmark, 2002). Findings indicated the system was effective as an assessment tool; in addition, VR programs can be planned to treat specific conditions and employed to assess progress. In a subsequent study, the VR system was used to examine functional improvement in a male participant in his late fifties 12 weeks post stroke, who had experienced right hemisphere damage leading to

left-side physical limitations. A 3D computer game formatted to meet the participant's needs was used with the PHANToM haptic device, which uses a stylus to allow interaction with a computer and provide feedback, and CrytalEyes display, which uses a special monitor and glasses to provide a 3D image. The VR intervention (12 sessions, 90 min, over 4 weeks) resulted in the participant having improved finger dexterity, grip strength, and motor control of the left upper extremity. The participant reported that he experienced improved ability to perform daily tasks. These functional improvements persisted at the 20 week follow up (Broeren, et al., 2004).

The use of the Cyber glove (measures finger position and movement) along with the Rutgers Master II-ND glove (measures finger position and applies force to the fingers) has been examined related to hand function in participants who experienced stroke. Researchers in one study examined effects of the glove system in three participants who were three and six years post left hemisphere stroke, while another study examined effects with participants who were one year post stroke with seven having right hemisphere strokes and one having a left hemisphere stroke (Adamovich, et al., 2003; Jack, et al., 2001). Findings from both studies showed improvements in range of motion, speed of motion, grip strength, and fractionation (independent finger movement). Taylor and Berry (1998) demonstrated improved speed and accuracy of finger movement in a 34 year old male who had experienced a stroke. The researchers used a computer game that mimicked the participant's common work-related actions to improve upper extremity functioning. Increased range of motion in the wrist and increased arm function has also been shown as a result of virtual computer facilitated training in a participant 13 months

post stroke (Gaggilio, et al., 2006). Systems using virtual "teachers" to instruct patients on performing movements used to achieve a certain objective have been shown to increase range of motion, flexion of the shoulder, grip strength, and decrease pain (Holden & Dyar, 2002). The IPEX VR system (uses a monitor, large screen, cyber gloves, and interaction with a virtual environment and objects) has provided data that suggests improvements in motor and brain recovery in individuals who have experienced stroke, along with increases in daily activities (Jang, et al., 2005). VR interventions focusing on functional improvements in upper extremities along with improvement in ADLs have been found to be a feasible intervention in the treatment of individuals who have experienced a stroke (Rand, et al., 2007). Improvements demonstrated following interventions using VR have been shown to transfer to real-world activities and skills in performing various ADLs (Jack, et al., 2001; Broeren, Rydmark, & Sunnerhagen, 2004). While there is evidence that supports the use of VR systems with the goal of improved functioning in people who have experienced a stroke, these systems are often high-tech, high-priced, and not readily available to healthcare professionals.

Home Based VR Gaming Systems in Rehabilitation

Home based gaming systems offer a lower-cost option for VR in rehabilitation settings. These systems are affordable, easily accessible, and can be used in a variety of settings and interventions (Flynn, Palma, & Bender, 2007). Few studies have been conducted on the use of commonly available home-based gaming systems in rehabilitation. Studies on low-cost systems examined the use, development, and feasibility of systems incorporating the Sony Playstation 2™ and the XBox™ gaming

systems. Morrow, Docan, Burdea, & Merians (2006) examined the development of a system for hand rehabilitation in people who have experienced a stroke using the Xbox™ gaming system and P5 game glove. The Xbox™ is a home based gaming system developed by Microsoft™. The P5 game glove was developed for use with the Xbox™ gaming system and responds to finger movement and hand position allowing virtual interaction during game play. The Xbox™ system costs approximately $600, compared to the IPEX system, which costs $17,600. The cost of the higher-priced system increases even more when the Rutgers Master II glove is used. While the P5 glove did not demonstrate the same level of functionality or accuracy as the Cyber glove and is designed for typical hand anatomy, there may still be benefits for patients in rehabilitation. Assessment of patients who have experienced a stroke using the Xbox™ based system are under development (Morrow, et al., 2006).

Flynn, Palma, and Bender (2007), examined the feasibility of using the Sony Playstation 2™ EyeToy™ for the chronic phase of stroke rehabilitation. The Playstation 2™ is a home-based game system developed by Sony. The EyeToy™ consists of a USB camera that displays an on-screen image of the player. The screen image moves along with the player's body movements and the player can interact with the on-screen objects and environment. The researchers examined the effects of an intervention (4.5 weeks) on several rehabilitation outcomes. The study focused on a 76 year old female who had experienced a right brain hemorrhagic stroke. The participant had completed both inpatient and outpatient rehabilitation including traditional treatments and was not in therapy during the study. She had no previous experience with VR, video or computer

games and was a retired physical therapist. The intervention (20 sessions, 60 min each) included using the Playstation 2 EyeToy™. The participant chose her preferred games. The participant kept a daily log of sessions by documenting games played, length of session, and any comments. This log was reviewed after the 10th and 20th sessions. An interview addressing ease of use, enjoyment, and adverse effects was conducted by the researchers one month after the intervention ended. The study also measured physical functional improvements (e.g. balance, range of motion, sensory reception, pain, motor movement, posture, mobility, and gait) using a pretest, midtest after the 10th session, post test, and a six month follow-up. Results of the study indicated that the Playstation 2™ EyeToy™ was an effective method for treatment during the chronic phase (following completion of traditional therapy interventions) of stroke rehabilitation. The participant reported that the games were enjoyable, motivating, competitive, and convenient. She expressed that she enjoyed the ability to play the games with family members and that time spent exercising passed quickly. The two most significant improvements were in the Fugl-Meyer Assessment (FMA), which measures sensorimotor function including balance, range of motion, sensory reception, pain, and motor movement, and the Dynamic Gait Index (DGI), which measures balance, posture, mobility, and gait. Scores from the FMA showed a 9.74% improvement in sensorimotor function with the largest change being in proprioception. The DGI demonstrated a significant reduction in risk of falling. Other improvements were found in the Upper Extremity Functional Index, Motor Activity Log, Mini-Mental State Exam, and Beck Depression Inventory (Flynn, Palma, & Bender 2007). This study was conducted on a single subject where specific limitations

were addressed by the researchers. Improvements that were not present with this participant may be evident in participants with different limitations or vice versa. This participant had also previously completed traditional therapy and some areas of improvement were above what might be present in a person still in traditional rehabilitation. While it is evident that VR has been shown to improve functioning in individuals receiving rehabilitation, nursing homes are now exploring the use of VR to maintain or improve functioning in older adults residing in long-term care (LTC).

VR and Healthy Older Adults

VR systems have been developed to address various areas of functioning in older adults. Research includes studies on improvements in cognitive, social, emotional, and physical functioning. Games provide a platform that can foster communication, imagination, and address hand-eye coordination, strategy, and the ability to solve problems (Gaggioli, Gorini, & Riva, 2007; Young, 2004; Barr, Noble, & Biddle, 2007). Studies have demonstrated improvements in cognitive and perceptual abilities through the use of video games (Lager & Bremberg, 2005; Green & Bavelier, 2006, 2007). An early study on computer games and frail elderly individuals residing in LTC reported that video games offer a fun and mentally stimulating activity that can improve self-esteem, concentration, and attention (Weisman, 1983). Studies using Atari video games with older adults have demonstrated improvements in hand-eye coordination, dexterity, intelligence, perceptual-motor and cognitive functioning, and increased quality of life including affect and self esteem (Drew & Waters, 1986; McGuire, 1984). Goldstein, Cajko, Oosterbroek, Michielsen, van Houten, & Salverda (1997) reported improvements

in reaction time and sense of well being in older adults playing Super Tetris (Cajko, Oosterbroek, Michielsen, van Houten, & Salverda, 1997), while older adults playing Pac-Man and Donkey Kong also demonstrated improved reaction times (Clark, Lanphear, & Riddick, 1987). Two studies have used virtual environments along with a treadmill to reduce falls by improving gait and the ability to step over obstacles in older adults (Jaffe, 1998; Giotakos, Tsirgogianni, & Tarnanas, 2007). Virtual environments have also been shown to improve lateral reach in older adults as opposed to reach performance using real objects (Lott, 2003). Frail older adults demonstrated increased standing tolerance after participating in a VR therapy program (Cunningham, 1999). A VR exercise program showed improvements in balance and mobility in older adults living in the community, while another virtual biking exercise program for healthy older adults resulted in increased duration, distance and energy consumption (Bisson, 2004; Chuang, 2003). These studies provide support for the use of video games and VR in improving various areas of functioning in older adults. With recent advancements in video games and VR and the increased availability of home-based systems, an opportunity exists to examine the use of this technology in improving functioning in older adults in community-based settings.

Numerous functional outcomes have been associated with the use of VR and video games. Low-cost video game systems offer a motivating, inexpensive alternative to higher priced VR systems, while still providing potential for functional improvements via systematic interventions. With the advancement and availability of these home-based gaming systems, opportunities for their use in improving and maintaining functioning in

older adults are becoming more apparent. The Nintendo Wii™ is one example of the advancement in home-based gaming systems, with controllers that respond to a players body movements and multiple games in which the player can interact with the on screen environment. With the lack of research on the use of the Nintendo Wii™, this study addresses the use of the Wii™ in increasing or maintaining functioning in older adults in a community setting.

CHAPTER THREE

METHOD

Introduction

This study examined the effects of an intervention using the Nintendo Wii™ on balance in people who participated in recreation activities in a community based setting. A quasi-experimental design was used and the study addressed (a) balance, (b) enjoyment, and (c) leisure competence. This section discusses the method used in this study.

Research Questions

(1) What are the effects of a recreation therapy intervention using the Nintendo Wii™ as compared to a Tai Chi activity on balance in older adults in a community setting?

(2) What are the effects of a recreation therapy intervention using the Nintendo Wii™ as compared to a Tai Chi activity on enjoyment in older adults in a community setting?

(3) What are the effects of a recreation therapy intervention using the Nintendo Wii™ as compared to a Tai Chi activity on leisure competence of in older adults in a community setting?

Institutional Review Board (IRB) Approval Information

A protocol for research involving human subjects was submitted to the Institutional Review Board at Clemson University. The study was given approval under expedited review.

Participants

Participants were chosen from members of a non-profit county senior organization. The individuals were recruited from programs at two senior centers. Members of the senior centers were age 60 years and older and resided independently in the community. The average age over all was 74.4 years. The average age of participants in the intervention group was 77.1 years and the average age for participants in the control group was 69 years. Overall there were 13 females and 2 males. The intervention group had 10 females and the control group had 3 females and 2 males. Eligibility for participation in the study was based on participants' desire to participate in the intervention (after informed consent (see Appendix B)), in addition to (a) demonstrated saftey awareness and no obvious cognitive impairment, (b) adequate short-term memory, (c) adequate hearing and/or minimal difficulty hearing, (d) ability to verbally communicate, (e) adequate visual ability, and (f) physical independence. Sixteen members were identified for participation in the study, with 10 being assigned to the intervention group and 6 assigned to the control group. Convenience sampling was used, with members already attending each senior center volunteering to be part of the either the Wii™ bowling intervention or Tai Chi class at their respective senior center. One participant dropped out after the first session.

Setting

This study was conducted at two senior centers in the southeastern U.S. A letter of support was obtained from the organization director (see Appendix A). The senior centers are part of a non-profit county senior organization that manages senior centers, as

well as offers meal services, home care, transportation, housing, and care management with coordination of services from social security, mental health, department of social services, Medicaid, Meals on Wheels, behavioral health services and community long term care. The senior centers provide a daily meal as well as activities including line and swing dance lessons, bingo, arts and craft, Tai Chi, billiards, card games, music, discussion groups, presentations, trips, and exercise classes and equipment, although Tai Chi was only offered at the one center with the control group and Wii bowling was only offered at the one center with the intervention group.

Equipment and Materials

The equipment used for this study included a Nintendo Wii™ game console including Wii™ remotes, sensor bar, and bowling game on the included Wii™ Sports game disk. The sensor bar works with the Wii™ remotes to sense the movement of players. The Nintendo Wii™ gaming system was connected to a television. Balance measures were conducted through the administration of the Timed "Up and Go" (TUG) (Podsiadlo & Richardson, 1991), using a chair and stopwatch, and the Activities Specific Balance Confidence Scale (ABC) (Powell & Meyers, 1995) test using a paper and pen questionnaire. To measure enjoyment, an Experience Questionnaire (Broach, Dattilo, McKenney, 2007) was used. Leisure skills competence was evaluated with the Leisure Skills Subscale of the Leisure Competence Measure (LSS LCM) (Kloseck & Crilly, 1991) using a graphical flow chart and guide (see Appendix F) and the participants were observed and scored by the researcher. All data was collected by the researcher.

Intervention

The intervention consisted of the individuals' participation in a bowling game using the Nintendo Wii™ game system. The control group participated in a Tai Chi class offered at the facility. The researcher facilitated the Nintendo Wii™ intervention and an instructor at the senior center led the Tai Chi class. Training on use of the system, game instructions and objectives, and correct body position during game play was provided prior to and throughout the intervention. Each individual's ability level and preferences were accounted for in the intervention, by providing additional instruction and assistance if needed, to allow for feelings of control and balance between their skill level and the demands of the intervention. By incorporating these aspects ability level into the intervention, along with immediate feedback from the game, there was the possibility for the participants to experience a sense of control and challenge leading to a state of flow where they can experience increased enjoyment, competence, and motivation (Moneta & Csikszentmihalyi, 1996; Csikszentmihalyi, 1990). The intervention consisted of participants playing the game using proper range of motion and body mechanics as determined by the researcher. Participants were required to identify and interact with on-screen objects (e.g. bowling ball, alley, bowling pins, character position). Cues, such as pointing, verbal prompts, and one to one assistance, were used to direct the participant to certain on-screen objects. Each session consisted of 30 minutes of activity. The Tai Chi class used for the control group was held as a group with all participants being led through the activity at the same time for a total of 30 minutes. The Wii™bowling sessions lasted one hour with participants coming up one at a time, one after the other to

bowl, for an average of 30 minutes of play time per person. The intervention occurred 2 days per week, for 5 weeks. There was one less session for the Tai Chi group, due to an absence of the instructor. The Tai Chi class consisted of participants being led through the 10 form and practice on the 24 form. The 10 form consists of 10 Tai Chi movements, while the 24 form consists of 24 movements. This class was also held twice a week for five weeks. Participants received traditional activities programming currently offered at the centers at the time of the intervention.

Research Design

This study employed a quasi-experimental repeated measures design, with no random assignment to examine changes in balance, enjoyment, and leisure competence. Both the intervention and control groups were assessed using identical measures at the same time increments. Measurements on balance and leisure competence were taken at the end of each week. Enjoyment was measured after each 30 minute session of Nintendo Wii™ and Tai Chi.

Procedures

The intervention was carried out for 5 weeks, 2 days per week. The independent variable was participation in the Nintendo Wii™ intervention, playing the bowling game. Participants continued to be involved in other activities offered at the facilities. An information sheet was used to record attendance and demographic information (see Appendix C). To examine enjoyment and fun, a modified experience questionnaire based on the flow model (Csikszentmihalyi, 1990), intrinsic motivation, social fun, and activity enjoyment was administered after each intervention session (Broach, Dattilo, McKenney,

2007). The questionnaire consists of eight questions related to the areas of challenge/skill ratio, anxiety, boredom, focused attention, desire to continue, desire to be doing something else, enjoyment, and social fun and was used as a probe for feelings of flow during the Wii™ bowling intervention to determine if the intervention was indeed a motivating and enjoyable means of physical activity and functional improvement (see Appendix G). The experience questionnaire was evaluated for content and face validity in a previous study by Broach, Dattilo, and McKenney (2007) through review by a "researcher who has examined people's flow in previous research" and then administered to 15 participants in an aquatic therapy class who provided feedback on the questionnaire items. The primary dependent variable was physical functional performance and was measured using a series of balance assessments. Balance assessments used included the Timed "Up and Go" test (TUG) (Podsiadlo & Richardson, 1991) and the Activities Specific Balance Confidence Scale (ABC) (Powell & Meyers, 1995).

The TUG test is a timed test that measures how long it takes an individual to stand from a chair, walk 3 meters, turn around, walk back, and sit down again (see Appendix D). The test has been evaluated for use in measuring mobility in older adults residing in the community. A score of 10 seconds or less indicates "normal gait speed, balance, functional level, and ability to go out", a score of 20 seconds or less indicates "good mobility, can go out alone, mobile without a gait aid", and a score of 30 seconds indicates "problems, cannot go outside alone, requires a gait aid" (Podsiadlo & Richardson, 1991; Shumway-Cook, Brauer, & Woollacott, 2000). A score of 14 seconds or more relates to a higher risk of falling (Podsiadlo & Richardson, 1991; Shumway-Cook, Brauer, &

Woollacott, 2000). The test has been shown to have high intra-rater (0.98) and inter-rater (0.99) reliability and internal consistency (0.96) (Podsiadlo & Richardson, 1991). Evidence also suggests that this test is a useful tool in measuring clinical change over time. It has been shown to be a reliable measure of mobility among multiple raters and over time and has demonstrated content and concurrent validity (Podsiadlo & Richardson, 1991).

The ABC test measures balance confidence by asking the participant to rate their performance on 16 tasks, by assigning a value of 0-100% indicating their level of confidence that they will not fall or become unsteady while performing the task (see Appendix E). The average percentage for all 16 items is calculated to determine the test score. A confidence score of 80% or higher indicates high physical functioning, a score of 50-80% indicates moderate physical functioning, and a score of less than 50% indicates a low level of physical functioning (Myers, Fletcher, Myers, & Sherk, 1998). A score of less than 67% indicates a higher risk of falling and is a predictor of future falls (Lajoie & Gallagher, 2004). This measure has been shown to be sensitive to identifying individuals at risk for falling and identify individuals who avoid activity due to fear of falling (Myers, Petrella, Ecclestone, Tudon-Locke, & O'Brien, 1996). Validity has been demonstrated in several studies addressing mobility, falls, and balance (Lajoie & Gallagher, 2004; Meyers, Fletcher, Meyers, & Sherk, 1998; Powell & Meyers, 1995; Whitney, et al., 1999). It has a high retest reliability in older adults living in the community (Powell & Meyers, 1995).

To measure leisure competence a portion of the LSS LCM was used (Kloseck & Crilly, 1997). The LCM is a tool used to measure outcomes and changes in client functioning over time related to leisure participation. This study utilized the Leisure Skills portion of the measure, which evaluates an individual's competence related to the skills required to be involved in a chosen leisure activity. Each participant was observed and given a score by the researcher of 1-7, with 1 indicating complete independence and 7 indicating total dependence with total assistance (see Appendix F). It has been shown to be effective in measuring change in leisure functioning through the use of recreation therapy interventions and is sensitive enough to measure client outcomes. It has been used to measure changes in functioning in older adults with no cognitive impairment as well as an assessment tool in older adults with cognitive impairment. The LCM has also been used with a variety of populations including rehabilitation, psychiatric, young adults, and adolescents in both clinical and community settings (Kloseck & Crilly, 1997). The LCM has been shown to have high internal reliability (α=.97), internal consistency (α=.92), and inter rater reliability (r=.91). There is support for its use as both a screening and evaluative tool and effectiveness with scoring by a single rater (Kloseck & Crill, 1997). The reliability and validity of selected instruments and measures have been determined through evidence of use in previous studies, recommendations by current rehabilitation professionals, and use in rehabilitation settings.

Data Analysis

Data analysis for this study consisted of descriptive statistics. Changes in the mean balance scores, Experience Questionnaire, and LSS LCM scores were compared

across and within intervention and control groups to examine differences between the intervention and control activities through graphical and visual analysis. When data were variable and it was difficult to determine a trend visually, the split-middle method was used to provide a more reliable estimate of the trend (Tawney & Gast, 1984). In this method data is divided into two equal parts. The mid-date (i.e., the half-time point) and mid-rate (i.e., the middle score) is then determined for each half of the data and a trend line is drawn between the two intersections of the mid-dates and mid-rates (Tawney & Gast, 1984).

CHAPTER FOUR

RESULTS

Findings presented here are results of data collection and analysis of the TUG (Podsiadlo & Richardson, 1991), ABC (Powell & Meyers, 1995), LCM (Kloseck & Crilly, 1997), and Experience Questionnaire, (Broach, Dattilo, McKenney, 2007). First, the results of the TUG tests will be presented for each participant over the course of the study, followed by the ABC results for each participant over the course of the study. Mean scores for each of these measures will also be presented for both the intervention and control group. Next, the mean LCM scores for both groups will be presented. Mean scores for each area addressed with the Enjoyment Questionnaire including (a) challenge/skill, (b) focused attention, (c) boredom during activity, (d) enjoyment of the activity, (e) desire to continue doing the activity, and (f) anxiety during the activity will be presented for each group.

Demographics

Data were collected and analyzed on a total of 15 participants. The intervention group had 10 participants and the control group had 5 participants. The average age of all participants was 74.4 years. The average age of participants in the intervention group was 77.1 years and the average age for participants in the control group was 69 years. Overall there were 13 females and 2 males. The intervention group had 10 females and the control group had 3 females and 2 males. All participants were members of the community senior centers in which the study took place.

Timed Up and Go

Intervention Group

Upon initiation of the intervention, the mean time taken to complete the TUG for the intervention group was M=14.2 sec (see Table 1 & Figure 1). At the conclusion of the intervention the mean time was M=11.0 sec, for an overall reduction in the amount of time required to stand, walk 3 meters, turn, walk back, and return to a seated position of 3.2 sec. Participants 3, 5, 7, and 10 showed a continual decrease in TUG times over the 5 week period, while participants 2, 4, 6, and 9, although fluctuating throughout the 5 week period, demonstrated an overall decrease in TUG times. Of all 10 intervention group participants, only 2 showed an increase in TUG times. Because data were variable and it was difficult to determine trend visually, the split middle method was used. For the overall mean scores on the TUG, the first split middle point was 13.6 and the second was at 10.6 which indicates a decelerating trend. A decelerating trend for the mean TUG scores suggests that overall the group demonstrated improved ability to stand, walk 3 meters, turn, walk back, and return to a seated position.

Control Group

Upon initiation of the intervention, the mean time taken to complete the TUG for the control group was M=8.7 sec (see Table 2 & Figure 1). At the conclusion of the intervention the mean time was M=8.5 sec, for an overall reduction in the amount of time required to stand, walk 3 meters, turn, walk back, and return to a seated position of 0.2 sec. Participants 1, 2, and 3 showed an overall decrease in TUG times, although this increase was not seen each week. Participant 1 demonstrated a gradual increase in TUG

times before decreasing in the final week. Participants 4 and 5 demonstrated an increase in TUG times with participant 5 having increasingly higher times each week. For the overall mean scores on the TUG, the first split middle point was 8.7 and the second was at 8.8, which indicates an accelerating trend. An accelerating trend for the mean TUG scores suggests that overall the group demonstrated decreased ability to stand, walk 3 meters, turn, walk back, and return to a seated position.

Table 1

TUG Results for Intervention Group

	Weeks				
Participants (Gender, Age)	**1**	**2**	**3**	**4**	**5**
1 (F, 76)	8.2	7.3	8.6	8.6	8.7
2 (F, 62)	13.9	9.2	9.6	8.2	8.3
3 (F, 87)	32.5	25.6	19.3	19.1	18.0
4 (F, 69)	10.6	9.0	9.8	7.8	8.1
5 (F, 83)	9.3	9.0	8.1	7.8	7.6
6 (F, 78)	9.5	8.6	9.3	8.1	7.5
7 (F, 84)	15.7	15.1	12.1	11.7	11.5
8 (F, 70)		8.4	11.2		
9 (F, 76)		15.7	19.6		12.3
10 (F, 86)		21.8	17.6		17.4
Mean Time for all Participants	14.2	13.0	12.5	10.2	11.0

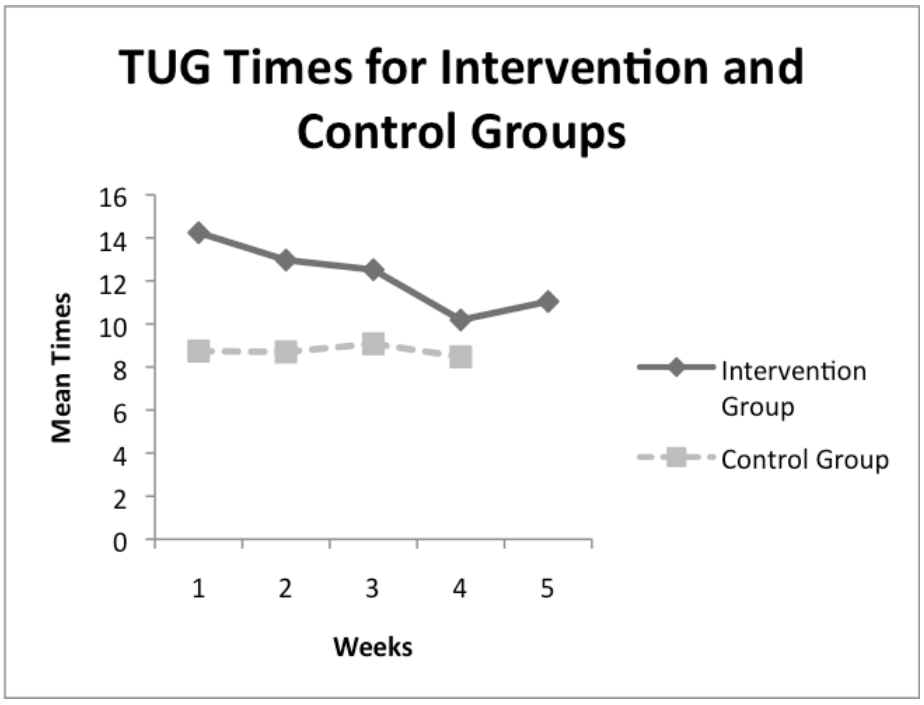
Table 2

TUG Results for Control Group

	Weeks			
Participants (Gender, Age)	**1**	**2**	**3**	**4**
1 (M, 68)	9.7	10.2	11.1	9.3
2 (F, 62)	8.9	7.9	8.5	7.3
3 (F, 76)	9.3	9.0	9.4	8.1
4 (M, 77)	8.4	8.8	7.8	9.2
5 (F, 62)	7.4	7.6	8.6	
Mean Time for all Participants	8.7	8.7	9.1	8.5

Figure 1

Mean TUG Results for the Intervention and Control Groups



The Activities Specific Balance Confidence Scale

Intervention

Upon initiation of the intervention, the mean balance confidence percentage for the intervention group was M=68.5% (see Table 3 & Figure 2). At the conclusion of the intervention, the mean balance confidence percentage for the intervention group was M=65.6%, for an overall reduction in mean percent confidence of 2.9%. Although there was a decrease in mean scores for the entire group, 5 of the 10 participants (numbers 2, 4, 5, 9, and 10) showed an overall increase in scores with a mean score of M=62.1% at the beginning of the intervention to a score of M=68.8% at the end of the study. These participants showed an overall increase in balance confidence of 6.7%. For the overall mean scores on the ABC, the first split middle point was 66.3 and the second was at 63.1 which indicates a decelerating trend. A decelerating trend for the mean ABC scores suggests that overall the group demonstrated decreased balance confidence.

Control Group

Upon initiation of the intervention, the mean balance confidence percentage for the control group was M=86.4% (see Table 4 & Figure 2). At the conclusion of the control, the mean balance confidence percentage for the intervention group was M=79.7%, for an overall reduction in mean percent confidence of 6.7%. Two participants in the control group, numbers 4 and 5, demonstrated an overall increase of M=3.5% in mean scores with a mean score of M=87.8% at the beginning of the intervention compared to a score of M=91.3% at the end of the intervention. For the overall mean scores on the ABC, the first split middle point was 85.2 and the second was

at 81.7, which indicates a decelerating trend. A decelerating trend for the mean ABC scores suggests that overall the group demonstrated decreased balance confidence.

Table 3

ABC Results for Intervention Group

	Weeks				
Participants	**1**	**2**	**3**	**4**	**5**
1	98.8	97.5	97.5	97.5	96.3
2	34.4	46.9	35.6	35.6	50.0
3	21.9	42.2	9.4	13.8	10.0
4	59.4	55.6	58.8	64.4	73.8
5	92.5	76.3	91.3	97.5	96.3
6	86.3	81.8	77.5	71.9	78.8
7	86.3	45.0	47.5	43.8	61.3
8		88.8	80.6		
9		60.6	41.9		64.4
10		45.6	58.8		59.4
Mean Confidence for all Participants	68.5	64.0	59.9	60.6	65.6

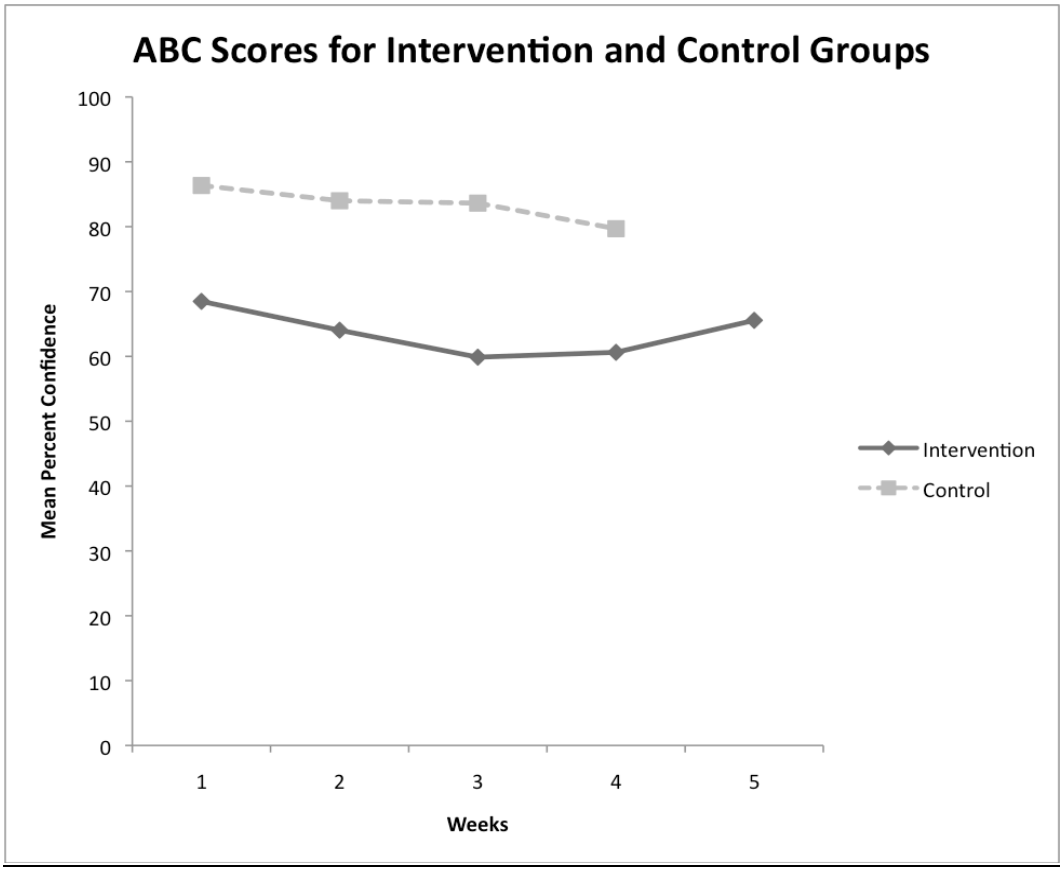
Table 4

ABC Results for Control Group

	Weeks			
Participants	**1**	**2**	**3**	**4**
1	81.9	68.8	67.5	65.0
2	78.1	76.9	74.4	71.3
3	96.1	95.6	92.5	93.8
4	83.8	86.3	90.0	88.8
5	91.9	92.5	93.8	
Mean Confidence for all Participants	86.4	84.0	83.6	79.7

Figure 2

Mean ABC Percentages for the Intervention and Control Groups



Leisure Competence Measure

Intervention Group

Upon initiation of the intervention, the mean LSS LCM score for the intervention group was M=4.0 (see Table 5 & Figure 3). At the conclusion of the intervention, the mean LSS LCM score for the intervention group was M=5.9 for an overall increase in LSS LCM score of 1.9. For the overall mean scores on the LSS LCM, the first split middle point was 4.2 and the second was at 5.9, which indicates an accelerating trend. An

accelerating trend for the mean LSS LCM scores suggests that overall the group demonstrated increased leisure skills competence.

Control Group

Upon initiation of the intervention, the mean LSS LCM score for the control group was M=4.0 (see Table 6 & Figure 3). At the conclusion of the control, the mean LSS LCM score for the intervention group was M=4.3 for an overall increase in LSS LCM score of 0.3. For the overall mean scores on the LSS LCM, the first split middle point was 4.0 and the second was at 4.2, which indicates an accelerating trend. An accelerating trend for the mean LSS LCM scores suggests that overall the group demonstrated increased leisure skills competence.

Table 5

Mean LSS LCM Scores for Intervention Group

	Weeks			
1	**2**	**3**	**4**	**5**
4.0	4.3	4.9	5.9	5.9

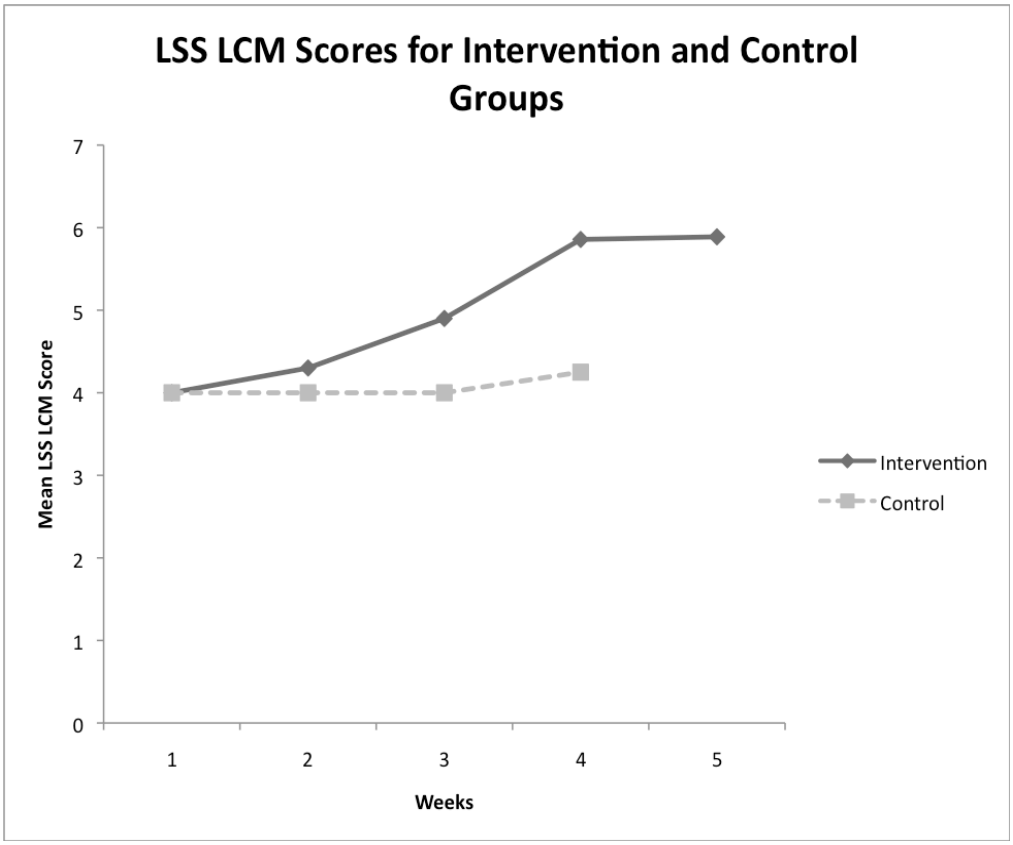
Table 6

Mean LSS LCM Scores for Control Group

	Weeks		
1	**2**	**3**	**4**
3.7	4.0	4.0	4.3

Figure 3

Mean LSS LCM Scores for the Intervention and Control Groups



Experience Questionnaire

Intervention Group

The Experience Questionnaire consisted of seven questions related to the areas of challenge/skill ratio, anxiety, boredom, focused attention, desire to continue, desire to be doing something else, and enjoyment (Broach, Dattilo, McKenney, 2007). Scores on the experience questionnaire correspond to the following (1) not at all, (2) slightly, (3) some, (4) a lot. The mean scores for the various components of the Enjoyment Questionnaire for the intervention group are as follows (see Table 7): A)

challenge/skill was 2.6 at the beginning of the intervention and 3.6 at the end of the intervention for an overall increase of 1.0 (see Figure 4), B) focused attention was 3.6 at the beginning of the intervention and 4.0 at the end of the intervention for an overall increase of 0.4 (see Figure 5), C) boredom remained around 1.0 over the duration of the intervention, with 1.4 during week 1 session 1 being the highest and a score of 1.0 at both the beginning and then end of the study for an overall change of 0.0 (see Figure 6) desire to do something else was 1.6 at the beginning of the intervention and 1.0 at the end of the intervention for an overall decrease of 0.6 (see Figure 7), E) enjoyment was 3.8 at the beginning of the intervention and 4.0 at the end of the intervention for an overall increase of 0.2 (see Figure 8), F) desire to continue activity remained around 4.0 over the duration of the study (see Figure 9), with 3.3 being the lowest score during week 3 session 1 and a score of 4.0 at both the beginning and end of the intervention for an overall change of 0.0, and G) anxiety was 1.8 at the beginning of the intervention and 1.7 at the end of the intervention for an overall decrease of 0.1 (see Figure 10). Because data were variable and it was difficult to determine trend visually, the split middle method was used on the overall mean scores to determine trend for the following components of the Experience Questionnaire: A) for challenge/skill, the first split middle point was 2.6 and the second was at 3.3, which indicates an accelerating trend and an increased sense that the challenge of the activity matched participants skills, B) for focused attention, the first split middle point was 3.9 and the second was 4.0, which indicates an accelerating trend and increase in focused attention, C) for boredom, the first split middle point was 1.0 and the second was 1.0 which indicates no change in boredom, D) for desire to do something else the

first split middle point was 1.0 and the second was 1.0, which indicates no change in desire to do something else, E) for enjoyment the first split middle point was 3.9 and the second was 4.0, which indicates an accelerating trend and an increase in enjoyment, F) for desire to continue activity the first split middle point was 4.0 and the second was 4.0, which indicates no change in desire to continue activity, and G) for anxiety the first split middle point was 1.8 and the second was 1.4, which indicates a decelerating trend and a decrease in anxiety.

Control Group

The mean scores for the various components of the Enjoyment Questionnaire for the control group are as follows (see Table 8): A) challenge/skill was 3.5 at the beginning of the intervention and 2.8 at the end of the intervention for an overall decrease of 0.7 (see Figure 4), B) focused attention was 3.5 at the beginning of the intervention and 4.0 at the end of the intervention for an overall increase of 0.5 (see Figure 5), C) boredom remained at 1.0 throughout the (see Figure 6), D) desire to do something else remained at 1.0 throughout the intervention (see Figure 7), E) enjoyment scores fluctuated between 4.0 and 3.5 throughout the intervention beginning but ended with a score of 4.0, representing no overall change (see Figure 8), F) desire to continue activity remained at 4.0 throughout the intervention (see Figure 9), and G) anxiety fluctuated between 1.4 and 2.0 throughout the intervention beginning but ended with a score of 1.5 for no overall change (see Figure 10). Because data were variable and it was difficult to determine the trend visually, the split middle method was used on the overall mean scores to determine trend for the following components of the Experience

Questionnaire (See Table 7): A) for challenge/skill, the first split middle point was 3.0 and the was second at 3.0, which indicates no change in the overall group's sense that the challenge of the activity matched their skills, B) for focused attention, the first split middle point was 3.7 and the second was 3.9, which indicates an accelerating trend and an increase in focused attention, C) for enjoyment the first split middle point was 3.8 and the second was 3.9, which indicates an accelerating trend and an increase in enjoyment, and F) for anxiety the first split middle point was 1.5 and the second was 1.5, which indicates a no change in anxiety.

Table 7

Split-Middle Calculation Trends for the Experience Questionnaire

	Intervention Group	Control Group
Challenge/Skill	A	U
Focused Attention	A	A
Boredom During the Activity	U	U
Desire to Do Something Else	U	U
Enjoyment of the Activity	A	A
Desire to Continue Activity	U	U
Anxiety During the Activity	D	U
Key: A= Accelerating Trend D= Decelerating Trend U= Unchanged		

Table 8

Mean Experience Questionnaire Scores for Intervention Group

	Weeks and Sessions									
	Week 1 Session 1	**Week 1 Session 2**	**Week 2 Session 1**	**Week 2 Session 2**	**Week 3 Session 1**	**Week 3 Session 2**	**Week 4 Session 1**	**Week 4 Session 2**	**Week 5 Session 1**	**Week 5 Session 2**
Challenge/Skill	2.6	2.9	2.3	3.1	2.5	3.3	3.3	2.7	3.3	3.6
Focused Attention	3.6	3.9	4.0	3.9	4.0	4.0	3.8	4.0	3.8	4.0
Boredom During the Activity	1.0	1.4	1.0	1.0	1.0	1.4	1.0	1.0	1.0	1.0
Desire to Do Something Else	1.6	1.4	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0
Enjoyment of the Activity	3.8	4.0	4.0	3.9	3.3	3.7	4.0	4.0	4.0	4.0
Desire to Continue Activity	4.0	3.9	4.0	3.9	3.3	3.6	4.0	4.0	4.0	4.0
Anxiety During the Activity	1.8	1.9	1.8	1.8	1.3	2.5	1.3	1.4	1.0	1.7

Table 9

Mean Experience Questionnaire Scores for Control Group

	Weeks and Sessions								
	Week 1 Session 1	**Week 2 Session 1**	**Week 2 Session 2**	**Week 3 Session 1**	**Week 3 Session 2**	**Week 4 Session 1**	**Week 4 Session 2**	**Week 5 Session 1**	**Week 5 Session 2**
Challenge/Skill	3.5	2.5	3.2	2.8	3.2	2.5	3.2	2.5	2.8
Focused Attention	3.5	3.8	3.8	3.8	4.0	3.5	3.8	3.5	4.0
Boredom During the Activity	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Desire to Do Something Else	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Enjoyment of the Activity	4.0	3.8	3.8	3.8	4.0	3.5	3.8	4.0	4.0
Desire to Continue Activity	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Anxiety During the Activity	1.5	1.5	1.6	1.5	1.4	1.5	1.4	2.0	1.5

Figure 4

Mean Challenge/Skill Scores for Intervention and Control Groups

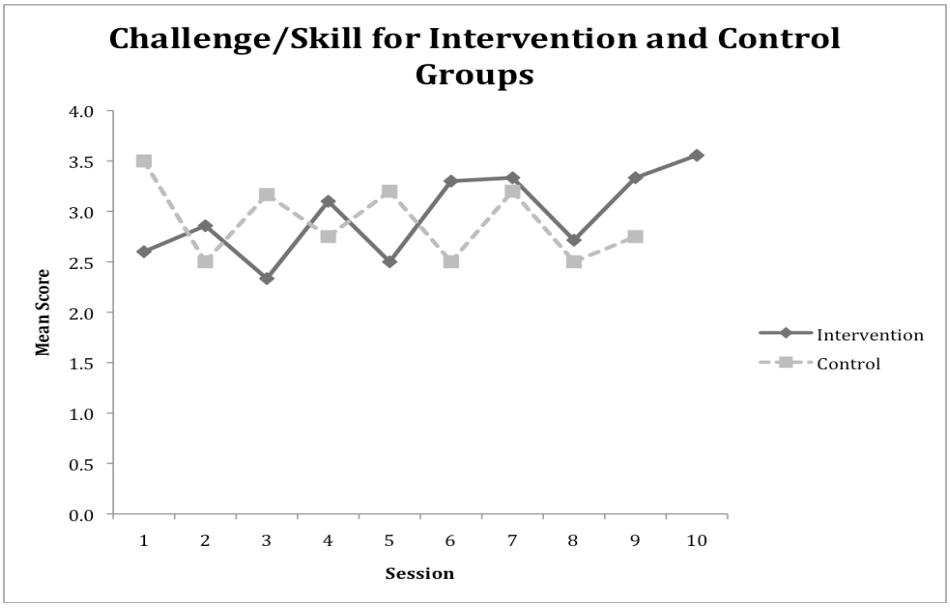


Figure 5

Mean Focused Attention Scores for Intervention and Control Groups

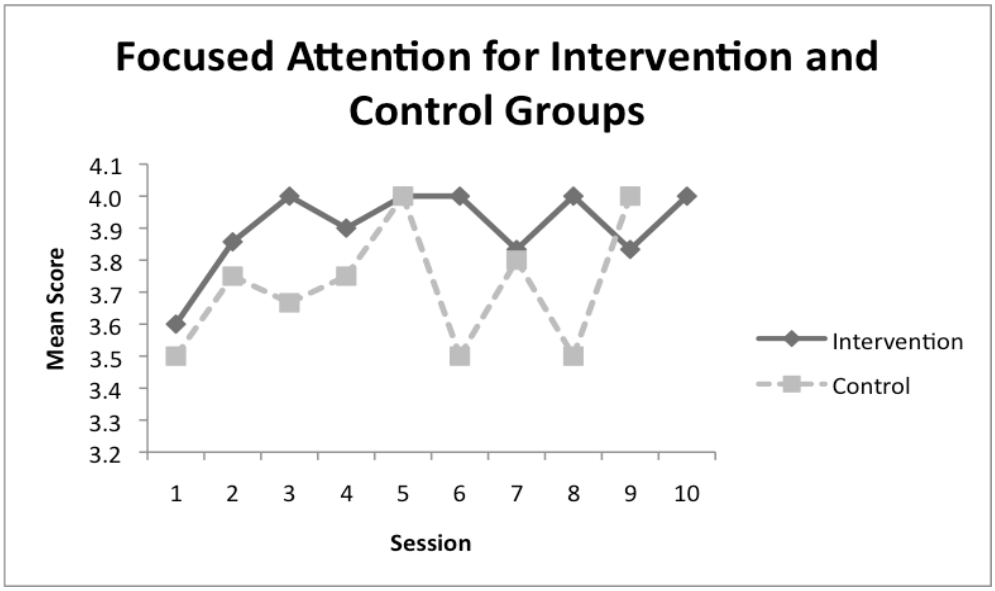


Figure 6

Mean Boredom Scores for Intervention and Control Groups

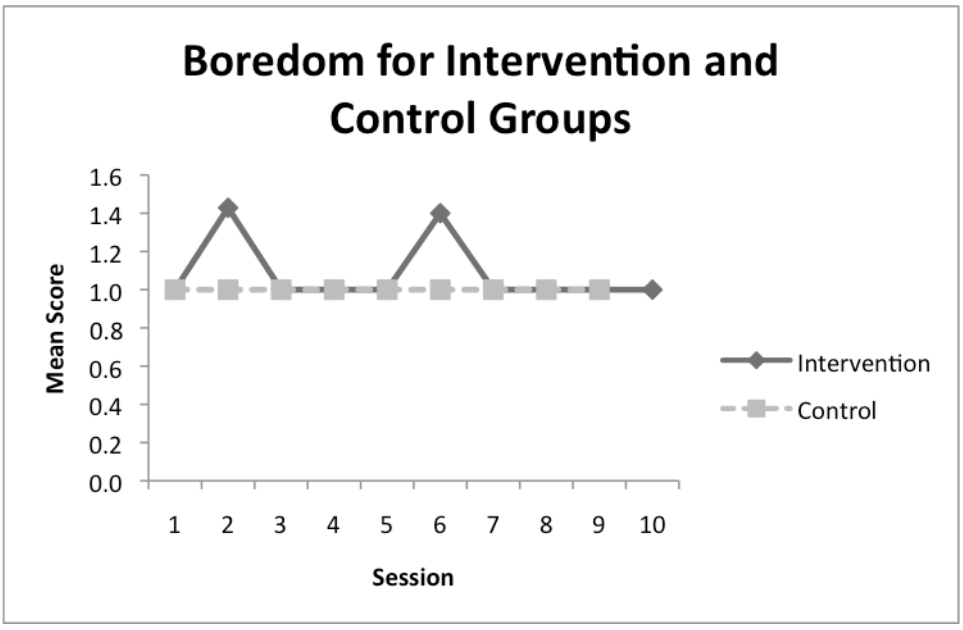


Figure 7

Mean Desire to do Something Else Scores for Intervention and Control Groups

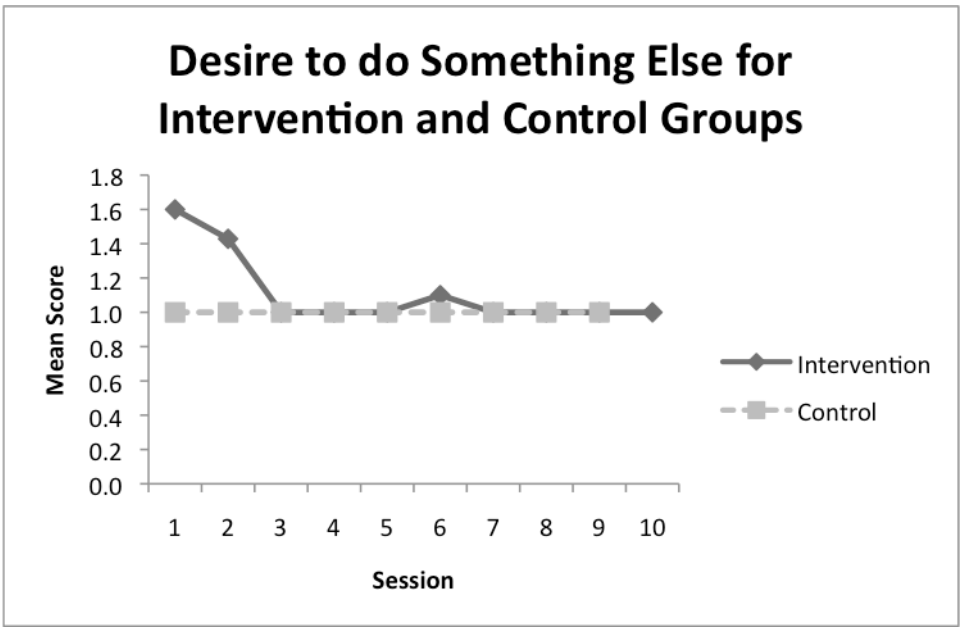


Figure 8

Mean Enjoyment Scores for Intervention and Control Groups

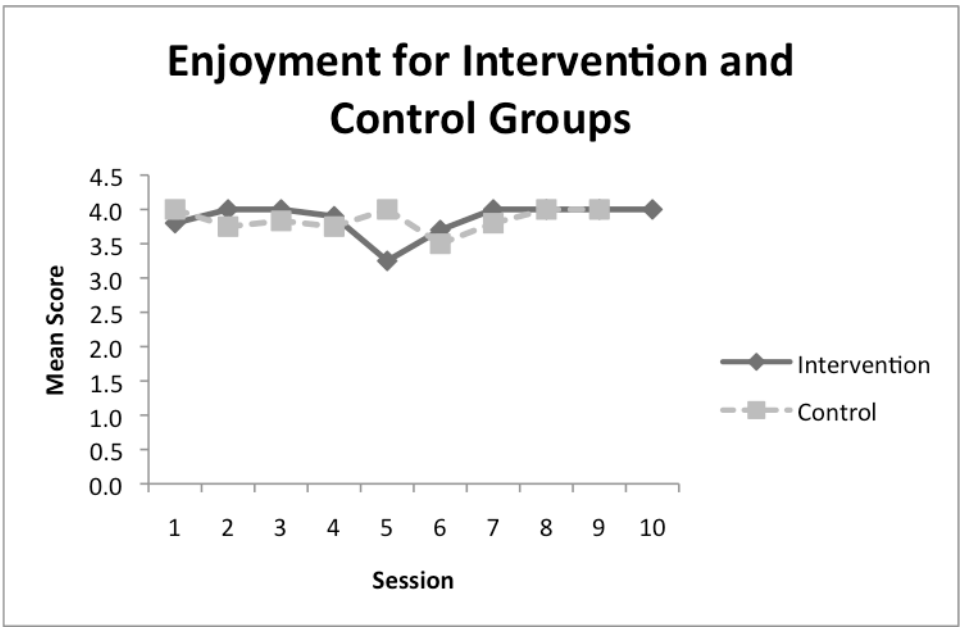


Figure 9

Mean Desire to Continue Scores for Intervention and Control Groups

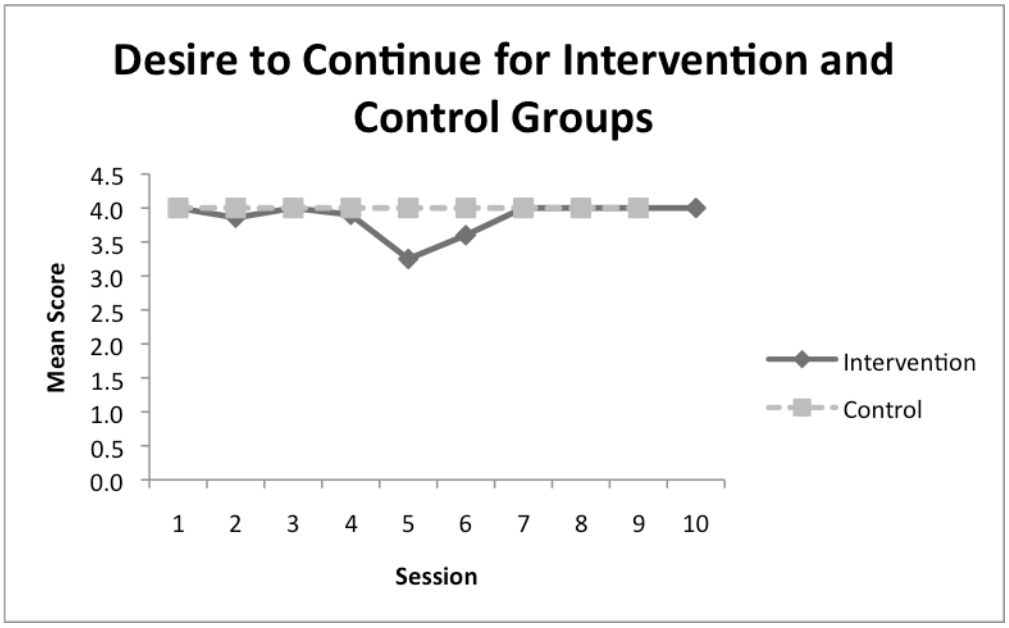
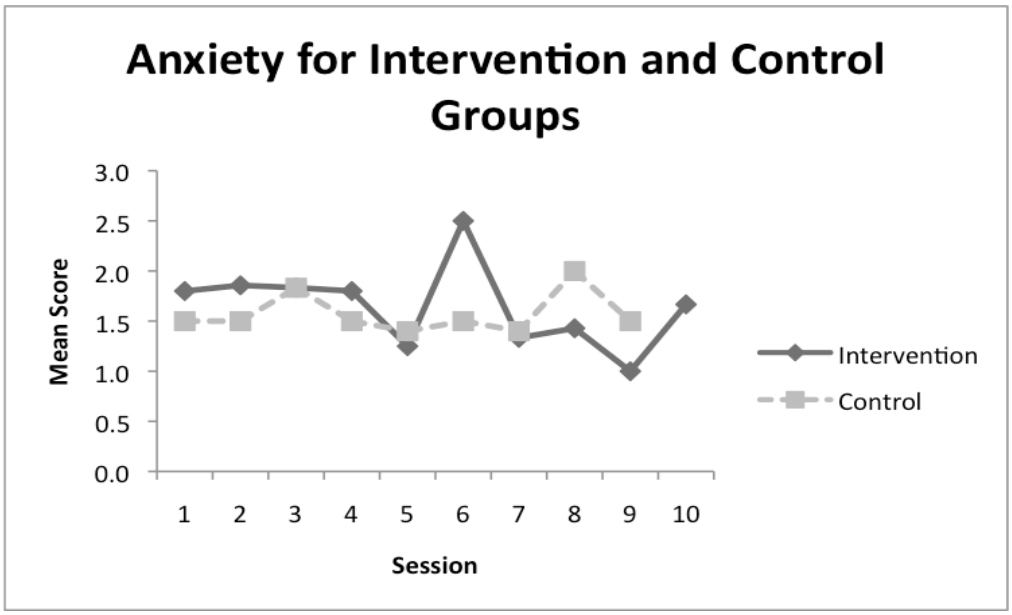


Figure 10

Mean Anxiety Scores for Intervention and Control Groups



CHAPTER FIVE

DISCUSSION AND RECOMMENDATIONS

Introduction

The purpose of this study was to compare the effects of an intervention using the Nintendo Wii™ with a Tai Chi intervention on balance, enjoyment, and leisure competence in older adults in a community setting. Data were collected through the use of the TUG, ABC, and LCM measures. This chapter discusses the findings, limitations, implications, and recommendations for future research.

Discussion of Findings

TUG

The data presented suggested that both the intervention and control groups demonstrated a decrease in mean TUG times over the course of the intervention. While this decrease suggests an improvement in balance for both groups, the intervention group demonstrated a greater decrease in mean TUG time with an overall decrease of 3.2 seconds compared to the control group mean TUG time decreasing by a total of 0.2 seconds. Although the intervention group's mean TUG time was higher overall, the group showed a greater change in mean TUG time, suggesting that participants' ability to rise from a seated position, walk 3 meters, turn, and return to a seated position improved more than the control group's ability. This decrease in time to complete the TUG indicated that both groups demonstrated an increase in functional mobility, which is related to both balance and gait speed (Podsiadlo & Richardson, 1991), following participation in the Wii™ bowling intervention and Tai Chi class, with the Wii™

intervention group showing a greater improvement. While visual inspection revealed an overall increase for both groups, estimates from split middle calculations showed the intervention group had a decelerating trend that indicated improvement in their ability to rise from a seated position, walk 3 meters, turn, and return to a seated position. Although mean control group scores indicated a decrease in the time to complete the TUG, split middle calculations for the control group estimated an accelerating trend.

By increasing physical activity through both the Wii™ bowling and Tai Chi, the participants' physical function may have been improved, resulting in an overall decrease in TUG times. Several possible explanations exist for why the intervention group experienced a larger decrease in TUG times than the control group, and a decelerating trend in split-middle calculations while the control group experienced an accelerating trend. First, the participants in the control group were standing the entire time during the Tai Chi activity, while the participants in the intervention group were taking turns bowling, and were standing to play and then returning to their seat until their next turn, when they would again stand to play. This increase in sitting and standing may have lead to improvement in the intervention groups TUG times, as rising and returning to sit in a chair is timed in the measure. Another possible explanation is that the control group participants' TUG times were lower than those of the intervention group participants to begin with and were already within the normal standard of less than 10 seconds (Podsiadlo & Richardson, 1991; Shumway-Cook, Brauer, & Woollacott, 2000), which could indicate that a large decrease in time would not be expected.

The intervention and control group both demonstrated an overall decrease in balance confidence scores, indicating a decrease in their confidence in maintaining balance during performance of various daily activities. In addition, split middle calculations also estimated a decelerating trend in scores, which suggested an overall decline in balance confidence. Although overall balance confidence decreased in both groups, results from the control group showed a greater decrease than results from the intervention group, with a total decrease in balance confidence scores of 6.7% and 2.9% respectively. Of the 10 individuals in the intervention group, 5 showed an overall increase in balance confidence of 6.7%, while 2 of the 6 control group participants showed an overall increase of 3.5%. Although there was an overall decrease in balance confidence scores, five of the intervention group participants indicated they felt more confident performing a given set of daily activities at the end of the intervention than at the beginning. This indicated that 5 of 10 intervention group participants and 2 of 6 control group participants experiences improvements in confidence related to increased mobility, decreased falls, improved balance, and potential lessening of avoidance of activities due to fear of falling (Powell & Meyers, 1995; Lajoie & Gallagher, 2004; Meyers, Fletcher, Meyers, & Sherk, 1998; Whitney, et al., 1999; Myers, Petrella, Ecclestone, Tudon-Locke, &O'Brien, 2996).

A possible explanation for the decrease in balance confidence is that there were differences among individual participants. While the two groups demonstrated an overall decrease in scores, 5 of the intervention group participants and a 2 of the control group

participants experienced an increase in scores. The ABC measure references activities done in everyday life. While the Wii™ bowling intervention and Tai Chi class may have improved balance confidence in some participants, as evidenced by increases in ABC scores for some participants in both groups, the time needed for other participants to relate that improvement to the activities assessed in the ABC measure may not have passed. Another point to make is that the ABC may not have provided a clear representation of balance confidence in the groups measured. Many participants stated they do not regularly attempt many of the activities referenced in the measure, and therefore could not give an accurate percentage to represent their confidence in performing the activity. This may have resulted in overall lower scores for this measure.

LCM

Both intervention and the control groups demonstrated increases in LCM scores. The intervention group mean LCM score increased by 1.9 points, while the control group mean LCM score increased by 0.3 points. Visual inspection of graphical display of LSS LCM scores for the intervention group indicated an accelerating, stable trend. An accelerating, stable trend was also evident for the control group. Split middle calculations also supported accelerating trends in LSS LCM scores for both groups, with the intervention group showing a higher degree of acceleration than the control group. This increased LCM score indicate that over the course of the study participants in both groups experienced improvements in skill, knowledge, and behavior (Kloseck & Crilly, 1997) related to either Wii™ bowling or Tai Chi, with the intervention group showing an overall greater improvement.

Upon further examination of the LCM score for the leisure skills subscale, the intervention group showed overall higher scores than the control group. One potential explanation for this is the difference in degree of difficulty of the two activities. While both activities have a learning curve to performance proficiency, the learning curve associated with Wii™ bowling may be more related to learning the gaming system, using the Wii™ remote, buttons, and on-screen features, while the learning curve with the Tai Chi may be more of an ongoing process, where Tai Chi positions learned in the beginning are refined as participation in Tai Chi continues. Due to this difference in the two activities, participants' in Wii™ bowling may show a large improvement in competence when first beginning the activity once they become familiar with the gaming system and components, while Tai Chi participants may show a more gradual increase in competence as moves are refined and poses require more skill.

Experience Questionnaire

Scores for the Experience Questionnaire were presented by specific item. For the "challenge/skill" item the intervention group showed an increase of 1.0 point while the control group decreased by 0.7 points. These results suggest that the intervention group indicated their skill level matched the challenge of the activity more than the control group's skill level over the course of the study. The item related to "focused attention" increased for both groups with the intervention group's score increasing by 0.4 points and the control group increasing by 0.5 points. The item related to "enjoyment" increased by 0.2 points for the intervention group while the control group showed no overall change in "enjoyment". Over the course of the study "desire to do something else" remained 1.0

("not at all") for the control group, and decreased from 1.6 to 1.0 for an overall decrease of 0.6 in the intervention group. Both groups no overall change for items "boredom" and "desire to continue the activity", with "boredom" remaining around 1.0 ("not at all") and "desire to continue activity" remaining around 4.0 ("a lot") for both groups. For the "anxiety" item, the intervention group experienced a decrease of 0.1 points while the control group demonstrated no overall change in "anxiety" scores.

Results from the Experience Questionnaire appear to support the idea that Wii™ Bowling is an intervention that can potentially result in a flow experience, using the Experience Questionnaire as an indicator of flow. Participants involved in the Wii™ bowling activity showed an increased score on challenge/skill, that is they reported feeling as though the challenge of the bowling activity increasingly matched their skill level. Balance between a person's skill level and the challenges of an activity, leads to an optimal experience where the individual is in a "flow channel" and they are completely engaged in the activity (Moneta & Csikszentmihalyi, 1996). In addition to providing a balance between challenge and skill, Experience Questionnaire scores for the Wii™ bowling group also demonstrated an increase in focused attention, showing that participants reported increased focus and engagement in the activity than in other activities in which they may participate. While an optimal experience and a state of flow are created by a balance between challenge and skill they can also be characterized by engagement in an activity where outside matters seem to be lessened or disappear altogether (Moneta & Csikszentmihalyi, 1996). Increased focused attention can lead to a state where engagement in an activity is at a point where attention to outside occurrences

is decreased. In addition, participants in the Wii™ bowling group reported increased enjoyment in the activity. Enjoyment is another component (alongside balance in challenge/skill), that promotes flow and an optimal experience (Csikszentmihalyi, 1990). When examining leisure competence (see Figure 3), challenge/skill (see Figure 4), and focused attention (see Figure 5) scores in the intervention group, leisure competence increased as participants reported an increase in focused attention and sense that the challenge of the Wii™ bowling activity was matched with their skill level. As challenge/skill, focused attention, and competence increased, desire to do something else decreased and desire to continue participation in the activity remained high. These results support the notion that as positive feedback is received during participation in an activity, competence in that activity improves, leading to increased motivation to maintain participation (Deci & Ryan, 2000).

Implications

VR has been shown to be a beneficial method of improving physical function and in addition to this study video games have been shown to promote participation in leisure activities that can lead to physical functional improvements as well as competence in leisure activities. With increasing physical activity being the number one initiative of Healthy People 2010 (US Department of Health and Human Services, 2006), therapeutic recreation professionals can play an important role in improving the health of older adults by promoting increased physical activity through recreation interventions while addressing a key issue for older adults.

While previous research has shown that VR systems and video games can be beneficial in improving physical function in older adults, the Nintendo Wii™ offers a more affordable and accessible option. With the advancement in technology offered by the Nintendo Wii™, making it a readily available and reasonably priced system when compared to previously developed VR systems, more facilities will be able to incorporate its use into their programming to improve physical function. As opposed to previous home-based gaming systems designed to improve physical function through game play (Flynn, Palma, & Bender, 2007; Morrow, Docan, Burdea, & Merians, 2006), the Nintendo Wii™ does not require any additional equipment and offers players more choice in games available.

Implications for Practice

The results of this study can be used to inform TR professionals in community-based settings serving a variety of clients, including senior adults. Findings of this study support the effectiveness of using the Nintendo Wii™ as an intervention for older adults in community based settings, and more specifically, its effects on physical function related to balance as well as leisure competence. Findings from this study suggest that the use of video games, such as the Nintendo Wii™, can be used as a means of eliciting a flow experience. When an individual experiences flow and positive feelings related to participation in an activity, they are more likely to continue participating in that activity (Csikszentmihalyi & Csikszentmihalyi, 1988; Wankel, 1993). The Wii™ bowling activity provided an opportunity for a flow experience by facilitating participants' matching of challenge and skill an activity, as well as by an increase in focused attention.

The increases in challenge/skill and focused attention coincided with increases in competence. The increased positive feelings associated with a match between challenge and skill and focused attention, in addition to improvements in competence, may have potentially contributed to increased motivation to continue participation. Since adherence is a key aspect of physical activity programs for older adults, it is important to consider programs that offer opportunities for a match between challenge and skill, opportunities for focused attention, and increases in competence. Providing challenging, engaging, and enjoyable activities that lead to optimal experiences, such as the Nintendo Wii™, could be used to increase physical activity in older adults and promote continued participation by providing programming that is physically beneficial as well as enjoyable and motivating.

Implications for TR

The majority of the research completed on the use of VR and video games in improving physical function has been completed in the fields of psychology, computer science, and physical medicine and rehabilitation, including physical therapy, occupational therapy, gerontology, and nursing. In addition to improving the competence of the participants and providing opportunity for an optimal flow experience, participants also demonstrated increases in physical function and balance through decreased TUG times. While many interventions exist to address physical function in relation to balance and fall prevention, recreation therapy can be on the forefront of providing meaningful, stimulating, and motivating interventions that address primary concerns for older adults. With the use of the Nintendo Wii™ becoming increasingly common in settings where TR

professionals practice, opportunity exists for the TR profession to play a key role in the development of programs using the Wii™ and the implementation of its use in healthcare and community-based practice. The goal of TR is "to help people with illnesses, disabilities, and other conditions to develop and use their leisure in ways that enhance their health, independence, and well-being" (NTRS, 1996, p. 23). Since video game play is considered a leisure activity, the TR profession should be a leader in the use of the Nintendo Wii™ and development of research examining its effectiveness in improving functioning and quality of life.

Future Research

While balance is a key issue among older adults and this study demonstrated increased balance after participation in the Wii™ intervention, other areas of physical function, including ability to perform ADLs, range of motion, grip strength, coordination, upper extremity use, lower extremity use, trunk control, and endurance should be examined. This study examined changes in challenge/skill, focused attention, boredom, desire, enjoyment, and anxiety, but other areas of psychological function may have also been affected. Future research on the use of the Nintendo Wii™ in TR should focus not only on improving physical function, but also on its possible impact on psychological function. Cognitive function, attention, and memory are also areas that should be examined. Comparison between the use of the Nintendo Wii™ between community-based and clinical settings should also be addressed, to determine if benefits can be achieved in multiple TR settings. Another possible benefit identified during the course of this study was that the Nintendo Wii™ may improve socialization and interaction. Since

the Wii™ intervention was carried out in a group setting, there was opportunity for participants to interact with, encourage, and enjoy the company of one another. This aspect of participation in Nintendo Wii™ interventions should be further investigated in regard to its impact on the psychological and psychosocial well-being of older adults. As more research on the use of the Nintendo Wii™ in TR settings is completed and evidence of its effectiveness in addressing issues related to TR practice emerge, its use could be expanded to multiple settings and populations.

Limitations

One major limitation related of this study was duration. The sessions were 30 minutes of activity, two times per week, for 5 weeks. Although some variables indicated change, a longer study duration may have been helpful to show changes in function. In addition, more time should be provided for participants to become comfortable with the activities and learn how to correctly use the equipment and participate in the activities.

Sampling for the study was a convenience sample of two senior centers and was dependent on individuals attending the facility at the time of data collection. Over the course of the study, many participants missed one or more sessions, resulting in missing data, which may have had an impact on the overall results. Although the split-middle method was used for data that was variable and difficult to determine trend visually, the small sample size limited the analytic methods employed making it difficult to detect significant differences.

No attempt was made to limit participation in other activities offered by the senior centers or outside of the senior center, so there is no knowledge of which groups, other

than the Wii™ bowling and Tai Chi the participants were involved in. Participants in the Wii™ bowling group, however, were not involved in the Tai Chi group and participants in the Tai Chi group were not involved in the Wii™ bowling group. Participants may have also participated in the study activities prior to this study.

Another limitation may have been differences between participants in the intervention and control groups. While care was taken to select two groups as similar as possible by identifying members of a community senior center who lived independently, who were similar in age and had no apparent significant differences in safety awareness, cognitive function, short term memory, hearing, verbal communication, vision, and physical independence, the control group appeared (after the study) to be higher functioning related to overall physical function than the intervention group. This higher level of physical function may have led to both a ceiling and floor effect where the initial scores of the control group were either high or low enough, that there was little room for significant improvements. There was also a fewer number of participants in the control group.

This study also addressed three variables, physical function (specifically balance), enjoyment, and leisure competence. While this study suggested some changes in these outcomes following participation, this study may have missed changes in outcomes that were not assessed. The intervention for this study consisted of the bowling game on the Nintendo Wii™ system. Other games offered by the system may also result in functional changes, and programs could be targeted to the specific interests of the participants. Since the intervention introduced a new activity (Wii™ bowling), some results could be

related to the novelty associated with this introduction. The researcher spent additional time the Wii™ intervention group, which may have affected the results.

Despite its limitations, I am hopeful that this study will achieve several objectives. First, I hope to add to the knowledge base for TR practice in terms of using VR and video games to improve function. In addition, I am optimistic that this study will empower TR professionals and researchers to be innovators and seek out, develop, and research newly emerging technology and ideas to further the TR field. And finally, I would like this study to promote the use of meaningful, enjoyable, and motivating leisure activities to better the lives of individuals through improvements in function.

APPENDICES

Appendix A

Letter of Support

PICKENS COUNTY SENIORS UNLIMITED

FORMERLY PICKENS COUNTY COUNCIL ON AGING

CHARLES A. PARSONS
EXECUTIVE DIRECTOR

P.O. BOX 1323
PICKENS, SOUTH CAROLINA 29671
(864) 878-0172
FAX: (864) 878-6018
EMAIL: PICKENSSRS@BELLSOUTH.NET

I understand that Hollie Rader will be conducting research with Pickens County Seniors Unlimited as part of thesis requirements at Clemson University. Lynne Cory will serve as principal investigator for the research study, with Hollie Rader serving as co-investigator. The research will take place at one or more of the four senior centers operated by Pickens County Seniors Unlimited. The purpose of this research is to compare the effects of a recreation therapy intervention using the Nintendo Wii™ on physical function, enjoyment, and apathy in individuals attending Pickens County Seniors Unlimited senior centers with activities currently provided by Pickens County Seniors Unlimited. Participation in the study will consist of either participating in a recreation therapy intervention using the Nintendo Wii™ bowling activity or attending current activities offered at the senior centers. The recreation therapy intervention (Nintendo Wii™ bowling activity) will be conducted by Hollie Rader and will involve 1 hour group sessions of playing a video bowling game, 3 times per week. Participants will be assessed using a physical function assessment, experience questionnaire, and apathy scale. I understand that this study is planned to take place over a 4-6 week period.

Al Parsons
Executive Director

Appendix B

Informed Consent

Consent Form for Participation in a Research Study
Clemson University
Comparison of Recreation Therapy Intervention using Nintendo Wii™ Bowling with Participation in a Tai Chi Program on Balance, Enjoyment, and Leisure Competence of Older Adults in a Community Based Setting

Description of the research and your participation
You are invited to participate in a research study conducted by Principal Investigator Dr. Lynne Cory along with Co-Investigator Hollie Rader. The purpose of this research is to compare a Recreation Therapy intervention using Nintendo Wii™ Bowling with participation in a Tai Chi Program on balance, enjoyment, and leisure competence of older adults in a community-based setting. Hollie Rader, Co-Investigator, is conducting this study as part of thesis requirements at Clemson University.

Participation in the study will consist of participating in either a recreation therapy intervention using the Nintendo Wii™ bowling activity or continuing your participation in a Tai Chi program offered by Pickens County Seniors Unlimited.

The Nintendo Wii™ bowling activity involves using a video game to bowl using a handheld remote control. Participants will hold the remote control in their dominant hand, press a button on the remote control during the backswing motion of their arm while raising the virtual bowling ball, and then discontinue pressing the button on the remote control at the "release" of the virtual bowling ball onto the bowling lane. Participants will compete with one another in groups of 2-4 participants per game. The Nintendo Wii™ bowling activity will be conducted by Hollie Rader and will involve 30-minute group sessions of playing a video bowling game, 2 times per week for a period of four weeks. Following bowling sessions, Ms. Rader will assess participants for potential changes in balance, enjoyment, and leisure competence as described below.

The Tai Chi program will continue as is. Tai Chi involves a "slow, graceful learned sequence of movements" involving "relaxed muscles with weight shifting from foot to foot to maintain balance combined with deep breathing." (Allsop & Dattilo, 2000). The currently occurring Tai Chi program will continue to be conducted by a qualified instructor 2 times per week for 30 minute-group sessions for four weeks and following the Tai-Chi sessions Ms. Rader will assess participants for potential changes in balance, enjoyment, and leisure competence as described below.

Since this is a study that examines potential changes in balance, enjoyment and leisure competence and compares differences between groups, we will conduct brief assessments about your balance (one time per week), enjoyment of activity (after each 30 min session), and leisure competence (one time per week). The estimated amount of time required for assessment is: (a) the balance assessment will take approximately 5-10 minutes, (b) the enjoyment questionnaire and leisure competence measure should each take approximately 2-5 minutes. In addition, we will also collect information about your age, gender, and weight.

This form is valid only if the Clemson University IRB stamp of approval is shown here:

CLEMSON UNIVERSITY
IRB CONSENT FORM
APPROVED 9/30/09
EXPIRES 9/29/10

Risks and discomforts
There are possible risks or discomforts associated with this research; however, risks for participation in this study are not greater than those that may occur in daily life. Potential risks include those that would occur in any community-based, supervised exercise program for independent older adults and may include loss of balance, falls, overexertion, and muscle or tissue injury.

Potential benefits
Benefits related to participation include assisting practitioners and educators gain understanding of the effects of using the Nintendo Wii™ as a tool for recreation therapy interventions. Other potential benefits may include improved balance, enjoyment, and increased knowledge about the use of the Nintendo Wii™ bowling as a recreation therapy intervention.

Approximate number of participants
The approximate number of participants involved in the study is 20.

Termination of participation by the investigator
Participation may be terminated by the investigator if participants are unable to engage fully in any of the activities related to the study.

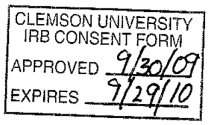
Protection of confidentiality
For this research study, researchers will keep records of your participation in this study. Records include written documentation on paper as well as computerized records. Results of your participation will be confidential and will not be released in any way that would allow someone to recognize you unless otherwise required by law. Your records will be deidentified and coded with a number rather than your name so that your identity will be protected. We will do everything we can to protect your privacy. Your identity will not be revealed in any publication that might result from this study.

In rare cases, a research study will be evaluated by an oversight agency, such as the Clemson University Institutional Review Board or the federal Office for Human Research Protections, that would require that we share the information we collect from you. If this happens, the information would only be used to determine if we conducted this study properly and adequately protected your rights as a participant.

Voluntary participation
Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Contact information
If you have any questions or concerns about this study or if any problems arise, please contact Dr. Lynne Cory at Clemson University at 864.656.2198. If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Institutional Review Board at 864.656.6460.

This form is valid only if the Clemson University IRB stamp of approval is shown here:



Consent
I have read this consent form and have been given the opportunity to ask questions.
I give my consent to participate in this study.

Participant's signature: _____ Date: _____

A copy of this consent form should be given to you.

This form is valid only if the Clemson University IRB stamp of approval is shown here:

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IRB CONSENT FORM
APPROVED 9/30/09
EXPIRES 9/29/10

Revised: June 2005
Page 3 of 3

Appendix C

Information Sheet

Information Sheet for Participants in Wii™ Bowling and Tai Chi Programs

Identification Number:_____
Date: _____
Senior Center Location: _____
Group: Wii™ Bowling Tai Chi

Wii™ Fit Balance Assessment

Actual Chronological Age: _____years
Sex: Female Male
Weight: _____ lbs
Center of Balance: Left Side: _____% Right Side: _____%

Randomly Selected Balance Tests

1. **Basic Balance Test**: _____
2. **Walking Test**: Left Side: _____% Right Side: _____%
3. **Agility Test**: _____
4. **Single Leg Balance Test**: _____
5. **Stillness Test**: _____

Wii™ Fit Age: _____years

Appendix D

TUG Test Form

Timed Up and Go (TUG) Test[1,2]

1. Equipment: arm chair, tape measure, tape, stop watch.

2. Begin the test with the subject sitting correctly in a chair with arms, the subject's back should resting on the back of the chair. The chair should be stableand positioned such that it will not move when the subject moves from sitting to standing.

3. Place a piece of tape or other marker on the floor 3 meters away from the chair so that it is easily seen by the subject.

4. Instructions : "On the word *GO* you will stand up, walk to the line on the floor, turn around and walk back to the chair and sit down. Walk at your regular pace.

5. Start timing on the word "*GO*" and stop timing when the subject is seated again correctly in the chair with their back resting on the back of the chair.

6. The subject wears their regular footwear, may use any gait aid that they normally use during ambulation, but may not be assisted by another person. There is no time limit. They may stop and rest (but not sit down) if they need to.

7. Normal healthy elderly usually complete the task in ten seconds or less. Very frail or weak elderly with poor mobility may take 2 minutes or more.

8. The subject should be given a practice trial that is not timed before testing.

9. Results correlate with gait speed, balance, functional level,the ability to go out, and can follow change over time.

10. Interpretation $\leq$ 10 seconds = normal

$\leq$ 20 seconds = good mobility, can go out alone, mobile without a gait aid.

< 30 seconds = problems, cannot go outside alone, requires a gait aid.

A score of more than or equal to fourteen seconds has been shown to indicate high risk of falls.

1. Podsiadlo D, Richardson S. *The Time "Up & Go": A Test of Basic Functional Mobility for Frail Elderly Persons.* Journal of the American Geriatrics Society 1991; 39(2): 142-148
2. Shumway - Cook A, Brauer S, Woollacott M. *Predicting the Probability for Falls in Community-Dwelling Older Adults Using the Timed Up & Go Test.* *Physical Therapy 2000 Vol 80(9): 896-903.*
Saskatoon Falls Prevention Consortium, Falls Screening and Referral Algorithm, TUG, Saskatoon Falls Prevention consortium, June, 2005

Appendix E

ABC Test Form

The Activities-specific Balance Confidence (ABC) Scale*

Administration:
The ABC can be self-administered or administered via personal or telephone interview. Larger typeset should be used for self-administration, while an enlarged version of the rating scale on an index card will facilitate in-person interviews. Regardless of method of administration, each respondent should be queried concerning their understanding of instructions, and probed regarding difficulty answering specific items.

Instructions to Participants:
For each of the following, please indicate your level of confidence in doing the activity without losing your balance or becoming unsteady from choosing one of the percentage points on the scale form 0% to 100%. If you do not currently do the activity in question, try and imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as it you were using these supports. If you have any questions about answering any of these items, please ask the administrator.

Instructions for Scoring:
The ABC is an 11-point scale and ratings should consist of whole numbers (0-100) for each item. **Total the ratings (possible range = 0 – 1600) and divide by 16 to get each subject's ABC score.** If a subject qualifies his/her response to items #2, #9, #11, #14 or #15 (different ratings for "up" vs. "down" or "onto" vs. "off"), solicit separate ratings and use the lowest confidence of the two (as this will limit the entire activity, for instance the likelihood of using the stairs.)

- 80% = high level of physical functioning
- 50-80% = moderate level of physical functioning
- < 50% = low level of physical functioning

Myers AM (1998)

- < 67% = older adults at risk for falling; predictive of future fall

LaJoie Y (2004)

1. Powell, LE & Myers AM. The Activities-specific Balance Confidence (ABC) Scale. *J Gerontol Med Sci* 1995; 50(1): M28-34
2. Myers AM, Fletcher PC, Myers AN, Sherk W. Discriminative and evaluative properties of the ABC Scale. J Gerontol A Biol Sci Med Sci. 1998;53:M287-M294.
3. Lajoie Y, Gallagher SP. Predicting falls within the elderly community: comparison of postural sway, reaction time, the Berg balance scale and ABC scale for comparing fallers and non-fallers. Arch Gerontol Geriatr. 2004;38:11-26.

The Activities-specific Balance Confidence (ABC) Scale

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:

0% 10 20 30 40 50 60 70 80 90 100%

no confidence **completely confident**

"How confident are you that you will not lose your balance or become unsteady when you…

1. …walk around the house? ____%
2. …walk up or down stairs? ____%
3. …bend over and pick up a slipper from the front of a closet floor ____%
4. …reach for a small can off a shelf at eye level? ____%
5. …stand on your tiptoes and reach for something above your head? ____%
6. …stand on a chair and reach for something? ____%
7. …sweep the floor? ____%
8. …walk outside the house to a car parked in the driveway? ____%
9. …get into or out of a car? ____%
10. …walk across a parking lot to the mall? ____%
11. …walk up or down a ramp? ____%
12. …walk in a crowded mall where people rapidly walk past you? ____%
13. …are bumped into by people as you walk through the mall?____%
14. … step onto or off an escalator while you are holding onto a railing? ____%
15. … step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing? ____%
16. …walk outside on icy sidewalks? ____%

Appendix F

LCM

LEISURE SKILLS

Skills possessed by the client which affect leisure involvement. Ability to independently utilize assistive devices is not considered a form of dependency.

NO HELPER

7. **COMPLETE INDEPENDENCE:** Client is able to make leisure choices based on personal interests. Client possesses the skills necessary to participate in chosen leisure activities. Client possesses the ability to independently locate and utilize leisure resources.

6. **MODIFIED INDEPENDENCE:** Client is able to make leisure choices based on personal interests. Client possesses the skills necessary to participate in chosen leisure activities. With the necessary resource material (brochures, program calendars, adaptive aids, etc.) client possesses the ability to independently locate and utilize leisure resources.

HELPER

5. **MODIFIED DEPENDENCE:** Client is able to make leisure choices based on personal interests. Client possesses the skills necessary to participate in chosen leisure activities, but requires reassurance regarding his/her competence. With cueing client possesses the ability to locate and utilize leisure resources.

4. **MODIFIED DEPENDENCE WITH MINIMAL ASSISTANCE:** Client requires assistance to make leisure choices based on personal interests. Client requires reassurance to participate in leisure activities. Client requires direct assistance to locate and utilize leisure resources.

3. **MODIFIED DEPENDENCE WITH MODERATE ASSISTANCE:** Client requires assistance to make leisure choices based on personal interests. Client may require skill development to participate in chosen leisure activities. Client requires direct assistance to locate and/or utilize leisure resources.

2. **MODIFIED DEPENDENCE WITH MAXIMAL ASSISTANCE:** Client is unable to make leisure choices. Selection of activities must be made for the client. Client requires skill development to participate in leisure activities. Client is unable to locate and utilize leisure resources.

1. **TOTAL DEPENDENCE WITH TOTAL ASSISTANCE:** Due to cognitive and/or physical deficits client is unable to learn age appropriate leisure skills.

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FIGURE 22. FLOW DIAGRAM OUTLINING SCORING PROCEDURES FOR THE LEISURE SKILLS SUBSCALE

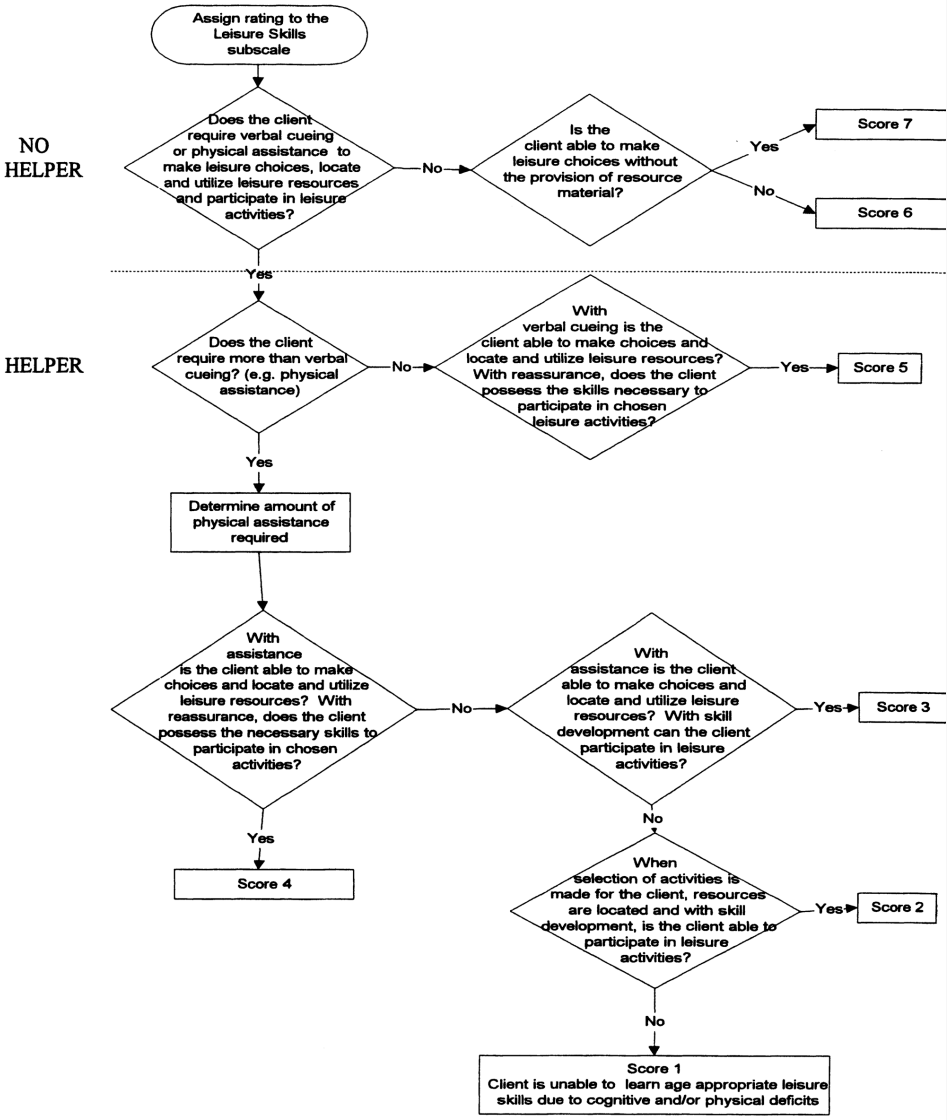


FIGURE 28. LEISURE COMPETENCE MEASURE© DATA SHEET

FUNCTIONAL INDICATORS	ADM __/__/__ dd mth yr	__/__/__ dd mth yr	__/__/__ dd mth yr	__/__/__ dd mth yr	D/C __/__/__ dd mth yr	F/U __/__/__ dd mth yr
LEISURE AWARENESS						
LEISURE ATTITUDE						
LEISURE SKILLS						
CULTURAL/SOCIAL BEHAVIOURS						
INTERPERSONAL SKILLS						
COMMUNITY INTEGRATION SKILLS						
SOCIAL CONTACT						
COMMUNITY PARTICIPATION						
TOTAL LCM SCORE (out of 56) -ADMISSION	/ 56	DISCHARGE/FOLLOW-UP			/ 56	/ 56

ADM = ADMISSION/BASELINE D/C = DISCHARGE F/U = FOLLOW-UP (≥ 2 MONTHS)

Note: Enter a value for each Functional Indicator
Enter "0" for "not assessed"

LEVELS		
	7. Complete Independence 6. Modified Independence	NO HELPER
	5. Modified Dependence 4. Modified Dependence with Minimal Assistance 3. Modified Dependence with Moderate Assistance 2. Modified Dependence with Maximal Assistance 1. Total Dependence with Total Assistance	HELPER

Appendix G

Experience Questionnaire

Enjoyment Questionnaire

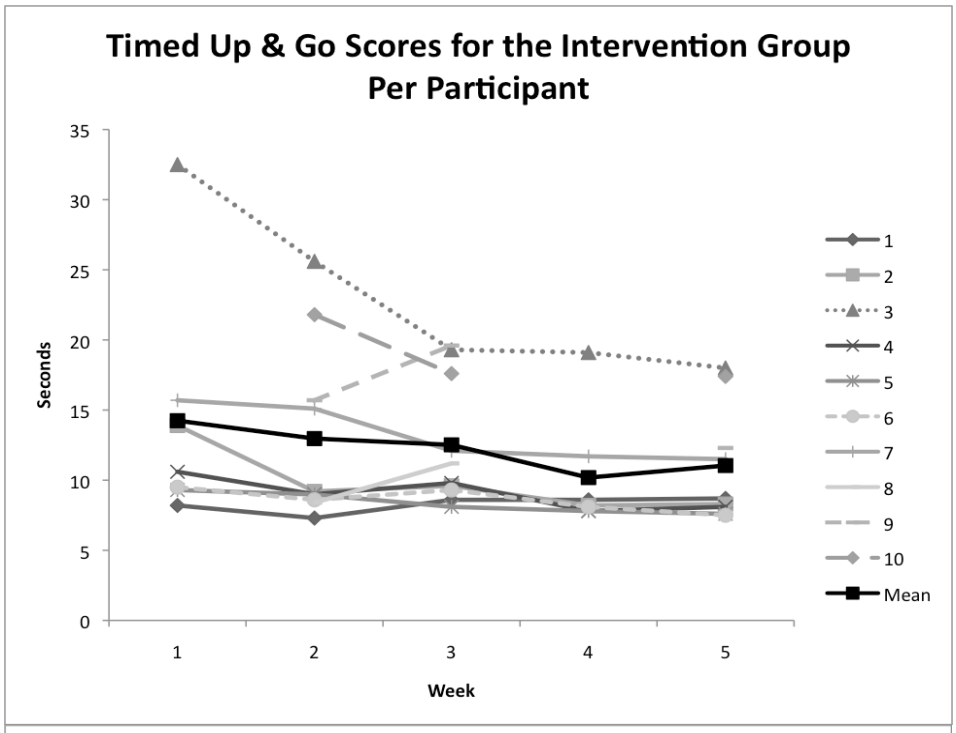
These statements relate to the thoughts and feelings you may have experienced during the program you have just completed. There are no right or wrong answers. Think about how you felt and complete the questionnaire using the form below. Please answer each item as carefully and as accurately as possible by placing a check in the appropriate box:

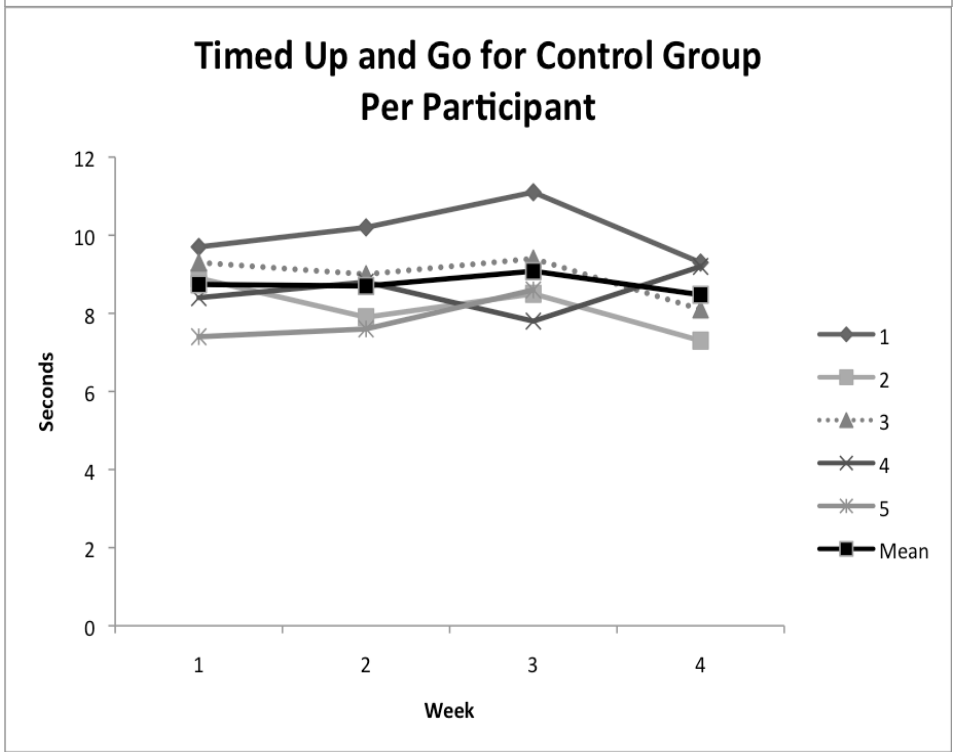
Questions	Not at all	Slightly	Some	A lot
1. My skills were matched with the challenge.				
2. The activity had my full attention while I was doing it.				
3. I was bored during the activity.				
4. While I was doing the activity I wished I was doing something else.				
5. I enjoyed the activity today.				
6. I would like to do the activity again.				
7. I was anxious during the activity.				

Adapted from Broach, Dattillo, & McKenny (2007)

Appendix H

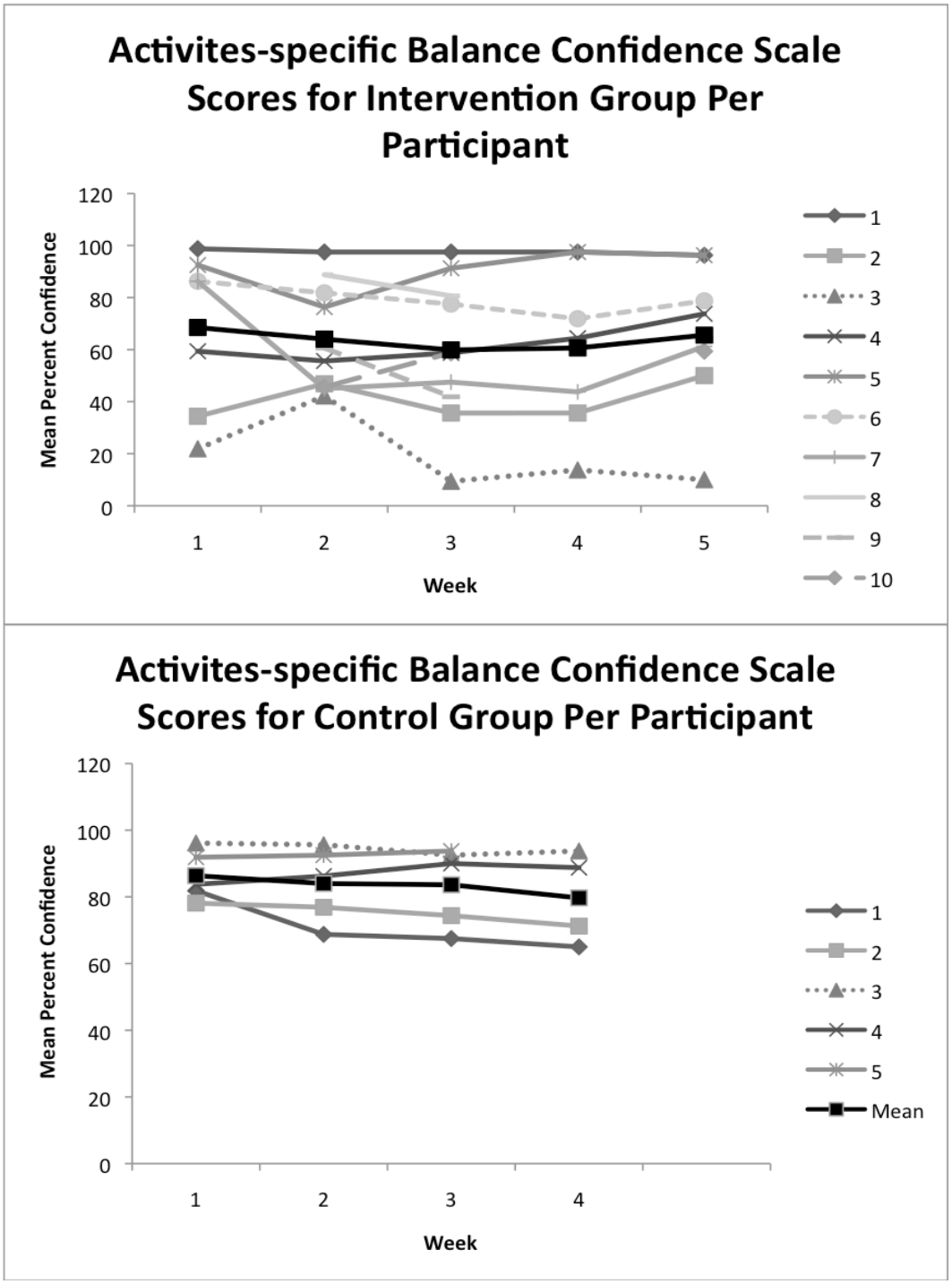
Graphs of TUG Scores for All Participants





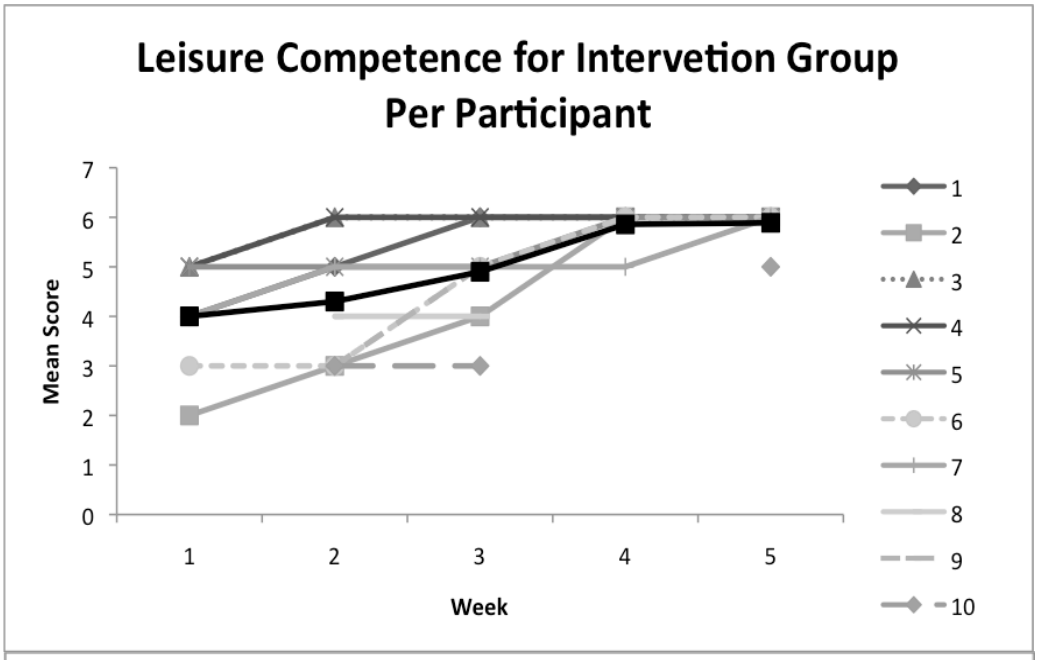
Appendix I

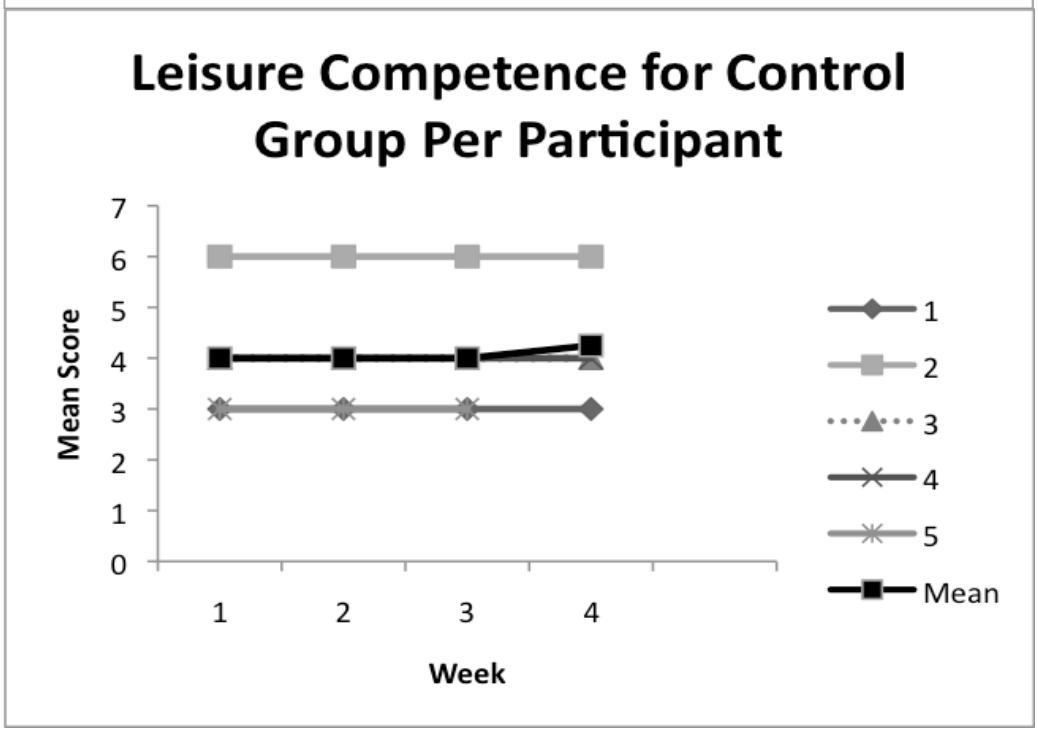
Graphs of ABC Scores for All Participants



Appendix J

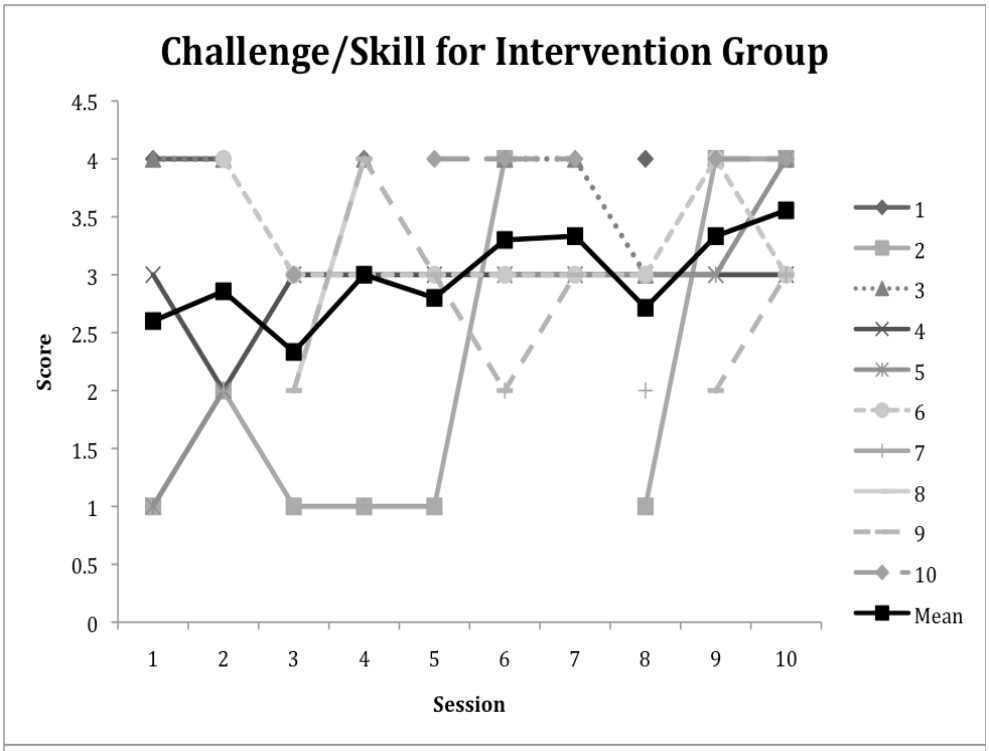
Graphs of LSS LCM Scores for All Participants

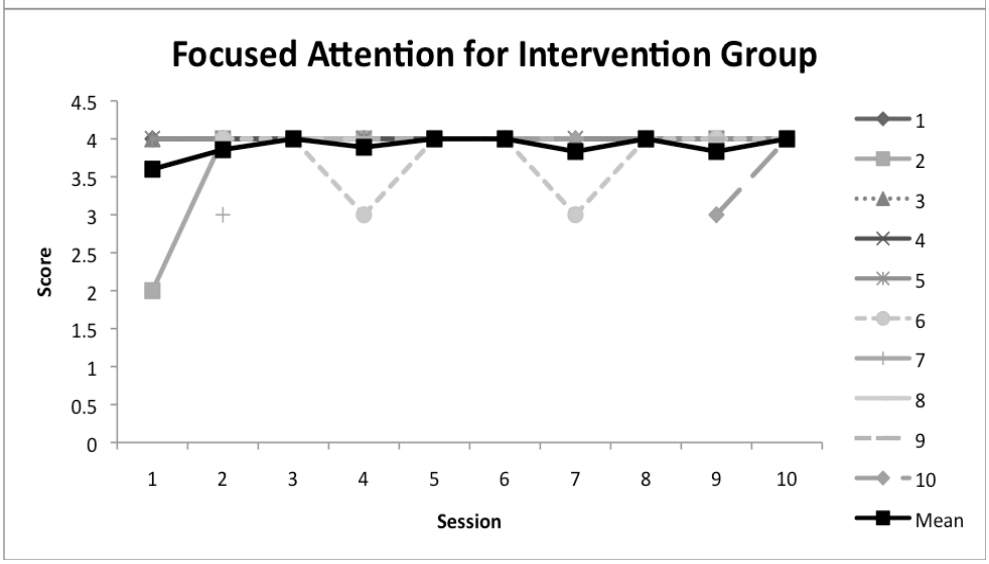


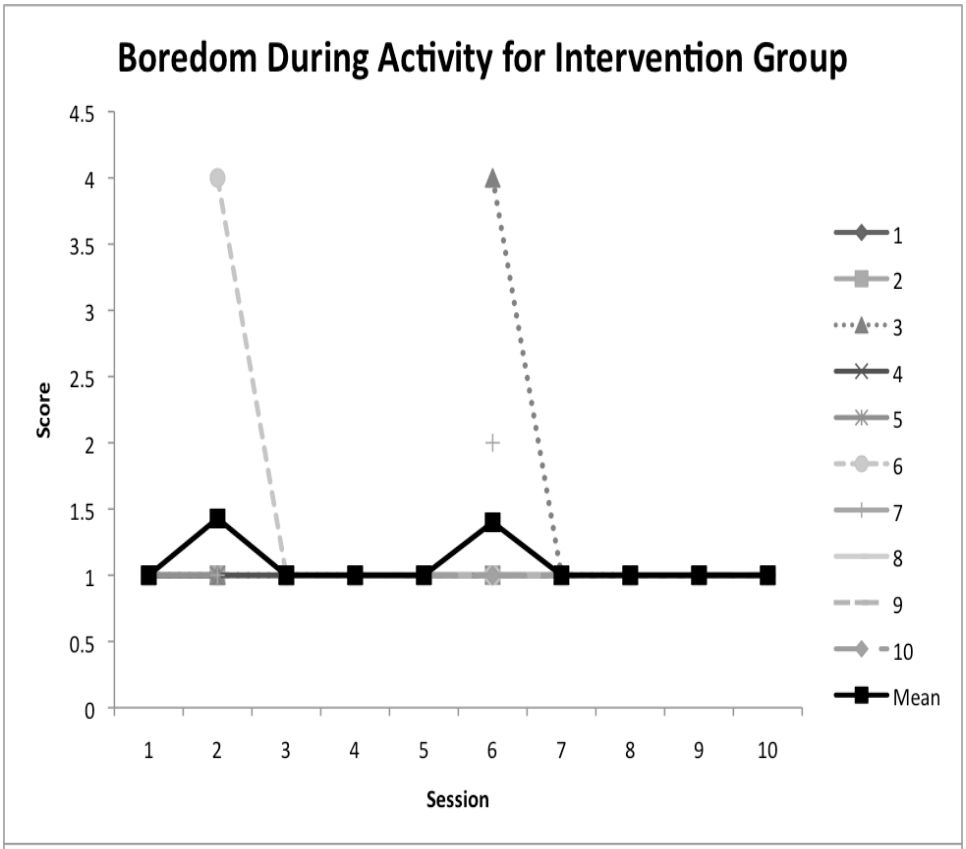


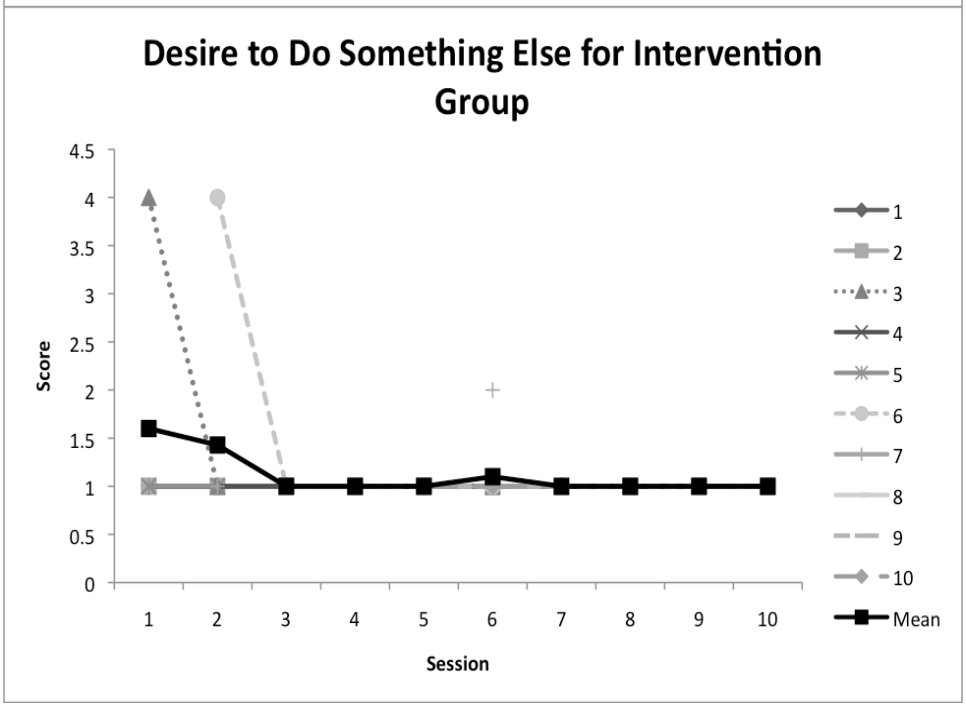
Appendix K

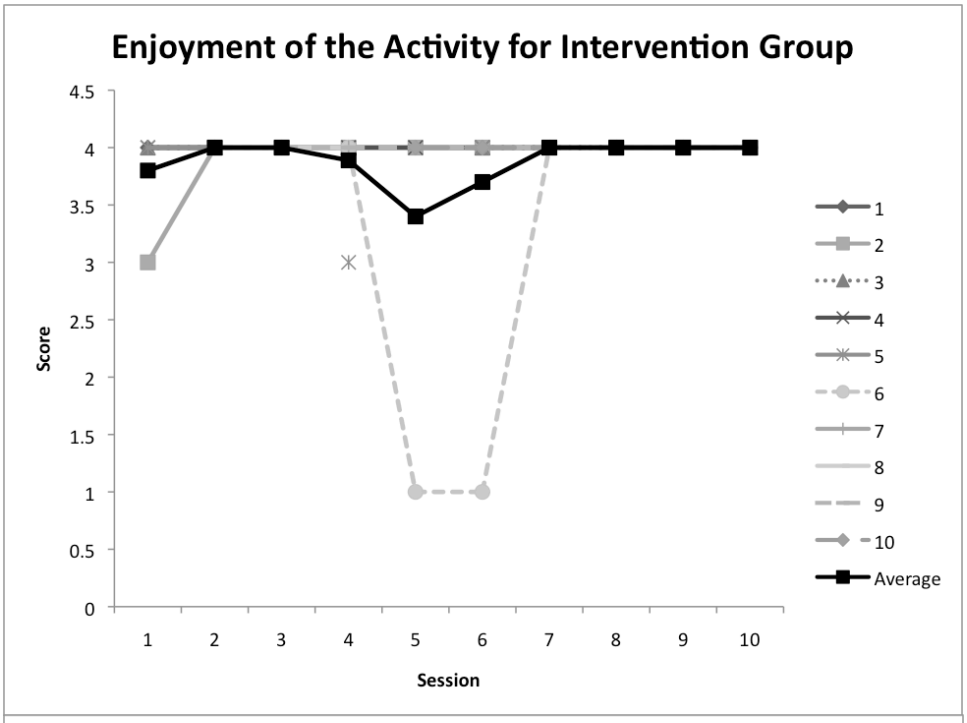
Graphs of Experience Questionnaire Scores for All Participants

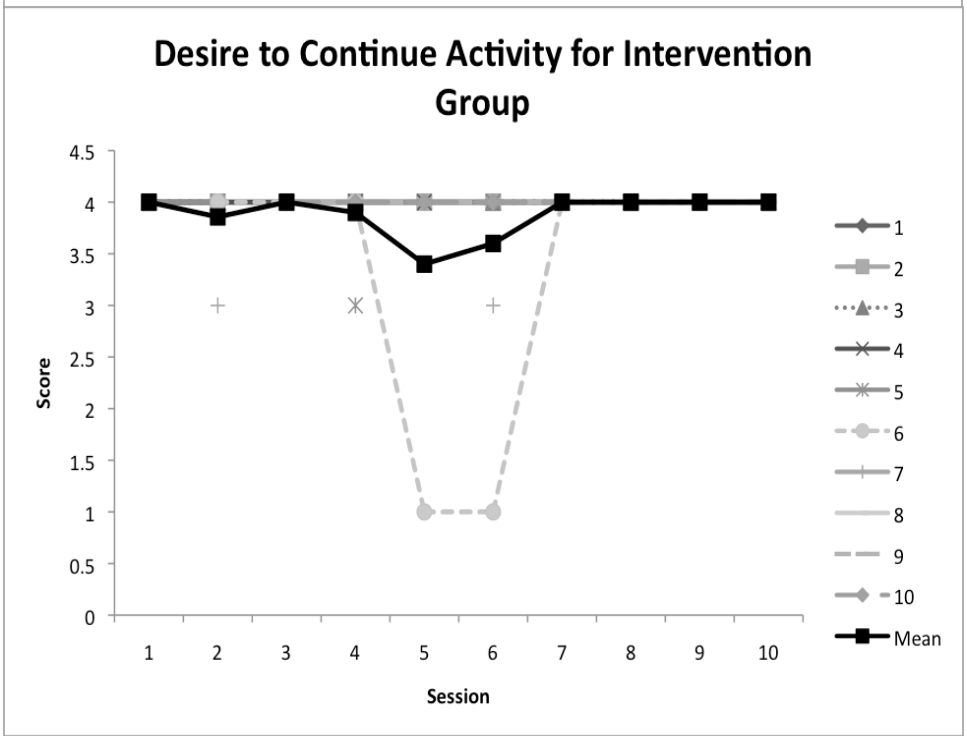


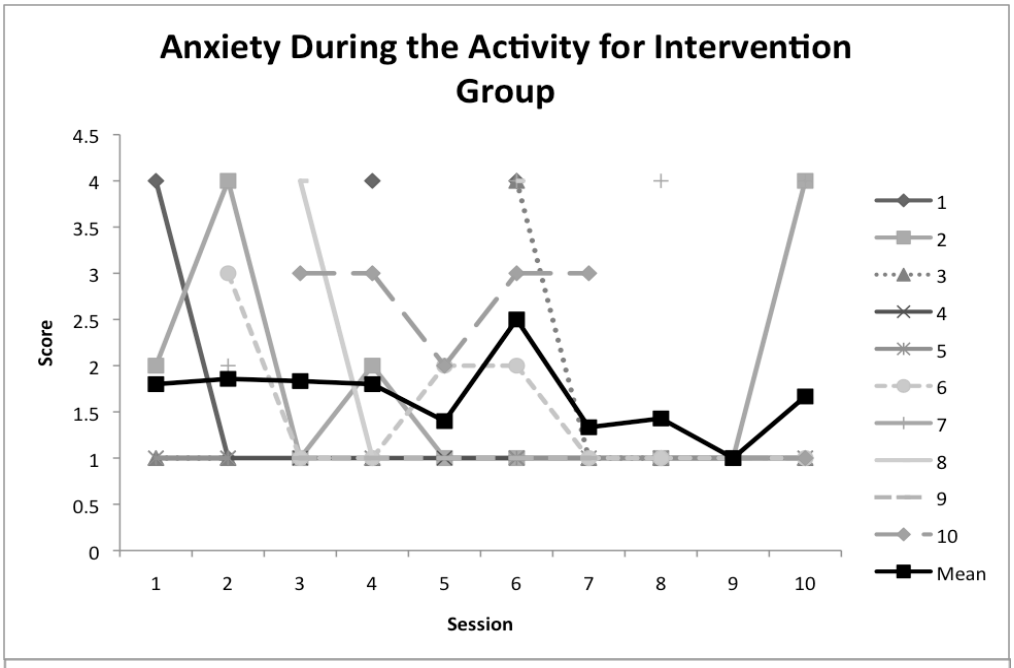


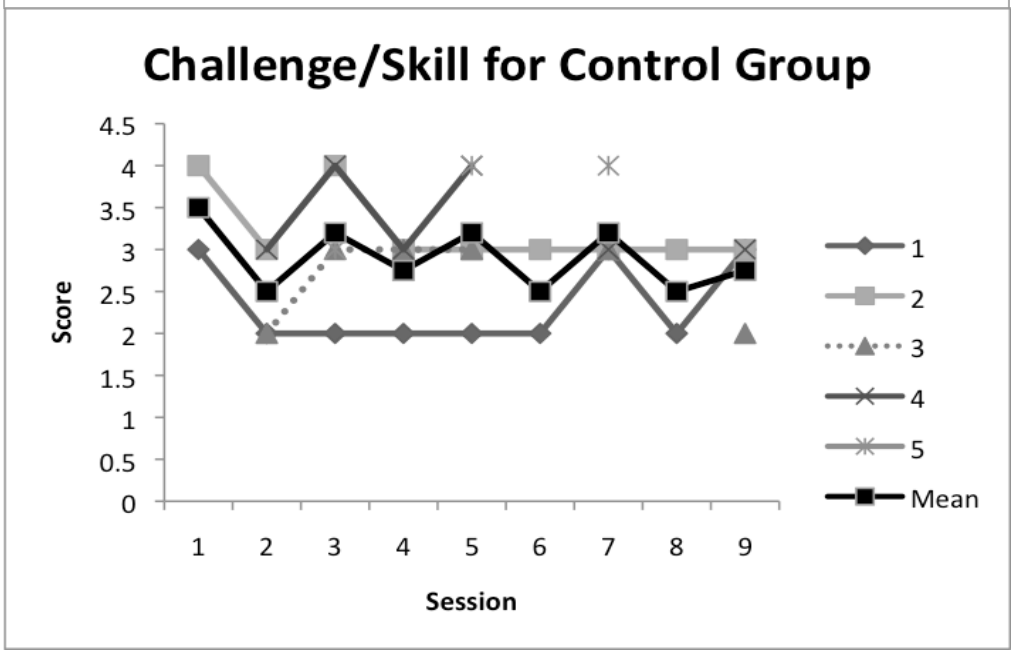

Boredom During Activity for Intervention Group
Score
Session
1
2
3
4
5
6
7
8
9
10
Mean

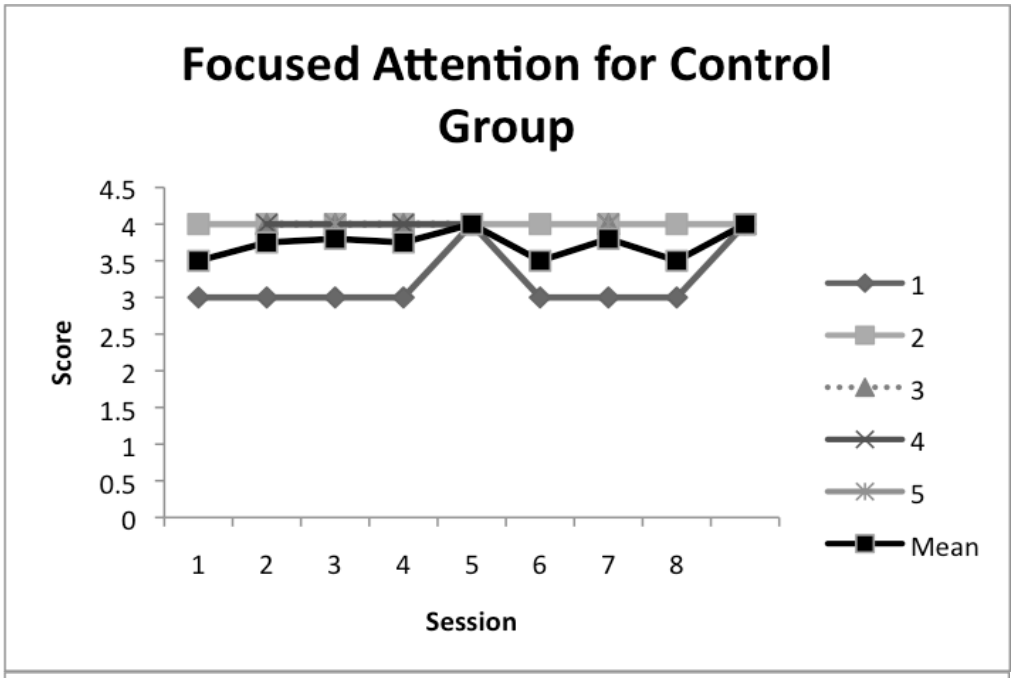

Desire to Do Something Else for Intervention Group
Score
Session
1
2
3
4
5
6
7
8
9
10
Mean

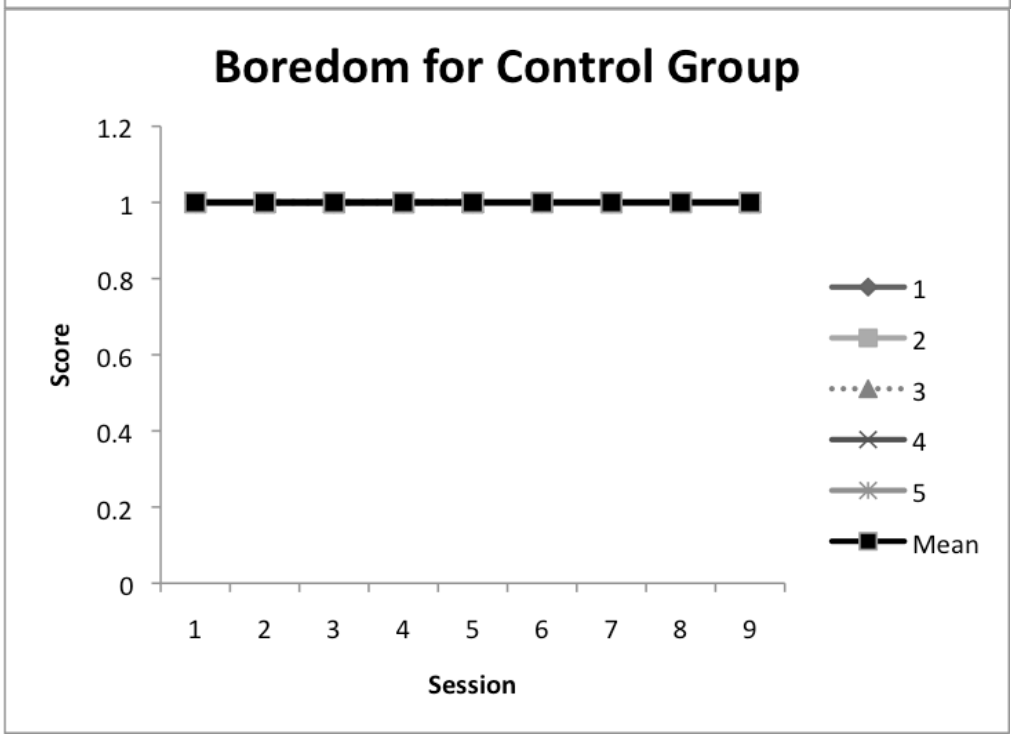

Enjoyment of the Activity for Intervention Group
Score
Session
1
2
3
4
5
6
7
8
9
10
Average

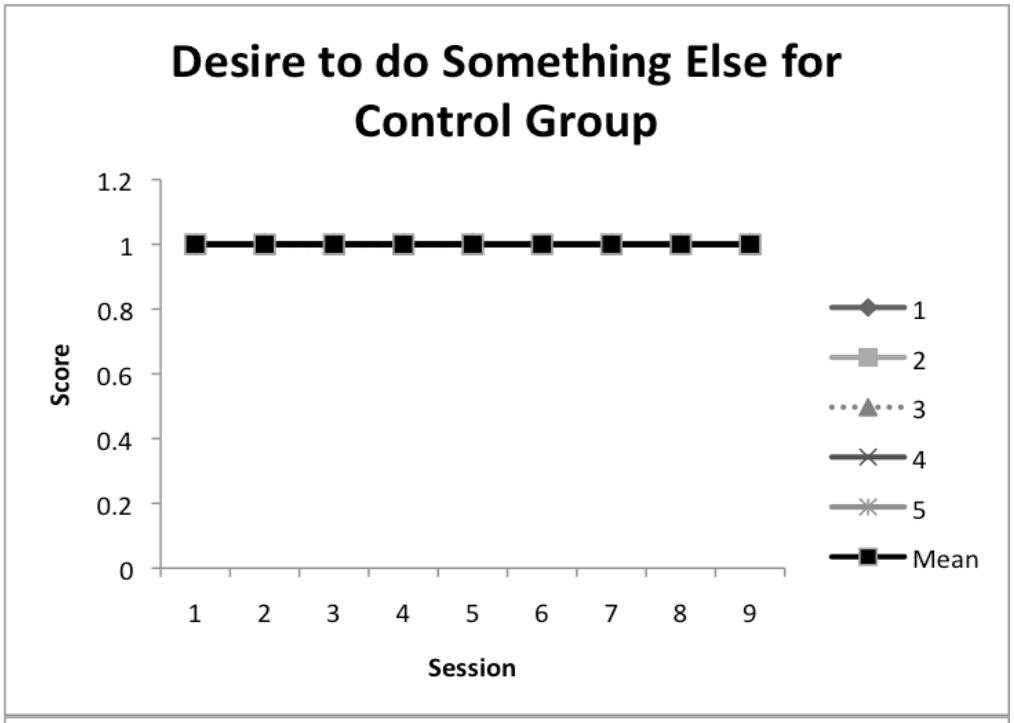

Desire to Continue Activity for Intervention Group
Score
Session
1
2
3
4
5
6
7
8
9
10
Mean

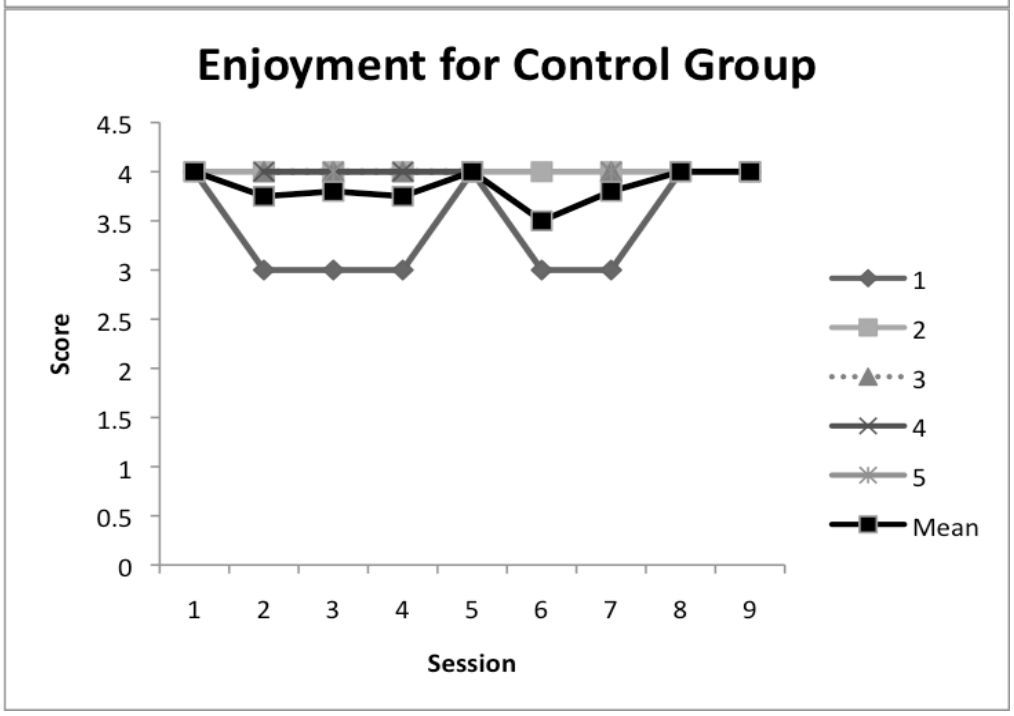

Anxiety During the Activity for Intervention Group
Score
Session
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1 2 3 4 5 6 7 8 9 10
1
2
3
4
5
6
7
8
9
10
Mean

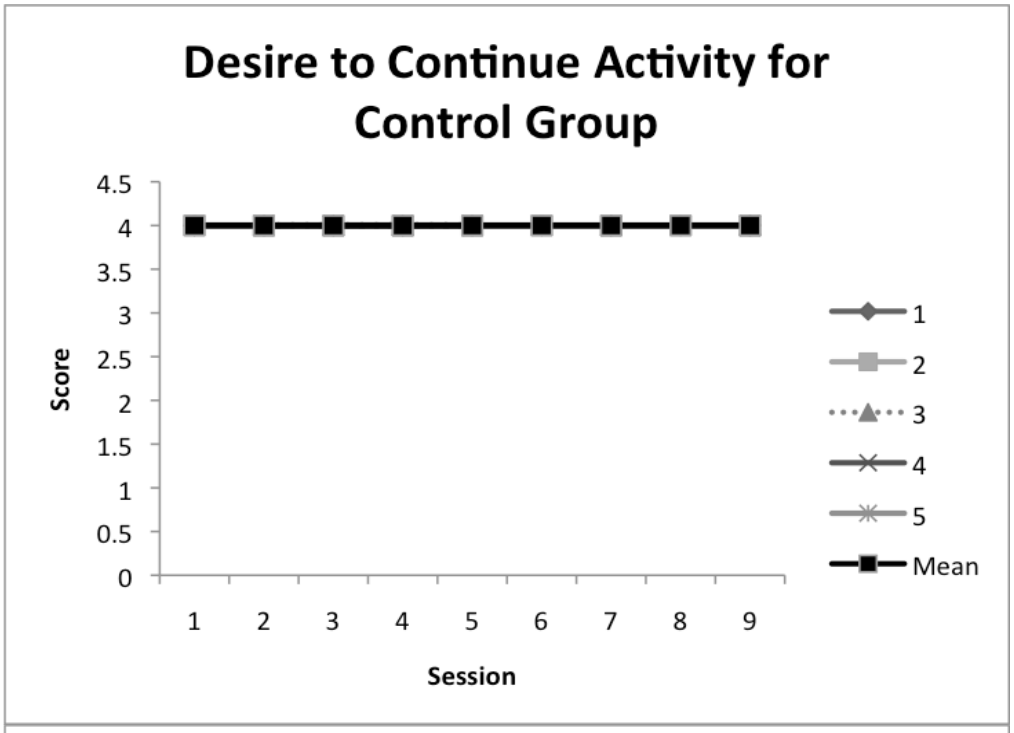

Challenge/Skill for Control Group
Score
Session
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1 2 3 4 5 6 7 8 9
1
2
3
4
5
Mean

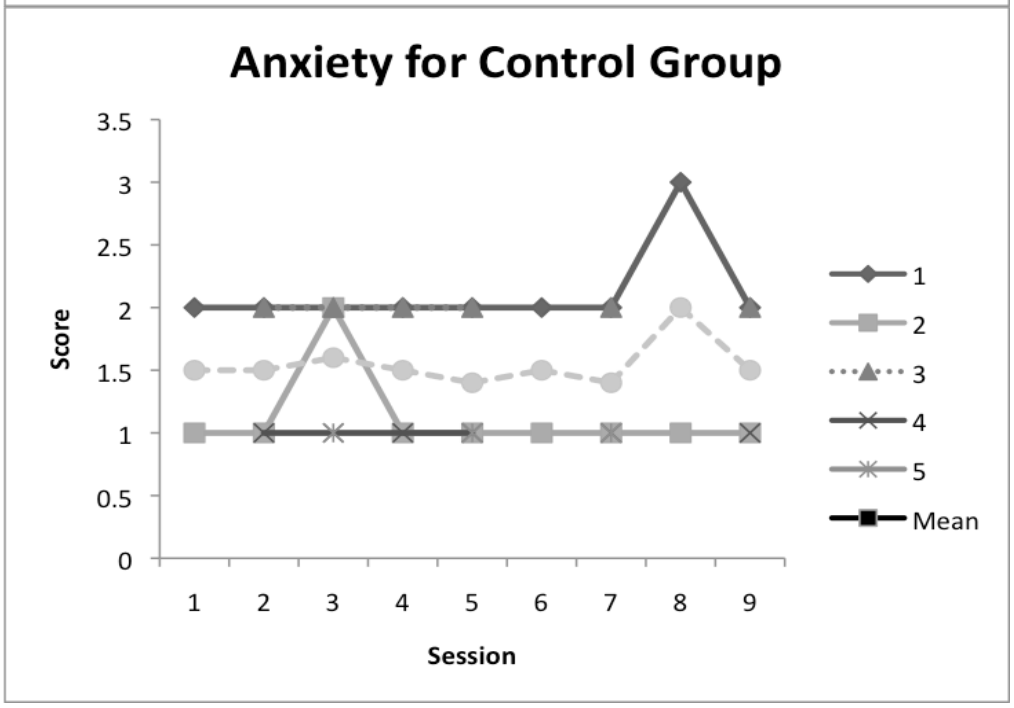

Focused Attention for Control Group
Score
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1 2 3 4 5 6 7 8
Session
1
2
3
4
5
Mean


Boredom for Control Group
Score
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9
Session
1
2
3
4
5
Mean


Desire to do Something Else for Control Group
Score
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9
Session
1
2
3
4
5
Mean


Enjoyment for Control Group
Score
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1 2 3 4 5 6 7 8 9
Session
1
2
3
4
5
Mean


Desire to Continue Activity for Control Group
Score
Session
1
2
3
4
5
Mean


Anxiety for Control Group
Score
Session
1
2
3
4
5
Mean

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