# EXAMINING THE RELATIONSHIPS BETWEEN BODY MOTION VIDEO GAMING OR MIND-BODY PRACTICE AND BALANCE, COGNITION, AND SOCIAL ENGAGEMENT IN COMMUNITY DWELLING OLDER ADULTS

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## ABSTRACT

As the population ages, there exists a desire to stay active and in one's own home. Institutionalization is required for some individuals, with the primary causes being falls, frailty, and cognitive decline. Body motion gaming systems and mind-body practices have been successfully utilized to address balance, cognition, and social engagement in different patient populations. This study was designed to investigate if similar benefits could be seen in healthy, community dwelling older adults. Eleven participants volunteered for the study. Pre, post, and one-month post assessments performed included the Berg Balance Scale, Functional Gait Assessment, 30-second Chair Stand Test, Montreal Cognitive Assessment, and Satisfaction with Life Scale. Participants were assigned into either a body motion gaming group, in which they played Wii Sports, or a mind body practice group, that used YouTube guided Tai Chi and yoga videos. Groups met two times per week for six weeks. Focus groups were conducted with all participants to assess perceived benefits, meaningfulness of the engaged occupation, and importance of small group participation. Although there were minimal statistically significant changes to the groups, multiple individuals made strong gains, including moving from fall risk scores on pretests to above cutoff levels. This was similar with cognitive scores. Qualitatively, individuals recognized progress not only in themselves, but also in their peers. They enjoyed the activities as well as their groups and felt accountable to one another to be present. After the conclusion of the study, some individuals started their own gaming

group and another began attending community Tai Chi classes. The individuals from this study regularly cited the importance of remaining active and being part of groups for quality of life. The body motion gaming and mind-body practice provided an opportunity for not only improving balance and cognition by trying new activities, but also social engagement by participating with peers.

# DEDICATION

I would like to dedicate this dissertation to my husband, Brian, and two sons, David and Boden. They have sacrificed, encouraged, and supported me through the entire doctoral program. I hope this has also been a positive experience for them, and will serve as a reminder of the importance of being a lifelong learner. To Bob and Sabina Wank, thank you for instilling in me the importance of education and for providing tireless support through this process. To David and Karen Puthoff, thank you for the encouragement to pursue this degree and the use of the treehouse as a quiet escape to write. Finally, to friends who have listened, counseled, and shared their time, I dedicate this to you.

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# CHAPTER I

## INTRODUCTION

By 2050, over 22% of the world's population will be over the age of 60, and 4% will be over the age of 80 (Bacha et al., 2017). In the United States, it is expected by 2060 that the population of individuals over age 65 will have increased to 92 million (Kirk-Sanchez & McGough, 2014). Over 11% of the total population in Taiwan in 2014 was comprised of individuals 65 years and older (Liou, Chen, Fu, & Chiang, 2015). Of these older adults in developed countries, approximately 1.5% to 8% live in nursing homes, despite a general preference for remaining in their own home (Kojima, 2018; Ribbe et al., 1997). The World Health Organization (2014) or WHO defined the older population as individuals who are 60 years and older, although historically age 65 was more widely accepted in western cultures. The natural aging process that occurs starting around this age is known to include changes in physical, emotional, and cognitive health (Klainin-Yobas, Oo, Yew, & Lau, 2015).

As individuals age, they are at risk for falls, decreased balance, depression, and cognitive decline (Conner et al., 2010; Liou et al., 2015; Ward et al., 2015). While some of these changes are considered part of the normal aging process, any could be detrimental to older adults who wish to age in place. Consistently, it is a goal of older adults to remain in their own homes as long as possible and avoid living in an institutionalized environment (Rantz et al., 2005). Occupational therapists (OT) follow the model of human occupation (MOHO) to practice client-centered goal-oriented interventions, which could include addressing the goal of staying in the home.

There are multiple modalities that therapists can utilize to help their patients meet their goals of improved balance, cognition, and social engagement. Body motion gaming and mind-body practice are two examples of such modalities. The use of the virtual environment through commercial gaming technology has been utilized to address these same deficits of falls, cognitive changes, and social isolation in other populations. For the purposes of this description, commercial gaming body motion technologies include devices such as the Nintendo Wii, Xbox Kinect, and some online gaming. Tai Chi and yoga are mind-body practices that also have support in the literature for helping older adults in decreasing falls, improving memory, and decreasing isolation (Brenes et al., 2019; A. W. Chan, Yu, & Choi, 2017; Eyre et al., 2016; K.-C. Siu, Padilla, & Rajaram, 2017). This paper seeks to explore whether the virtual environment and/or mind-body activities have a relationship with components of the aging process in otherwise healthy older adults who are aging in place.

High rates of cognitive impairment in this rising population demographic demonstrates "the importance of developing interventions to improve or maintain cognitive function in later life" (Kelly et al., 2014, p. 29). Interestingly, research indicates that it is possible to slow cognitive decline, and the use of digital game regimens is one promising option (Kaufman, Sauvé, Renaud, Sixsmith, & Mortenson, 2016). Similarly, participation in yoga in a pilot study demonstrated improved verbal and visuospatial memory (Eyre et al., 2016). Likewise, falls are a leading cause of morbidity and mortality in older adults, with one in three community-dwelling individuals falling at least one time per year (Sherrington et al., 2016). Falls can lead to a substantial financial and social burden for individuals, their families, and society. Finally, anxiety and depression can have a direct impact on an individual's ability to perform basic self-care and can reduce quality of life (Holmes et al., 2018). These three deficit areas have often

been addressed in the past through individual activities or exercise plans. The goal of this study is to explore if small group participation in a single modality can have an impact on all three deficit areas.

Body motion gaming technology was selected for this study because of the multiple aspects that can be addressed in a single session. For example, use of the Wii system can provide personalized and frequent feedback to the consumer (Forsberg, Nilsagård, & Boström, 2015). Additionally, video games can address balance, selective attention, and visual performance skills (Liou et al., 2015). A downside of utilizing this technology is that it is not always accepted by older adults (Laver, Ratcliffe, George, Burgess, & Crotty, 2011). The technology selected for this study will be utilized in group settings, which may influence the motivation for performance. In this study, a focus group at the conclusion of the experimental phase will explore this issue.

Mind-body activities were selected to challenge participants both physically and cognitively. These activities might be new for most of the participants, which will also challenge their ability to learn a new skill. Studies indicate Tai Chi is an effective form of exercise in decreasing fall risk, improving quality of life, and impacting multiple disease processes such as diabetes, Parkinson's, and chronic obstructive pulmonary disease (Huston & McFarlane, 2016). Likewise, yoga has been shown to affect the brain in positive ways related to neuroplasticity for cognition (Yang et al., 2016), and to help with decreasing the fall risk in older adults (Nick, Petramfar, Ghodsbin, Keshavarzi, & Jahanbin, 2016). Finally, technology will also be a component of this group because the lessons will be via YouTube, digital versatile discs (DVDs), or other online resources. This creates a transferrable skill to the home environment.

## Statement of the Problem

Researchers investigated reasons why institutionalization in older adults occurred and found that the greatest predictors were impaired cognition, low body mass index, and frequent falls (Salminen et al., 2017). This study began in 1991, and a follow-up was completed 22 years later to analyze which factors most often were linked with loss of independent living. Placement in a nursing home can lead to loss of autonomy for an individual and creates a large financial burden on families, society, and health care systems (Kojima, 2018). Frailty has also been linked to placement in a nursing home, however, studies indicate that this can be modified through therapy, which has the potential to delay this loss of independence (Kojima, 2018).

The use of gaming activities can be a successful therapy modality in different patient populations (Cheok, Tan, Low, & Hewitt, 2015; Deutsch, Borbely, Filler, Huhn, & Guarrera-Bowlby, 2008). The problem that this study is designed to address is whether this therapeutic modality can decrease frailty, improve balance and cognition, and change social isolation in community-dwelling older adults. The evidence suggests that Tai Chi and yoga also have these benefits (M.-y. Siu & Lee, 2018; Zheng et al., 2017). Therefore, this study will explore if there is a difference between gaming and mind-body practice after six weeks of group participation. This study will also include a focus group to examine if participants found meaning in these activities and the perceived value of group participation. This could help guide OT practice in the future as the population ages.

Loss of independence via institutionalization is a fear of many older adults (Kojima, 2018; Salminen et al., 2017). One additional gap noted in the literature is that many of these studies are completed with the individual in isolation. Unfortunately, research exists that a psychosocial component cannot be ignored in this population because of high rates of social isolation. Kaufman et al. (2016) noted that older adults who engaged in one or two social

activities performed higher on cognitive activities compared to peers with no social engagement. Participants' successful performance of cognitive tests increases as the number of activities increases. This study aims to address the role of small group participation in older adults in playing digital games or practicing mind-body activities and the impact on socioemotional factors.

## Purpose of the Study

This study was designed to explore the differences in the use of body motion gaming or mind-body activities in small groups of community-dwelling older adults and the relationships with fall risk, cognition, and social engagement. The gaps in the literature that were addressed by this study are the use of groups and comparison of these two modalities. According to Cagiltay, Ozcelik, and Ozcelik (2015), competition in games can increase both learning and motivation in participants. This study also investigated through focus groups if participation in small groups has a relationship with competition and motivation, which results in any change to balance, cognition, and social engagement scoring. In other words, this study explored the relationship of the group dynamics on the three focus areas by using the modalities of video gaming and mind-body practice.

## Research Questions and Hypotheses

The research questions for this study included a focus on physical, cognitive, and social engagement in older adults when participating in small group activities. Both quantitative and qualitative questions were used to capture data to answer these questions. An additional aspect that was considered was the role of a small group and how it impacted the participants in both

the control and experimental groups. The hypotheses for this study stemmed primarily from the literature. Gaming has been utilized with multiple patient populations with positive results in these same areas. Similarly, Tai Chi and yoga have been used with healthy older adults as well as adults with various diagnoses and both have shown multiple benefits. The research questions and hypotheses were as follows:

1. Was there a change in balance, gait, and/or fall risk following participation in Wii Sports (experimental) and/or mind-body activity (control) groups?

   $H_1$: Change will be seen in the Berg Balance Scale (BBS), Functional Gait Assessment (FGA), and 30-second chair stand test (30s CST) scores and participation in groups.

2. Was there a change in cognition scores following participation in the Wii Sports and/or mind-body activity groups?

   $H_2$: Change will occur after participating in the groups on the scores of the Montreal Cognitive Assessment (MOCA).

3. Was there a change in scores on a social engagement scale following participation in the Wii Sports and/or mind-body activity groups?

   $H_3$: A change will occur following participation in a group on the Satisfaction with Life Scale (SWLS) scores.

4. Were any changes in balance, cognition, and social engagement maintained one-month post completion of the Wii Sports and/or mind-body group activities?

   $H_4$: Any changes made during the group participation will be maintained one-month post completion.

5. Were there differences in changes in balance, cognition, and social engagement in pre/post/follow-up testing for participants in the Wii Sports group versus the mind-body activity group?

   $H_5$: Both groups will demonstrate change in each area after completion of the groups.
6. In what ways did participants find gaming or mind-body practices to be a meaningful occupations?
7. In what ways did older adults find meaning in small group participation?

## Rationale for the Study

The aging population is the largest growing population worldwide. As these individuals age, there are related healthcare concerns that can be costly both in terms of finances and in a loss of independence. Commercially available gaming systems are relatively inexpensive and have demonstrated success in various patient populations. Tai Chi and yoga can be free when using websites such as YouTube or minimal cost to join a local class. This study was designed to explore if these modalities can be a means to decrease fall risk, maintain cognition, and improve social engagement. Utilization of these types of activities can be done in the home, which eliminates the need for transportation, and with a partner, which can improve socialization. These two factors may help make the activity fun and motivating. Participating in a small group or partnership supports learning via the social cognitive theory, which can lead to improved cognitive processes and neuroplasticity (Cozolino & Sprokay, 2006; Gibson, 2004).

## Conceptual Framework

Embedded in the development of this research study was theory. By creating a theoretical foundation, the research questions and hypotheses emerged. The theories that discussed in this section have been selected from multiple interest areas, including OT, innovation and technology, learning, and group-based activity. Theories are used to guide clinical practice and the methodology of this study. This section details how they relate to the use of gaming in older adults in small group participation.

### Model of Human Occupation (MOHO)

Gary Kielhofner is credited along with Janice Burke in developing the MOHO (Kielhofner & Burke, 1980). It is centered on the assumption that "occupation is a central aspect of the human experience. It is man's innate urge toward exploration and mastery and his consequent ability to symbolize that makes him unique among animals" (Kielhofner & Burke, 1980, p. 573). Occupation in this sense is not one's employment, but rather one's daily undertakings or activities of daily living (ADL), which can be anything from getting dressed, preparing and eating a meal, driving, or exercising. It is an individualized set of activities that add meaning to that particular person. In MOHO, one key is the interaction between an individual's ability to participate in a meaningful occupation and that person's environment, which includes the physical, cultural, and social settings (Kielhofner & Burke, 1980).

Other components of the MOHO are the subsystems of volition, habituation, and performance. Volition refers to the internal motivation structures that drive the individual to participate in an occupation (Kielhofner & Burke, 1980). With regards to the research study, an individual may select to participate because s/he has noticed a decline in balance and wants to

see if it can be improved. Similarly, another participant may become involved because a grandchild has an interest in gaming and this person sees the study as a means to deepen the intergenerational relationship. From the mind-body practice aspect, the individual may have heard about benefits, but has never tried practicing before and this gives that person a safe environment to trial the activities. Therefore, having volition helps drive an individual towards participation in occupation.

Habituation refers to patterns and routines (Kielhofner & Burke, 1980). This is a representation of automatic routines in occupation. Tying this to the current study, a change in the ability to complete a morning routine or exercise regimen due to changes in balance, cognition, or social support could lead to a disruption in habituation that drives an individual to seek an alternative solution. Performance is guided by volition and habituation and refers to the skill level of completing an occupation (Kielhofner & Burke, 1980). Gaming provides an opportunity to pursue an occupation virtually that perhaps an individual no longer has the skills to complete in the physical environment. That individual has the volition, but is likely missing the habituation of that occupation, and lacks the performance skills necessary. Gaming could be a solution that brings meaning back into that individual's occupational roles.

**Innovation and Technology**

Innovation creates long-lasting change through processes, technology, or strategic modeling (Dobni, 2008). In this study, it is innovative to use gaming with this population to decrease fall risk, maintain or improve cognition, and impact social engagement. It is innovative because there is a preconception that older adults do not engage in gaming, and therefore would

not be interested in this modality. Additionally, approaching these deficits from the perspective of maintaining the status of being a community-dwelling older adult is new.

Adoption of technology can be on a spectrum ranging from late to early adopters. Bandura (2006) noted that:

> People are initially reluctant to embark on new undertakings that involve costs and risks until they see the advantages that have been gained by early adopters. Modeled benefits accelerate diffusion by weakening the restraints of the more cautious potential adopters. (pp. 117-118)

Adoption of gaming has been slow in clinical practice settings, and older adults may be hesitant to try the devices out of fear. Modeling behavior, as encouraged by the social constructivist model, and providing education regarding potential benefits may influence older adults to participate in this research study (Merriam & Bierema, 2013). This may further carryover to a change in practice for OTs.

**Learning**

Participation in this study requires internal motivation to not only acknowledge deficits in balance, cognition, and quality of life, but the commitment to potentially change these deficits through dedicated effort. This effort includes being willing to try a new task and commit to six weeks of a study. This also involves participation in small groups. Cozolino and Sprokay (2006) described the impact of social learning, in that people engage more in learning opportunities when they are with other individuals. The environment must also be conducive for successful learning of a task or activity (Cozolino & Sprokay, 2006). In this study, the same environment will be utilized for each session. The physical space will have adequate lighting for visibility, room for each participant to easily move, and chairs for rest. Furthermore, an OT will be present

to provide safety and encouragement. Each of these things can positively impact the neural plastic changes that are necessary for learning.

In addition to the influence from peers and a safe environment, learning will best occur if the individual demonstrates strong self-efficacy and motivation to participate. Both gaming and mind-body practice will likely be new skills for many participants. Learning through these activities requires not only cognitive but also psychomotor skill development. High self-efficacy will equate to setting goals (Sitzmann & Ely, 2011), which could be met by gaming scores or other types of feedback in the different activities. By setting smaller goals related to the game, individuals with high self-efficacy will have longer-term goals regarding scores on the balance, cognitive, and quality of life assessments. Sitzmann and Ely (2011) also noted that motivation in learners can be increased by negative performances; therefore, an unexpected lower performance on a particular game may influence that individual to retry the activity and work harder on the skills needed for success. For mind-body practice group, some activities may seem very easy and the participants could be challenged to continue in the practice because they anticipate no changes based on the level of difficulty.

**Group Based Participation**

A key component of this study is the use of small groups and not playing the game or practicing Tai Chi or yoga in isolation. Lovell, Gordon, Mueller, Mulgrew, and Sharman (2016) studied exercise in moms and how group versus individual exercise impacted their performance. Although there may exist less autonomy in a group setting when deciding an exercise, a sense of belonging can increase motivation and psychological well-being (Lovell et al., 2016). These authors described how the self-determination theory is comprised of autonomy, competence, and

relatedness, and these are affected in variable ways by adding the component of group participants to the activity (Lovell et al., 2016). This is very similar to the design being considered herein that participants may have to compromise on the game played; however, they may experience greater motivation for achieving competence and may enjoy the social component of the game.

## Importance of the Study

Unfortunately, as the body ages, there are documented declines in physical, cognitive, and social-emotional health. These can have a negative impact on the individual, family, caregivers, and society. While stopping these deficits from occurring is not feasible, if there is a chance to delay the onset, the individual may be able to continue to maintain an independent lifestyle. Gaming was selected not only because of the documented benefits of high repetitions, consistent feedback, and cost, but also because it may allow a person to participate in a familiar activity s/he previously enjoyed in the physical environment. While it has been documented that older adults may not enjoy video games (Bacha et al., 2017), this is not an absolute. Approximately 25% of older Americans enjoy digital games, and that can be attributed to the activity being challenging, motivating, and relaxing (Kaufman et al., 2016). Mind-body practice was selected because of its documented benefits in older adults with balance and cognition. Therefore, this study will explore if one modality has a greater impact after six weeks and if the selected modalities have the potential to impact the aging process by allowing older adults to participate in fun yet challenging activities.

## Definition of Terms

In order to communicate the scope of this study effectively, it is beneficial to define some of the terminology utilized throughout this paper.

1. Balance: Balance is the ability to maintain an upright posture while performing functional gait and ADL. Furthermore, D'Addio et al. (2014) stated that balance is directly related to the motion of the center of mass to the base of support. This study will focus on dynamic standing balance. Although the games, Tai Chi, and yoga can be adapted to use while seated, the balance and gait assessments selected require the individual to be standing.
2. Cognition: Cognition refers to a hierarchy of skills that range from attention and memory to executive function. It includes the ability to perceive information, make choices, and be goal-directed (Miller & Wallis, 2009).
3. Community-dwelling and aging in place: The individual is independent or not institutionalized (Barry, Galvin, Keogh, Horgan, & Fahey, 2014). Community-dwelling or aging in place older adults can receive outside services such as food delivery or housekeeping.
4. Gaming systems: For the scope of this paper, gaming technology refers to commercially available, body motion systems. Examples include the Wii Fit, Wii Sports, and Xbox Kinect. These games require the individual to engage in player motion activities, weight shifting, and reach (Taylor, McCormick, Shawis, Impson, & Griffin, 2011). These do not include hand-held game controllers unless the individual is utilizing Wii components such as a steering wheel or a Wii stick. Furthermore, gaming in this study does not include online games or iPad games that do not involve body motions.

5. Older adults: The sample utilized for this study will follow the western definition and include individuals age 65 and older (World Health Organization, 2014).
6. Social engagement: Being an active participant in community groups or activities is the basis for defining social engagement. According to the literature, this can include virtual engagement. This definition is tied to the activity theory of aging and is focused on the benefits of engagement in occupation. Katz (2000) noted that "activity in old age appears to be a universal 'good,' and to prove it, a host of gerontological studies convincingly demonstrates the benefits of physical and social activities to those who must cope with illness, loneliness, disability, and trauma" (pp. 135-136).
7. Tai Chi: The mind-body practice of Tai Chi is from meditative martial arts from China that has slowly been adopted in the western hemisphere (Huston & McFarlane, 2016). It consists of a series of gentle movements to challenge the mind and body (Huston & McFarlane, 2016). According to A. W. K. Chan et al. (2018), the intensity of Tai Chi is comparable to a brisk walk.
8. Yoga: Yoga is a popular mind-body activity that combines the focus of breathing, posture, and meditation (Nick et al., 2016). Poses can be completed in sitting or standing and benefits include improving gait speed to increase self-esteem (Nick et al., 2016).
9. Meaningfulness: For this study, meaningfulness was operationally defined as finding purpose or having significance.

## Methodological Assumptions

Methodological assumptions are defined prior to the start of the research study. In this specific case, assumptions included:

1. Participants will honestly report information such as age, number of falls, education, and gaming or mind-body practice experience on the demographic intake form.
2. Participants will answer honestly during focus groups for qualitative data and on the SWLS.
3. Regular attendance to group sessions will occur.
4. Best effort will be given during activity sessions.

## Limitations of the Study

A primary limitation of this study was that the researcher provided physical assistance as needed during the groups, therefore actively interacting with the groups. Furthermore, the researcher was present and actively engaged with participants at all groups. The researcher has had multiple opportunities to interact with the participants in the forms of providing feedback on performance and engaging in casual conversation. The researcher also attends the church from which participants were recruited from, and, therefore knew some of the individuals entering the study.

Other limitations surround the use of human subjects. Limitations are those things that cannot be controlled. For example, it is not possible to control if a subject was honest during the completion of a demographic form or on the SWLS. Additionally, subjects may not have been entirely honest in the qualitative portion, especially if the perceived expectation was to give positive feedback and the person liked the researcher. A participant might have felt inclined to answer positively about the occupation of gaming because s/he thought that is what the researcher wanted. The reverse could also be true. Similarly, the same five assessments were

used for the pretest, posttest, and 1-month follow-up, therefore, carryover effects may have been present. Finally, it was not possible to control subjects remaining in or leaving the study.

The participants were recruited from one facility. Although there are three worship services, there was a high likelihood that the individuals were familiar and even friendly with one another. This may have impacted the data related to social engagement. Groups were assigned based on subject availability, so there was the opportunity to have groups of individuals that may not know each other as well. Additionally, these individuals are active in the church and the older adults' group, which may have resulted in an above average baseline score with the SWLS.

The researcher engaged in a significant literature review and maintained the bias that there exists the potential for the benefits of these modalities. The researcher admitted not all participants will likely have positive feedback, but she expected some changes in balance, cognition, and social engagement. This bias is a result of the literature surrounding the use of gaming and mind-body practice in multiple patient populations. These modalities will not stop the aging process, but it is believed that there will exist some benefits from participation.

## Delimitations of the Study

Delimitations are those items that the researcher has selected to include or exclude from the study. For this research study, participants self-selected into the program and some were already participating in physical, social, or cognitive activities as part of their normal daily routine. Participants were recruited from a local church, and this was primarily done directly through the older adults' activity group. Therefore, some of these individuals were already familiar with one another and participated at some level of community engagement. It was

important to recognize that these individuals demonstrated social engagement through church and community activities. Additionally, individuals who were not living independently in the community were excluded as will individuals younger than age 60. Individuals with significant medical history were excluded, including diagnoses such as stroke, vertigo or dizziness, severe osteoporosis, Parkinson's, recent joint replacement (less than six months), and dementia. The individuals participating should not have been otherwise receiving OT or physical therapy (PT) services at the time of the study. Unfortunately, after four weeks in the study, the researcher discovered that one participant had a stroke the week prior to beginning the activities and was receiving PT for balance.

# CHAPTER II

# LITERATURE REVIEW

## Problems Faced by the Aging Population

### *A High Rate of Falls*

The Centers for Disease Control and Prevention (2017) noted that every 20 minutes an older adult dies from a fall in the United States, and an individual falls every second. Of individuals aging in place, approximately 30% over the age of 65 will fall each year (Barry et al., 2014; Ward et al., 2015). This figure increases to 50% in those over the age of 80 (Sritharan, 2016). The risk of falls increases as individuals continue to age, and this creates a burden, including both financial and physical on the individual, caregivers, public health organizations, and family members (Sherrington et al., 2016). There is a substantial financial impact related to falls in the older adult population. In the United States in the early 2000s, over $19 billion was spent on this issue, and the cost is expected to reach over $32 billion by 2020 (Ward et al., 2015).

Beyond a financial burden, there are multiple other consequences for the individual. In individuals over 75, falls are the leading cause of mortality (Scuffham, Chaplin, & Legood, 2003). Falls can result in a hip or upper extremity fracture, or traumatic brain injury. Furthermore, the individual will likely lose self-confidence, which can cause an overall decrease in functional mobility from fear of falling (Painter-Patton & Trujillo, 2015; Sritharan, 2016). This has the potential to lead to a loss of overall independence, increased risk of infection and pressure sores, and decreased quality of life (Sritharan, 2016). It is also important to note that

falls are under-reported, often due to a fear of loss of independence and risk of institutionalization.

Fall prevention is a complex issue because there are components that include the individual, environment, and task. From the individual perspective, there can be impairments in vestibular, sensory or proprioceptive, visual, or musculoskeletal systems that can result in decreased balance or postural control (Bacha et al., 2017). The individual may also overestimate his/her ability to complete a task or underestimate the skill required for task completion, which illustrates the task component related to falls. The environment can also lead to increased falls, for example, stepping out of a wet shower onto a slick surface without a nonskid mat or walking on an icy sidewalk can create unsafe situations.

However, there can be improvements made to lower the fall risk in this population. OT is well versed in assisting with the task and/or environmental adaptation. The environmental adaptions may include recommending removal of throw rugs, elimination of cords lying in open spaces, installation of lights for ambulating during the night, and proper installation of grab bars in the home. Additionally, OT is essential for addressing the fear of falling and how it impacts participation with activities of daily living (ADL) (Painter-Patton & Trujillo, 2015). Individuals may have the motivation to participate in ADL, but are limited by anxiety, which can lead to depression and eventually social isolation (Painter-Patton & Trujillo, 2015). It is important to address the fear of falling. With patient or client education, the topic of falling should be multifaceted and include exercise, environmental modification, and education (Painter-Patton & Trujillo, 2015).

Exercise has been shown repeatedly to be beneficial in decreasing the risk of falls. Exercise is also demonstrated to be the most cost-effective means to target frequent falls in older

adults, however, adoption of exercise has been slow (Davis et al., 2010). With exercise that focuses on balance training, occurs over two hours per week, and goes beyond walking, the fall rate of older adults can be decreased (Sherrington et al., 2016). This analysis is based on community-dwelling older adults. Unfortunately, the same results have not been demonstrated for those in residential care settings who are more dependent (Sherrington et al., 2016). A more intensive work-out that totals minimally three hours per week has the greatest potential to lower fall risk, according to a meta-analysis completed by Sherrington et al. (2016). Unfortunately, inactivity rates in this population can be as high as 54%, and inactivity increases with age (Smith, Banting, Eime, O'Sullivan, & van Uffelen, 2017).

Falls are multifaceted, and the individual may fall due to diminished physical ability, poor home set-up, decline in cognitive skills, or a combination of any of the factors. The desired task may contribute to falls also through poor anticipation of skills required or, in combination with the individual, decreasing cognition for correctly completing the task. It is impossible to fully eliminate falls, but through individual, environmental, or task modifications, the risk can decrease.

### *Cognitive Decline*

Cognitive decline is an anticipated consequence of normal aging. However, this can vary in part due to lifestyle and behavior (Kirk-Sanchez & McGough, 2014; Luchetti, Terracciano, Stephan, & Sutin, 2015). Additionally, psychological characteristics may contribute to the variability of cognitive decline (Luchetti et al., 2015). Unfortunately, the presence of cognitive decline can result in decreased functional abilities and significantly increased health care costs (Kelly et al., 2014). The natural decline of cognition in older adults is seen in impaired

multitasking, decreased response time, reduced inhibitory control, and decreased processing time (Kirk-Sanchez & McGough, 2014). Any of these impairments could influence the individual's ability to perform instrumental activities of daily living (IADL), including meal preparation, driving, and caregiving for another family member. This could directly affect the ability of the individual to age in place and, therefore, result in institutionalization.

Mavros et al. (2017) noted that by 2050 there will be 135 million individuals globally living with dementia. Evidence suggests that higher physical activity levels and aerobic activity can preserve cognitive function (Mavros et al., 2017). As with balance, it is important to note that it is higher dosed exercise that can reduce the risk of cognitive impairment and dementia (Kirk-Sanchez & McGough, 2014). Frailty and disability in older adults are linked to mild cognitive impairment and risk of more significant decline over time. Participation in muscle strengthening and aerobic activity programs have demonstrated clinical relevance with relation to slowing cognitive decline (Mavros et al., 2017).

Beyond exercise, participation in cognitive, leisure, and social activities are associated with decreased risk of an Alzheimer's dementia diagnosis (Wilson, Scherr, Schneider, Tang, & Bennett, 2007). However, evidence remains limited that lifestyle can indeed maintain or improve cognitive function (Park et al., 2014). Park et al. (2014) demonstrated that productive engagement in various occupations led to an increase in episodic memory compared to receptive engagement. Furthermore, the authors found that "sustained effort to acquire a demanding new skill improved episodic memory and no evidence suggesting that socializing, information exchange, and novelty alone facilitated cognitive function" (Park et al., 2014, p. 110). This demonstrates the need for a task to be a new and challenging effort for there to exist a cognitive change for the individuals. Having a gradually challenging task without being overwhelmingly

difficult is a crucial principle of neural plasticity, which is the basis for new skill development or learning (Zelinski & Reyes, 2009).

### *Depression and Social Disengagement*

It has been hypothesized that as the population ages and with a growing shortage of geriatric mental health providers, there will exist a gap in the management of mental health issues (Mojtabai, 2014). Depression is underdiagnosed and yet widespread in the older adult population, but these individuals seek help at a lower rate than any other adult category (Conner et al., 2010). This phenomenon can be a result of stigma attached to mental illness. Additionally, seeking help can vary based on ethnicity (Conner et al., 2010). For example, Conner et al. (2010) found that African American survey participants were less likely to have a favorable view of services, although the majority never sought medical attention. Another issue facing this population is social disconnectedness, and there is a link between this isolation and higher rates of mental health issues (Cornwell & Waite, 2009). Researchers recommend that further studies reviewing interventions for reducing social isolation need to be completed because current research is limited (Findlay, 2003).

As noted previously, there are substantial benefits on decreasing fall risk and maintaining or improving cognition when an individual participates in exercise. It is important to note that some studies have demonstrated that psychosocial factors and depression can increase fall risk and decrease confidence with balance (K.-C. Siu et al., 2017). This demonstrates the interconnectivity between these highlighted three topics of balance, cognition, and social engagement. Interestingly, rates of exercise participation are low, but there exists an association between social support and physical activity (Smith et al., 2017). In other words, if an individual

has social support from multiple sources, and family specifically, there is a greater likelihood that individual will partake in physical activity. Therefore, having social engagement can increase exercise, which has a relationship with improved health and lowering the risk factors for institutionalization.

Unfortunately, the reverse is also true. Social isolation can lead to higher rates of morbidity and mortality, infection, depression, and cognitive decline in older adults (Cornwell & Waite, 2009). Like balance or fall risk, social disengagement is multifaceted. Social disconnectedness is a lack of relationships, while perceived isolation is loneliness and limited discernable support (Cornwell & Waite, 2009). Due to the broadness of these categories, indicators can vary widely in the research. For example, some studies have focused on the impact of living alone while others have considered participation in social activities. Regardless of the approach or defining terms, evidence suggests that individuals that do have social networks also have improved coping strategies, means to reduce stress, and greater self-esteem (Cornwell & Waite, 2009).

These benefits have led to the creation of villages in several countries, which provide older adults with a community of services such as transportation, companionship, housekeeping, and health care advocacy (Graham, Scharlach, & Price Wolf, 2014). These villages counteract the increased social isolation that is felt in this population, and this is primarily through volunteerism. Benefits of being a volunteer in these organizations also have many of the same benefits as being a recipient of services, including reduced isolation, better physical and functional health, and higher life satisfaction (Graham et al., 2014). These types of programs offer older adults a means to improve social engagement, which can have positive results on many other aspects in their lives. As the population continues to age, promotion of programs that

offer service access and social engagement for community-dwelling older adults will need to be available in order to decrease their risk of loss of independence.

**Benefits of the Virtual Environment in Other Populations**

Since physical and cognitive declines are part of the normal aging process, it is worth considering whether the literature provides a possible means to help older adults continue to age in place. Body motion gaming technology has been utilized with a variety of patient populations with improvements noted in areas of balance, cognition, and social engagement. These studies, as well as some that have considered populations of healthy older adults, will be presented to lay the groundwork for future research that could potentially slow down these normal processes and allow for continued aging in place.

Body motion gaming allows for high repetitions, high frequency, longer duration of an activity in a safe environment, and for the individual to complete tasks that perhaps could not be performed in the natural or physical environment (Deutsch et al., 2008). Video games also offer both visual and auditory feedback immediately, which can be motivational and fun for individuals (Chao, Scherer, & Montgomery, 2015). With many games available, the individual has a wide selection of activities and can try multiple types of games, which can lead to increased motivation to participate in the activity. The older adult would be able to choose a virtual activity that the individual previously enjoyed in the physical environment, but is no longer able to perform (Kahlbaugh, Sperandio, Carlson, & Hauselt, 2011). Finally, the systems are relatively inexpensive and widely available (Goble, Cone, & Fling, 2014; Mhatre et al., 2013). While there are many benefits to the use of gaming technology, there are some

limitations, the largest being frustration with using the gaming systems and set-up required (Forsberg et al., 2015).

### *Balance and Gaming*

The use of gaming technology has been widely studied for its effects on balance. Many studies have considered individuals with neurological diagnoses such as cerebral vascular accident (CVA), Parkinson's disease (PD), multiple sclerosis (MS), traumatic brain injury (TBI), and spinal cord injury (SCI). However, individuals with orthopedic conditions have also demonstrated improved balance with use of the virtual environment. Studies have started to focus on older adults, including both those aging in place and others in institutions, to determine if this is a beneficial activity for improving balance.

It has been demonstrated that use of the Wii Balance Board had statistically significant improvement in static balance compared to traditional treatment for individuals with TBI, and the patients reported it was more enjoyable (Gil-Gómez, Lloréns, Alcañiz, & Colomer, 2011). Similarly, balance control issues were improved in individuals with MS with some participants also reporting feeling safer (Forsberg et al., 2015), which can be a considerable factor with decreasing fall risk because the fear of falling can often limit participation in IADL. Likewise, individuals with PD demonstrated improvements in both dynamic and static balance, and it was determined that they could safely and conveniently use the Wii Fit in the home setting without the supervision of a therapist (Mhatre et al., 2013). In a small study, researchers used the Wii Fit to address balance in older adults who are aging in place (Bainbridge, Bevans, Keeley, & Oriel, 2011). While their BBS changes were not found to be significant, there were perceived

improvements in confidence in the participants, which may lead to increased participation in activity.

One reason for the changes in balance with using these types of devices is the number of repetitions required to complete the activity. Creating the high volume of repetitions of a task is difficult in traditional therapy sessions or community exercise programs. For motor learning to occur, activities must be intensive, task specific, and repetitive. In a comparison study of the Wii Fit, Wii Sports, Kinetic, and PlayStation 2 EyeToy game, all of these technologies provided a statistically significant increased number of weight shifts to the affected side for individuals post-CVA compared to traditional treatment (Peters, McPherson, Fletcher, McClenaghan, & Fritz, 2013). In order for motor learning and neural plasticity to occur, an individual needs a high number of repetitions in meaningful activity (Kleim & Jones, 2008), which is provided through these types of body motion games.

### *Cognition and Gaming*

Research has also focused on the use of gaming technology on improving aspects of cognition. For individuals who were institutionalized and presented with mild cognitive impairment, use of gaming at a frequency of two times per week for 20-minute sessions did indicate a positive change in simple reaction ability (Liou et al., 2015). Additionally, other researchers have investigated if older adults perceived positive changes in their cognition with use of gaming (Duplàa, Kaufman, Sauvé, & Renaud, 2017). These authors found that older adults did perceive greater cognitive benefits, compared to social or emotional, from playing digital games. The authors hypothesized the social benefits were fewer because this population does not engage as frequently in online gaming communities (Duplàa et al., 2017). These

individuals, however, did perceive the cognitive benefits of improved psychomotor skills and memory, although the perceptions varied based on gender (Duplàa et al., 2017).

A key for influencing change in the area of cognition is observing if the improvements can be maintained over time. This was explored using the Wii Fit games for individuals with PD. The researchers found that cognitive training with the game improved performance of ADL and this was maintained at two months (Pompeu et al., 2012). In other words, the cognitive skills that were required to complete the Wii Fit games carried over to normal functional activities, which can increase a person's level of independence and reduce caregiver burden. However, not all research has seen this carryover. For example, Boot et al. (2013) found that participants did not believe that participation in gaming would improve functional cognition. Similarly, carryover beyond three months in healthy older adults has been limited, and researchers suggest necessary boosting sessions to maintain the cognitive changes (Ballesteros et al., 2015).

Participating in gaming requires an individual to learn from mistakes, develop alternative strategies, make quick decisions, and adapt to new challenges (Zelinski & Reyes, 2009). These challenges result in positive changes in older adults for several components of cognition, and these changes can occur with short sessions (Toril, Reales, & Ballesteros, 2014). Further research is required to investigate the long-term effects of gaming, the differences in age and gender using this technology, and how changes in frequency and duration of the task influence overall benefits.

### *Social Engagement and Gaming*

This area has been the least researched. However, in other populations, the use of gaming technology has shown the ability to impact social engagement. In one study with children with

autism spectrum disorders, researchers found that the children had higher rates of peer interaction following video gaming sessions with their peers (Hillier, 2013). The author did note that it was not possible to fully connect the changes in social behavior to the gaming activity because the students were in school together and learning appropriate interactions. The virtual environment, however, reinforced what they were learning in their lessons.

Other research has found that games that require natural body movements, which include the Wii and Kinect, led to greater social interaction between participants compared to games with hand controllers (Lindley, Le Couteur, & Berthouze, 2008). This suggests that it may be possible to lessen social disengagement in older adults by participating in peer gaming activities that involve body movement. By engaging older adults in small groups using gaming technology, it may lead to greater interaction amongst the peers.

With a recent surge in online gaming, there has also been an increase in social interaction, with some games requiring teamwork and collaboration (Kowert, Domahidi, Festl, & Quandt, 2014; Männikkö, Billieux, & Kääriäinen, 2015). These games are not specifically the body motion games that will be utilized for this study, but more typically hand controller type games that the players connect through online resources. Players must develop trust and community building, and players in these types of online gaming activities are motivated by socialization (Männikkö et al., 2015). In a study that considered whether multiplayer video games have positive social outcomes, Männikkö et al. (2015) found that games are "indeed associated with forming social ties within a community of gaming peers…Results suggest that gamers who develop gaming social capital are likely to develop face-to-face ties with others in their real-world community" (p. 393). In other words, there are positive social implications for some gaming experiences.

With regards to console games, including the Wii, there are noted social benefits for older adults. Through group participation, a meeting place is created for a diverse population (Schell, Hausknecht, Zhang, & Kaufman, 2016). The social interaction also created feelings of social connectedness, decreased rates of depression, and less isolation, which are parts of healthy aging (Schell et al., 2016). Interestingly, in a study of older adults playing Wii bowling in teams, participants not only developed friendships in the group, but some study participants became engaged with new activities with other individuals after starting the research project, which demonstrates carry over and learning (Schell et al., 2016).

## Benefits of Mind-Body Practice in Older Adults

Gallant, Tartaglia, Hardman, and Burke (2017) described Tai Chi as a "Chinese martial-arts based exercise characterized by slow, fluid movements and breathing awareness that leads to improved balance, strength, and flexibility, and has been linked to a variety of health benefits" (p. 2). Some of those other health benefits include improved cardiovascular function, decreased perceived stress, decreased blood pressure, increased energy expenditure, decreased body mass index, and decreased depression (A. W. K. Chan et al., 2018; Hui, Xie, Woo, & Kwok, 2016; Huston & McFarlane, 2016). Furthermore, Tai Chi can decrease the fear of falling, improve muscle strength, and enhance the quality of sleep (Zheng et al., 2017). The activity has also been predominantly well received by older adults in the community, which increases participation.

### *Balance and Mind-Body Practice*

The practice of Tai Chi involves "whole body coordination of continuous, rhythmic movements with dynamic weight shifting and single limb support" (Sungkarat, Boripuntakul,

Chattipakorn, Watcharasaksilp, & Lord, 2017, p. 721). Tai Chi has been found to be a successful tool for older adults in both improving balance and decreasing a fear of falling. In a study by Ory et al. (2015), the authors found that after a 12-week program that met two times per week participants demonstrated multiple benefits. The Timed Up and Go test was statistically significantly lower, which is a measure of balance and mobility. Additionally, participants had improved fall-related confidence (Ory et al., 2015), which could lead to increased activity participation. Tai Chi has also been recognized in fall prevention for its cost effectiveness (Huston & McFarlane, 2016).

Yoga is also a mind-body practice, but it focuses on mediation, breathing, and postures, and can be performed standing or sitting (Nick et al., 2016). Other benefits include it is simple to learn and can be practiced across ability levels (Nick et al., 2016). Yoga originated in ancient India and is now recognized as a complementary or integrative health approach (Brenes et al., 2019). In the United States, the most practiced form of yoga is Hatha yoga, which focuses on physical postures (Brenes et al., 2019), which can be linked to balance. In a study of healthy older adults, scores on the BBS were significantly improved for a group performing yoga compared to their control counterparts (Nick et al., 2016). Additionally, Portz, Waddington, Atler, Van Puymbroeck, and Schmid (2018) found yoga to be a safe activity for individuals post-CVA as an activity for balance and self-management.

### *Cognition and Mind-Body Practice*

The practice of Tai Chi has been linked to improved mental health and function. Tai Chi is an exercise that has been noted to combine both physical and cognitive properties into its practice (M.-y. Siu & Lee, 2018). The cognitive component is based on the attention required for

the repetitive movements and executive functioning for learning a new sequences of movements (M.-y. Siu & Lee, 2018). In a qualitative study by Zheng et al. (2017), participants reported feeling calm, having increased attention, and being anxiety-free, which can lead to improved function. In addition to attention, studies have shown Tai Chi can improve processing speed in cognitive activities (Huston & McFarlane, 2016). For individuals with mild cognitive impairment, the practice of Tai Chi demonstrated significant improvement in general cognitive functioning as well as performance of IADL (M.-y. Siu & Lee, 2018).

From a yoga perspective, results have been mixed. In a comparison of cycle ergometry, treadmill walking, and yoga in relation to cognition, it was the walking that demonstrated the biggest change for individuals with relapsing-remitting MS (Sandroff, Hillman, Benedict, & Motl, 2015). However, in a meta-analysis by Gothe and McAuley (2015), the authors found a potential to improve specific cognitive functions. Likewise, in individuals with mild cognitive impairment, yoga was beneficial especially for attention and verbal memory (Brenes et al., 2019). In a pilot study by Eyre et al. (2016), yoga was found to have a promising impact on verbal memory performance.

### *Social Engagement and Mind-Body Practice*

Practicing Tai Chi in a group setting allowed participants to feel engaged with their peers in a relaxed setting and participants felt more relaxed after the sessions, which led them to feeling more at peace around other individuals (Zheng et al., 2017). The practice of Tai Chi also results in a mental calm or a feeling of joyfulness (Hui et al., 2016), which could have the potential of leading a participant to engage more freely with peers. In a study of hidden older adults, which is defined as adults who are hidden or disengaged from society, the practice of a

community Tai Chi group resulted in a larger social network, decreased loneliness, and improved social support (A. W. Chan et al., 2017). Interestingly, the loneliness and social support measurements were unchanged after three months, but did show improvement after six months, indicating the development of relationships over time (A. W. Chan et al., 2017). Finally, in a study that focused on Latinos and levels of depression, it was found that Tai Chi had a statistically significant improvement on psychosocial status (K.-C. Siu et al., 2017). K.-C. Siu et al. (2017) demonstrated that those who had the lowest scores at baseline with depression had greater improvements. Depression or poor psychosocial status is associated with falls and decreased function (K.-C. Siu et al., 2017).

Yoga has been categorized as a social contagion, meaning it is an activity in which many individuals find their path to yoga from friends or family (Wertman, Wister, & Mitchell, 2016). It has also been a source of intergenerational experiences that bridge gaps between family members (Wertman et al., 2016). In a qualitative study, yoga participants also reported less isolation, a sense of community, and connectedness with like-minded individuals (Wertman et al., 2016). In a study by Mehta, Keshavan, and Gangadhar (2016), through the postures and breathing, there were influences on the participants' neurological systems that led to increased social cognition and social connectedness, as well as decreased negative symptoms. The authors noted that yoga creates a prosocial environment because of shared experiences (Mehta et al., 2016).

**Assessment Tools**

In order to assess the relationship between the use of body motion video gaming and mind-body practice with balance, cognition, and social engagement, multiple assessments have

been selected based on their clinical use and documented attributes. The BBS is a means to evaluate balance and is a common clinic tool (see Appendix B). The FGA and 30s CST can provide information on the individual's gait and endurance, which both can impact balance and/or fall risk (see Appendices C and D). From a cognitive perspective, the MOCA is an assessment that offers a wide-ranging category of items (see Appendix E). Finally, a frequently utilized assessment of quality of life is the SWLS (see Appendix F). Each of these tests will now be described individually.

The BBS was developed as a means to functionally assess balance in older adults using 14 items that are scored from a zero, which is the inability to complete a task, to a four, which is completely independent and safe (Lusardi, Pellecchia, & Schulman, 2003; Steffen, Hacker, & Mollinger, 2002). The functional tasks include items such as turning in a circle, standing unsupported, and tandem stance. The tasks increase in difficulty through the duration of the test (Rogers, Rogers, Takeshima, & Islam, 2003). According to Berg, Wood-Dauphine, Williams, and Gayton (1989), there is high inter- and intra-rater reliability and high internal consistency. The BBS has been assessed for content validity against numerous other measurements, including the Barthel Index, Timed Up and Go, Tinetti balance, and Fugl-Meyer (Steffen et al., 2002). This tool has also been used as a predictive measure in determining fall risk (Bogle Thorbahn & Newton, 1996). The BBS is considered one of six core physical therapy measurements because of scientific supporting evidence (Academy of Neurologic Physical Therapy, 2018).

Likewise, the FGA was also selected as a core measurement of balance for physical therapists (Academy of Neurologic Physical Therapy, 2018). In the current study, participants were asked to stand to participate in both the body motion and mind body practice. Both occupations also involved movement away from their center of mass. Some tasks also involved

stepping or even stepping over an object. The FGA comprises seven items from the Dynamic Gait Index, but also includes gait with a narrow base, ambulation backwards, and gait with eyes closed (Wrisley, Marchetti, Kuharsky, & Whitney, 2004). Although it was initially developed to assess individuals with vestibular disorders, it has demonstrated that a score of 22/30 provides predictive validity for fall risk classification in community-dwelling older adults (Wrisley & Kumar, 2010). Wrisley et al. (2004) found that the FGA had an overall acceptable reliability, internal consistency, and concurrent validity.

The 30s CST is designed to measure lower extremity strength by having an individual complete as many sit to stand transitions without the use of the upper extremities during a 30-second interval (Rogers et al., 2003). This test also offers a glimpse into endurance because it assesses number of repetitions over time. The inability to stand from a chair without use of armrests can be an indicator of frailty, which as aforementioned, is a strong predictor of nursing home admission (Lusardi et al., 2003). This assessment was selected for this study because Milanović et al. (2013) found that there is a significant reduction in muscle strength between participants from two age groups, 60-69 and 70-80.

The MOCA is designed to be a 10-minute assessment that includes an evaluation of short-term memory, visuospatial abilities, verbal abstraction, serial subtraction, orientation, and fluency (Nasreddine et al., 2005). With individuals with Alzheimer's dementia, mild cognitive impairment, and no impairment, the MOCA has good internal consistency, and the items discriminated well between groups (Nasreddine et al., 2005). The MOCA has also been shown to better detect mild cognitive impairment compared to the oft used Mini-Mental Status Exam (MMSE) (Zadikoff et al., 2008). Similarly, Luis, Keegan, and Mullan (2009) also found that the MOCA had excellent sensitivity and specificity for detecting Alzheimer's disease or mild

cognitive impairment. Finally, the MOCA's visuo-executive scores are predictive of functional status, which is not part of the MMSE (Toglia, Fitzgerald, O'Dell, Mastrogiovanni, & Lin, 2011).

The final assessment to be utilized was developed in 1985 as a brief assessment of life satisfaction (Pavot & Diener, 2008). The SWLS has since been used in multiple research studies to assess subjective well-being. This scale is a 5-question survey with scores ranging from five, the lowest satisfaction, to 35, which indicates extremely satisfied (Pavot & Diener, 1993). Normative data for older adults indicates well above the average score, ranging from 23.6 to 27.9 (Pavot & Diener, 2008). Data has been collected on other populations, including college students, male prison inmates, gifted adults, Holocaust survivors, and adults in midlife. This assessment was selected because of its broad and accepted use in many different populations.

**Adult Learning Theory and Older Adults**

A concept that arose in the 1980's was productive aging, which meant that older adults wanted to transition from full-time work to full-time leisure and this equates to lifelong learning (Merriam & Kee, 2014). Sustained social engagement and participation in productive activities has been linked with successful aging, as defined by the avoidance of disease and ability to maintain physical and cognitive health (Sloane-Seale & Kops, 2013). Merriam and Kee (2014) noted that "in addition to physical, social, emotional, and perhaps spiritual well-being, one of the by-products of engaging in learning activities is the resultant social connectivity, which in turn promotes cognitive functioning" (p. 135). This engagement in learning activities is not dependent on whether the activity is formal or informal.

One area of increasing interest to older adults for continued learning opportunities is computer literacy and technology, according to Shedletsky (as cited in Merriam & Kee, 2014).

Zhang, Grenhart, McLaughlin, and Allaire (2017) described the growth of computer technology use in older adults, finding that 58% of Americans in this age group were online, compared to only 28% 10 years prior. Therefore, a need exists to ensure that older adults have access to technology and learning opportunities to grow in those skillsets. It should be noted that older adults who utilize computer technology tend to be better educated, have less anxiety about technology, and have a higher level of computer efficacy (Zhang et al., 2017). In other words, these individuals are more likely to have utilized technology for work or interests as a younger adult.

Findings from a qualitative study of perceptions regarding older adult lifelong learning support the rationale for this study. Older adults enjoy being lifelong learners for three primary reasons: learning for the sake of learning, socializing, and achieving a goal (Sloane-Seale & Kops, 2013). Participants sought out intellectual stimulation, but also enjoyed being part of a community of learners (Sloane-Seale & Kops, 2013). The current study is designed to teach a new activity to older adults in a small group or community, and participants can set goals related to the game if that increases their motivation. By participating, the members have an opportunity to continue being lifelong learners.

# CHAPTER III

# METHODOLOGY

## Population and Sample

Prior to starting any subject recruitment or data collection, approval was received from the Institutional Review Board (IRB) of the University of Tennessee at Chattanooga (see Appendix A). Once this had occurred, recruiting a sample was the first major task. The population selected for this study was older adults in the southeast United States who are community dwelling. The sample was recruited from a local church. The participants were recruited through posted information in the church, write-ups in weekly and monthly bulletins, and through a face-to-face meeting between the researcher and the older adults group. The inclusion criteria included that the individuals were 60 years or older, continued to maintain his/her own home, ambulated with or without an assistive device, and had intact vision with or without corrective lenses. Participants must still drive or have access to reliable transportation. Due to a low sample, two subjects were admitted to the study who were aged 63 and 64. The exclusion criteria was significant hearing loss, resided in an assistive living community, and had a history of a debilitating diagnosis such as stroke, Parkinson's, or dementia that severely impacts mobility and/or cognition. Participants should not have dizziness or severe osteoporosis.

The researcher corresponded with the leader of the older adults group to schedule a date when the researcher would speak directly to the participants to request volunteers that are willing to commit to up to six weeks of activity in the groups. Participants agreed to participate two times a week for the full six weeks. The participants also agreed to return for follow-up tests that

would be completed at one month after the conclusion of the study and to a short focus group to assess the meaningfulness of this occupation. Ideally, 16 subjects were sought to participate with eight in the control group and four in two separate experimental groups. Unfortunately, a less than desired *N* was achieved and there were a total of 11 participants. Three groups were formed, two participated in Wii gaming and one did mind-body practice.

## Variables

The independent variable for this study was the participation in the experimental groups compared to being in a control group. According to Gliner, Morgan, and Leech (2011), the independent variable is often a treatment, workshop, or method that is applied to one group, but not the other to assess for change. Group assignment is a nominal scale variable. Dependent variables are the outcome measures of the implementation of the independent variable (Gliner et al., 2011). For this study, the dependent variables included fall risk, gait stability and endurance, balance, cognition, and quality of life. These were measured with the following assessments: BBS, FGA, 30s CST, MOCA, and SWLS. Each of these tests produced a ratio scale variable. Multiple attribute variables were collected during pretesting and later analyzed following the completion of the posttest data collection. These were primarily collected via a demographic form (see Appendix G) and included age, gender, handedness, level of education, gaming history, mind-body practice history, marital status, and community involvement. Of these, age, level of education, and gaming history were ordinal measurements while the rest were nominal (Gliner et al., 2011).

This study also had a qualitative component, creating a mixed methods design (Gliner et al., 2011). This data was collected from researcher field notes that were documented at the

conclusion of each group session and via three focus groups at the conclusion of the six weeks. In other words, each of the three groups participated in a single focus group. This aimed to assess if the participants found meaning in the occupations of gaming and mind-body practice and any perceived benefits they found from participation in the small group activities. This data will be analyzed using thematic coding (Patton, 2015). The field notes collected by the researcher were used to triangulate this qualitative feedback and quantitative scoring (Rossman & Rallis, 2017). Following each session, the researcher recorded field notes or memos concerning participant behavior, group dynamics, and other pertinent events from that day's activities.

## Data Collection

After IRB approval was received, the researcher began recruiting for the study. Subjects self-selected into the study by either filling out an informational sign-up sheet posted at the church or speaking directly to the researcher. The participants then presented less than one week prior to the start of the groups to review the informed consent, complete the demographic information, and complete pretest assessments. Two OTs performed the majority of the pre-testing to establish baseline data. Due to vacations, an additional OT was utilized to capture the data on three participants who were unable to be present on the initial test day. These same individuals were utilized to collect data at the completion of the six weeks and 1-month post. The subjects underwent the BBS, MOCA, FGA, SWLS, and 30s CST. They were completed in this order to allow rest breaks between the balance and endurance assessments. In order to limit bias from carryover effects, version 7.1 of the MOCA was used for the pretest and 7.2 for posttest (Gliner et al., 2011). The subjects were assigned a random letter and number code to protect

privacy, and all data was stored both in a locked cabinet and on a locked computer once entered electronically. Only the researcher had access to these items.

## Research Design

This experiment consisted of one group of four members performing Tai Chi, and two groups that played Wii Sports. Of those, one group had three participants, while the other had four. The small group size for the gaming group was chosen because the various Wii Sports games accommodate between one and four players. Participants were able to rest when it was another player's turn or when the game only allowed for two players. The Tai Chi group was able to accommodate more participants because the space was large. Rest breaks were built into the activities by the researcher and participants were educated that they could rest as needed. Participants were assigned to groups based on their availability. Three time slots were created for the groups and participants signed up for a slot that best met their schedule. The activity was then randomly assigned to the timeslot.

Participants in all groups began with a brief warm-up exercise period. All completed the same set of exercises throughout the duration of the six weeks. These exercises included seated activities such as shoulder rolls, ankle rolls, knee flexion, and seated marching. In standing with a chair for support as needed, participants performed heel raises, hip extension, marching, and a heel cord stretch. Participants performed two sets of 10 reps of heel raises and 10 reps of the others. Standing heel cord stretches were included because ankle strategies are essential for fall prevention (N. Fell, personal communication, March 2019). Additionally, another item that occurred for each group session was the researcher completed field notes within eight hours of the group.

Once the warm-up exercises were completed, the gaming group engaged in the Wii Sports. During the first session, orientation to the Wii Stick was provided as well as an overview of the games available. The first game used was bowling. This was chosen because it can be performed with very little movement and up to four participants can play in any game. If a participant had a fear of falling or struggled with the technology, the bowling game could be modified to allow the person to sit. Significant rest time was automatically built into the game because rest occurred while the other players took turns. Both sessions during the first week were spent bowling to continue to ease the participants into the activity.

During each of the five subsequent weeks, a new game was added. Tennis was second because the participants were still making the same moves to complete the activity, thus participants helped each other learn the movement. Again, if needed, it could have been performed seated, but all participants did perform each Wii game in standing with the researcher providing close supervision as necessary. This supervision decreased from close to distant as the games progressed and participants became more familiar with the activities and more confident in their own abilities. Baseball was the next game added, and this marked the first opportunity that the participants were doing different moves because one player acted as the pitcher and the other was the batter. To prepare for this game, participants engaged in batting practices. Golf was added during the fifth week. During the fifth and sixth weeks, time was allotted at the end for participants to choose a previously played game.

The mind-body practice group also utilized technology to lead the activities. After completion of the warm-up exercises, YouTube videos led the participants through Tai Chi initially, and then yoga was added in the third week. This method was selected because the Wii was something that could potentially be carried over to the home to continue seeing benefits. By

using a digital instructor, this group could also carryover the technology to the home. The researcher briefly instructed the participants during the first session regarding a general overview of the benefits and purpose of mind-body practice. A YouTube led video of approximately 25 minutes was utilized for the first two weeks. This video was selected because it showed three different methods for performing the activities, including standing, sitting, and decreased upper extremity function. This allowed participants that were fearful of falling to slowly engage in the movements. Also by using the same video for two weeks, this led to increased familiarity to the movements.

During the third and fourth week, a different Tai Chi video was introduced. All participants performed the tasks in standing, and no one required rest breaks during the video times. The second video was chosen because the instructor provided very clear and concise directions and there were no distractions because he was alone in a room. Yoga was slowly introduced at the conclusion of the Tai Chi. The yoga videos used were ten minutes or less in length and specifically designed for older adults and balance training. A third and final Tai Chi video was introduced during week four. This was the most complicated to follow because there were no verbal instructions. Participants had to watch and mirror his movements and read the brief instructions. Of note, it was filmed in a river at the Grand Canyon and the water was relaxing for the participants. During week six, the participants selected which videos they wanted to use as a group.

At the conclusion of the activities on the last day, both a focus group and the posttest assessments were completed. The same OTs completed these for reliability. These same examinations were completed one-month post completion of the activities generally by the same individuals. Due to some scheduling difficulties, it was not possible to use the same two

therapists for each testing session. With consideration to each aspect of the design, this study will be a quasi-randomized experiment with pretest and posttest control group design (Gliner et al., 2011).

As aforementioned, during the last session for each group, a short focus group occurred. This was done to understand the participants' perceptions of the meaning of the different occupations as well as to explore the importance of group activity. The researcher was also interested if the participants in one group perceived greater improvements or changes in balance, cognition, and social engagement compared to the other group. The focus groups were both videotaped and audio recorded to allow for transcription and analysis. The researcher completed transcription of the three focus groups within 72 hours. Finally, data was triangulated with field notes that consider how the participants engaged with one another and how they responded to the activities.

Data was analyzed using IBM SPSS statistical analysis software for quantitative analysis. The first step was establishing homogeneity, which was noted. The analysis included addressing changes from pretest to posttest scores as well as differences between groups. A test of homogeneity of variances using Levene statistic found no significant differences between the eleven individuals (Gliner et al., 2011). Differences from posttest data was assessed using paired t-tests as well to see if either the gaming or mind-body activity had a larger impact on balance, cognition, and social engagement. For the qualitative data, focus groups were recorded and transcribed. Provalis was used to thematic coding. These themes were triangulated with field notes.

# CHAPTER IV

# Data Analysis

## Sample Demographics

Participants were recruited from a local church through word-of-mouth, a posted sign-up sheet in the fellowship hall, and a statement printed in the weekly bulletin for three weeks. Initially, 20 individuals registered for the classes. However, four did not respond to follow-up contact from the researcher, three did not meet the medical criteria and had significant prior medical events, and two felt like the time commitment would be too much with other appointments. Therefore, 11 subjects completed the study, which was a less than desired *N*. Of those, only two were able to attend every session, but no one missed more than two.

The average or mean age of participants at the start of the classes was 71.55, while the median was 70. The range was 63-83 years old. Originally, the goal had been to recruit only individuals aged 65 and older, however, two participants were very eager and the age was expanded to 60 as a baseline. This is consistent with the WHO definition of older adult. Of the participants, there were three males and eight females. All participants were right handed, but interestingly, one male participant enjoyed switching to play the Wii games with his left hand about midway through each session. Only three participants reported any gaming experience on a weekly basis and this was limited to computer games or handheld devices. No participants recently engaged in body-motion gaming. Similarly, three participants noted some mind-body practice, but very limited. All participants noted being socially engaged with the majority of individuals (8/11) indicating performing an activity outside the home three to five times a week.

All groups met in the same room at the church, which is a large activity space with a wall-mounted television. The researcher moved two tables before the Monday class to allow room for all activities, and these remained to the side until after the second Thursday group. The room is designed for large group meetings and has windows along one entire wall, which allowed significant natural light. Unfortunately, the natural light was not enough for participation in activities, therefore the overhead fluorescent lights were used. Typically, the church building was very quiet, and groups were uninterrupted. However, two days per week there were day-care activities, and occasionally the kids could be heard running in the hall. Of note, the participants never voiced any distraction from the children, even during the Tai Chi videos.

## Pretest Analysis

Participants underwent pretesting the week prior to the groups starting. A summary of pretest results is in Table 1. One OT performed the BBS and MOCA, while a second OT performed the FGA, SWLS, and 30s CST. It took approximately 20 minutes per participant to complete these tests. One participant was unable to test on the same day as the rest and she ended up being the only person not tested in the morning. When participants arrived for their tests, they were given the choice of three time slots for groups and each received their top choice.

Regarding the BBS, the average score at pretest data collection was a 51.18, and the scores ranged from 43-56. A score of less than 45 is considered a useful indicator of fall risk (Bogle Thorbahn & Newton, 1996). Two participants in the study fell into this higher fall risk category. Age was not a factor with this, as the two were the second youngest and second oldest. Two participants scored a perfect 56/56 on their pre-test.

An accepted cutoff score for the MOCA that indicates normal cognitive function is 26 and above (Nasreddine et al., 2005). The average score at pre-test was a 26.45. Four individuals were below this cutoff with scores. Two individuals recorded a 29/30. All participants completed high school; therefore, no score changes were made based on level of education. The third assessment was the FGA, which assesses postural stability while performing different tasks during gait. According to Wrisley and Kumar (2010), a score of <22/30 in community dwelling older adults was predictive of falls. In the current study, the average pretest score was 23.18, with a range from 13-30. It was determined that four of 11 participants fell below the cutoff, indicating fall risk. Of the four, two participants were also considered fall risk from the BBS results.

The final two assessments were the SWLS and 30s CST. The average score for the SWLS was 27.36, and scores ranged from 20-35. The low score of 20 indicates being neutral with life satisfaction, while a top score of 35 is extremely satisfied. The 30s CST test is also a fall predictor, but scores are based on age. Of the participants, four subjects' scores were reflective of being a fall risk based on low repetitions and age.

Table 1

Pre-Test Data and Identification of Fall Risk and Cognitive Decline

| Age | BBS (pre) | MOCA (pre) | FGA (pre) | SWLS (pre) | 30s CST (pre) |
|---|---|---|---|---|---|
| 77 | 50 | 27 | 19* | 26 | 10 |
| 66 | 52 | 28 | 23 | 20 | 11 |
| 66 | 53 | 24** | 26 | 28 | 12 |
| 83 | 56 | 23** | 19* | 26 | 14 |
| 63 | 54 | 29 | 26 | 32 | 10* |
| 67 | 48 | 28 | 27 | 22 | 9* |
| 79 | 44* | 27 | 19* | 28 | 5* |
| 82 | 53 | 25** | 30 | 35 | 11 |
| 70 | 56 | 24** | 26 | 32 | 24 |
| 70 | 56 | 29 | 28 | 31 | 10 |
| 64 | 40* | 28 | 12* | 21 | 4* |

* Indicative of high fall risk
** Indicative cognitive decline

## Research Question 1

*Was there a change in balance, gait, and/or fall risk following participation in Wii Sports (experimental) and/or mind-body activity (control) groups?*

The primary questions for this study focused on whether or not there was a relationship between balance, cognition, and social engagement when participating in either body motion gaming or mind-body practice. The first question focused on whether or not a change occurred in balance, gait, and/or fall risk following participation in either the gaming or mind-body group. Therefore, the BBS, FGA, and 30s CST were utilized in this analysis. A paired samples *t*-Test was run for both the gaming participants ($N$=7) and Tai Chi participants ($N$=4) for those specific tests. For the body motion gaming group, there was a positive change, but not a significant

difference. In other words, the mean scores for each set of tests increased. The mean for the BBS posttest increased to a 53.29 (from 51.86), FGA increased to 26.43 (pretest 25.00), and the 30s CST to 13.57 (pretest 11.57). The 30s CST was a significant gain at the *p*=.07 level. This can be seen in Table 2.

Table 2

Balance Changes from Body Motion Gaming Over Six Weeks

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | BBS (pre) - Berg Post | -1.429 | 4.117 | 1.556 | -5.236 | 2.379 | -.918 | 6 | .394 |
| Pair 2 | FGA (pre) - FGA (Post) | -1.429 | 1.902 | .719 | -3.188 | .331 | -1.987 | 6 | .094 |
| Pair 3 | 30s CST (pre) - 30s CST (post) | -2.000 | 2.449 | .926 | -4.265 | .265 | -2.160 | 6 | .074 |

For those participants who engaged in Tai Chi and yoga practice, there were not significant changes in these three assessments from pretesting to posttesting. It is important to note that the sample was only four participants, which would impact demonstrating a relationship between the activity and gains made with balance. However, similar to the gaming group, it should be noted that all three tests did improve over the six weeks. These results are in Table 3.

Table 3

Balance Changes from Mind Body Practice Over Six Weeks

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | BBS (pre) - Berg Post | -5.000 | 6.377 | 3.189 | -15.147 | 5.147 | -1.568 | 3 | .215 |
| Pair 2 | FGA (pre) - FGA (Post) | -1.250 | 3.304 | 1.652 | -6.507 | 4.007 | -.757 | 3 | .504 |
| Pair 3 | 30s CST (pre) - 30s CST (post) | -3.000 | 4.082 | 2.041 | -9.496 | 3.496 | -1.470 | 3 | .238 |

Having a less than desired sample impacted the overall changes in the group performance. However, there were some individual changes that were worth noting. On pretesting, it was found that two individuals were considered high fall risk based on all three exams. Both of those individuals improved to score above the cutoff number on the BBS. Similarly, one individual who was a high fall risk with the FGA gained six points. The score is still considered a fall risk, but that score is closer to the cutoff and demonstrates clinical improvement. One of four also moved above the fall risk cutoff in the 30s CST. This is seen in Table 4, where the positive changes are bolded.

Table 4

Individual Balance Changes from Pre- to Post-Testing

| Age | BBS (pre) | BBS (Post) | FGA (pre) | FGA (Post) | 30s CST (pre) | 30s CST (post) |
|---|---|---|---|---|---|---|
| 77 | 50 | 55 | 19* | **20*** | 10 | 10 |
| 83 | 56 | 56 | 19* | 18* | 14 | 23 |
| 63 | 54 | 53 | 26 | 28 | 10* | 10* |
| 67 | 48 | 53 | 27 | 26 | 9* | **10*** |
| 79 | 44* | **53** | 19* | 18* | 5* | **11** |
| 64 | 40* | **54** | 12* | **18*** | 4* | **6*** |

* Indicative of fall risk

Part of decreasing fall risk is increasing confidence. The researcher's field notes demonstrated that participants felt as if they were making positive gains in the areas of balance and endurance. During the second week, it was noted that during the Tai Chi group, fewer members were staying immediately over their base of support and one participant began standing for all activities. During the first week, she was unable to tolerate the full routine standing and performed some tasks seated. She also verbalized being fearful of performing some activities in standing, at times emphatic that she would fall. On occasion over the six weeks she sat briefly, but the group noted that her confidence increased and the times spent sitting were much less. Additionally, this individual required close supervision by the researcher initially as well as upper extremity (UE) support on a chair back, but then progressed to distant supervision and no UE support.

In the gaming group, another participant noted being surprised about her level of confidence increasing over time with practice and feeling as if she could push herself further with the motions. From the researcher's field notes, another participant, BW60, noted during week four, "I know I'm getting better. I almost fell twice yesterday, but I didn't! I caught myself!" (BW60,

personal communication, September 10, 2019) Likewise, during the focus group, MB38 noted that “my balance is better and I’m not weaving across, acting like a drunk!” (MB38, personal communication, September 25, 2019) The group members also provided feedback to one another about noticing improvements, which helped build confidence and friendships. Finally, RW31 noted in the focus group that her endurance has increased and she felt she was now able to walk further distances as evidenced by her activity level at a recent women’s conference (RW31, personal communication, September 26, 2019).

## Research Question 2

*Was there a change in cognition scores following participation in the Wii Sports and/or mind-body activity groups?*

Due to the prevalence of cognitive changes with the aging process, it was important to assess if there was a relationship between participating in these activities and cognitive improvement. Specifically, the second research question asked if any change would occur in cognitive scores after participation in either group activity. As noted above, four individuals fell below the cutoff line that is indicative for cognitive decline on MOCA. There was not a significant change in either group when assessing cognition with the MOCA. On an individual basis, three of the four who were below the cutoff with their pretests did improve their scores to a score that would indicate normal cognitive function, or greater than 26. Of the score that was unchanged, the participant refused a portion of the test, which automatically was a loss of three points. This is demonstrated in Table 5.

Table 5

Individual Cognitive Changes from Pre- to Post-Testing

| Age | MOCA (pre) | MOCA Post |
|---|---|---|
| 66 | 24** | 27 |
| 83 | 23** | 23** |
| 70 | 24** | 26 |
| 82 | 25** | 26 |

** Indicative of cognitive decline

The field notes indicated that learning occurred and participants saw changes in themselves from a cognitive standpoint. An example of this was when the gaming groups were playing baseball. Multiple members commented on learning different movements to impact pitching and hitting, but also the complexity with being distracted by another player doing an opposite movement, such as hitting versus pitching. During the Tai Chi group, a member commented that after three sessions, she was able to recall the movements faster and were performed easier, which demonstrated learning. The repetition of using the same game or same videos for multiple sessions reinforced memory skills and motor learning.

## Research Question 3

*Was there a change in scores on a social engagement scale following participation in the Wii Sports and/or mind-body activity groups?*

The third aspect that was considered was if social engagement or quality of life changed through participation in the six weeks of activity in either group. The SWLS was used to measure this. It is important to note that from the demographic form, all 11 participants noted some social engagement, and most indicated being involved in community activities at least two

or three times per week. Additionally, one participant scored neutral on the self-assessment at the pre-test, but all the others were above neutral in their assessment of life satisfaction. For the gaming group, there was a statistically significant gain from the pretest to posttest ($p$=.04), with the mean changing from a 27.57 to 29.86. This was not seen in the mind body practice group, where the mean score for the assessment decreased from a 27 to a 26.50.

Again, with a small *N*, it is of utmost importance to consider all data. The field notes provided a plethora of observations about social engagement and the importance of the group. Each group behaved differently through the six weeks. The Monday-Wednesday gaming group was positive and complimentary of one another as they learned the games. There was laughter each session, and overall the level of competitiveness stayed relatively low. That was different than the Tuesday-Thursday gaming group. That group was competitive, often engaged in trash talking, and were boisterous. They laughed and overall enjoyed one another's company. This was evidenced by members of that group continue to get together for weekly gaming sessions. The mind body group was quiet, but each session ended with a small group reflection. Participants noted one another's progress and share details about what was happening in their lives. Most of these women knew each other in passing, but only two were good friends at the start.

It is important to consider why a decline in mean scores occurred for the Tai Chi group. In looking over the field notes as the groups were concluding, there were significant events that happened outside of the confines of the group setting. One participant reported to the group that she had a fall in her neighborhood and recently also had a stroke. Another member was involved in a minor car accident, but while she was uninjured she was dealing with multiple stressors of trying to get her car repaired. Each group member reported enjoying coming to the sessions and

they found it to be a peaceful and relaxing practice, but the scores on the SWLS may have been reflective of the outside life stresses.

## Research Question 4

*Were any changes in balance, cognition, and social engagement maintained one-month post completion of the Wii Sports and/or mind-body group activities?*

Although changes were small and generally not statistically significant, it was deemed important to see if any changes persisted over time. Research question four explored if changes in balance, cognition, and social engagement were maintained 1-month postcompletion of the groups. One participant was not available for one month follow-up testing because she was out-of-state and would not be back for two more months. She did report that she was on her farm, helping perform daily tasks related to its upkeep, and she continued to do the stretches daily that started each session (MJ30, personal communication, October 31, 2019). She verbally reported that she felt she has maintained gains that were made from the Tai Chi (MJ30, personal communication, October 31, 2019). A second participant, who was part of the gaming group, was sick on the day of follow-up posttests. Her spouse reported she continued her regular visits to workout at the Young Mens' Christian Association (YMCA), but has been hampered by arthritic pain in recent weeks (JL43, personal communication, October 31, 2019).

Paired sample *t*-tests were run to compare the one-month data to the posttest data. Ideally, no decline would be noted. For the gaming group, all the means between posttest data and one month follow-up stayed within one point. Interestingly, there was a difference with the BBS, a statistically significant improvement ($p$=.03). Some of the members continued the gaming

activity and others have started new activities. There may also be a carryover effect because they completed the test three times. These results are seen in Table 6.

Table 6

Posttest and One-Month Follow-up Gaming Group

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | Berg Post - BBS (1 month) | -1.500 | 1.225 | .500 | -2.785 | -.215 | -3.000 | 5 | .030 |
| Pair 2 | MOCA Post - MOCA (1 month) | -.667 | 2.338 | .955 | -3.120 | 1.787 | -.698 | 5 | .516 |
| Pair 3 | FGA (Post) - FGA(1 month) | -1.000 | 2.280 | .931 | -3.393 | 1.393 | -1.074 | 5 | .332 |
| Pair 4 | SWLS (post) - SWLS (1 month) | .167 | 1.329 | .543 | -1.228 | 1.562 | .307 | 5 | .771 |
| Pair 5 | 30s CST (post) - 30sec (1 month) | -.500 | 2.429 | .992 | -3.049 | 2.049 | -.504 | 5 | .636 |

The mind-body group only had three individuals in this final analysis. The means for the BBS, MOCA, and FGA all increased, but not statistically significant. The means for the SWLS and 30s CST dropped slightly, but also not significantly. Generally speaking, however, all gains initially made from fall risk levels were maintained.

The follow-up testing allowed not only the gathering of the quantitative data, but also offered an opportunity to see how participant's lives have changed since the program ended. Participant MB38 reported during her one-month follow-up that she has started volunteering in a

reading program at a local elementary school, something she was pursuing while the groups were on-going. She also reported feeling much stronger, especially with the 30s CST. She originally only had five stands and was considered a fall risk at pre-testing, but scored 11 repetitions during both post-testing and the one-month follow-up. Participant RW31 was responsible for starting the continuation of the gaming group, and all of her balance scores were higher than the posttest at her follow-up. MC80 has been enjoying the extra groups and he noted that other church members are attending. He stated some of those individuals were surprised they were sore and he told them they needed to stick to it (MC80, personal communication, November 10, 2019). Finally, one member whose FGA was below the fall risk criteria for both pre- and posttests was six points higher and above the cutoff after the one-month. She reported that she has been staying active with community engagement and is trying to attend the gaming group.

## Research Question 5

*Were there differences in changes in balance, cognition, and social engagement in pre/post/follow-up testing for participants in the Wii Sports group versus the mind-body activity group?*

Research question five explored if one modality was more effective than the other in the areas of balance, cognition, and social engagement. There were minimal statistically significant findings in either group. However, both groups saw individual participants benefit from the activities. Perhaps more importantly, there were no differences between the groups. As an OT, both modalities demonstrated the ability to positively impact the lives of these older adults. A major component of therapeutic practice is finding an activity that not only creates positive change, but is meaningful to the individual. This ties directly into the sixth research question.

## Research Question 6

*In what ways did participants find gaming or mind-body practices to be a meaningful occupations?*

This question focused on the interest level of participants and if they found mind-body practice or body motion gaming to be meaningful occupations. Although large group changes were not achieved, participants in both groups found the experiences to be positive in terms of making gains with balance, cognition, and social engagement. Interestingly, when the individuals signed up for a group that best met their own schedule, they did not know what activity was being assigned to that group. Overwhelmingly, the participants ended up doing the activity that s/he preferred. Only one participant, MB38, was slightly disappointed to not be doing Tai Chi. However, although gaming and sports were brand new to her, she actively engaged and came to enjoy the activity. Members of both activity groups later voiced that they would not have been happy had they been assigned differently. Therefore, having the positive attitude towards the activity could have contributed to the positive experiences that were expressed throughout the six weeks and during the focus groups.

In a review of both the researcher's field notes and the thematic coding from focus groups, it was found that individuals from both activities cited physical improvement. The participants also recognized learning that occurred, and the formation of new relationships. Those benefits were not necessarily reflected in the quantitative data. However, from analysis of field notes and coding focus groups, using Miner Qualitative Data Analysis Software (QDA), multiple themes emerged that not only answered this research question, but further explored self-perceptions, the aging process, and socialization. The main themes that emerged were the importance of having fun during the activities, the need to stay engaged in a community,

perceived changes from participation, and how learning occurred through the group participation. Each of these will be further explored.

**Meaningfulness of the Engaged Occupation and Having Fun**

Throughout the six weeks, participants voiced enjoying the groups. One of the most surprising displays of this happened during the second session of the Tai Chi group. Participant NR65 began crying at the end of the session. This was in part due to the support of her peers when she shared a recent medical scare, but she also added, "I didn't think I'd like this, but I loved it! You just never know, you have to try things" (NR65, personal communication, August 22, 2019). This theme carried over throughout the groups for the duration of the six weeks. Multiple members voiced disappointment of having to miss sessions due to vacations or appointments, as well as excitement to be back. Two participants in the Tai Chi group even requested the YouTube links in order to continue the practice outside of the group meeting when they were scheduled to be away.

As mentioned previously, participant MB38 was not initially excited to be in the gaming group. She did not have a sports background nor did she ever participate in any type of gaming. She shared with the group that her family was amused that she was doing this activity because it was so out of her character. However, she had a great support system through her peers and came to enjoy the games. The support from her peers came in the form of positive verbal feedback, high five's, and the sense of community created that allowed for trying and failing. For example, each member took turns going first with a new game, which created some anxiety, but more importantly, confidence. This confidence and evidence she was intrinsically motivated to participate was demonstrated when her two peers were going to be away for one session and she

asked the researcher to come anyway (MB38, personal communication, September 3, 2019). She felt she needed the balance practice and it was fun to do the games. On that day, the researcher had her continue in a familiar game, but the researcher served as the other participant and let MB38 make the decisions about the games played. She was given the opportunity to take that day off since her group members could not be present, but she made the choice to come, which demonstrated how meaningful the occupation had become to her.

During the focus group, there were 18 comments about having fun as a group performing these activities. These ranged from being excited about coming to group or seeing it on the day's schedule to commenting about laughing together. Participant JL43 commented, "I definitely got benefit from [Wii gaming]. It was fun. Number one, it was fun, and number two, I got exercise…I really did enjoy using the Wii, it was fun for me every day. I looked forward to coming" (JL43, personal communication, September 25, 2019). Beyond enjoying the activity, part of having fun also meant for some participants being able to laugh at themselves. The participants were asked to try new activities in front of peers, and on occasion that meant not being successful. The participants expressed that laughing and staying relaxed helped them get through learning the new task, either in the form of a new game or use of a different video.

Two additional examples that support finding meaning in these activities came after the conclusion of the groups. One participant from the Tai Chi group is now attending a Tai Chi class near her home with her spouse. While she reports not going every time due to her schedule, they try to go as often as possible because she found the activity beneficial and liked the group setting. Additionally, a participant from a Wii group has started an adult Wii gaming group at the church. RW31 owned a Wii unit, but did not enjoy playing by herself. She stated, "I've played all these games at home. And I quit … after I lost people to do it with. Doing it with yourself

isn't fun" (RW31, personal communication, September 26, 2019). The group found the activity meaningful and she has gone on to organize a weekly get together.

**Perceived and Unexpected Benefits**

The meaningfulness of the occupation was also discussed in terms of some unexpected benefits. Some perceived benefits such as improved balance and cognition were previously discussed. During the focus group, participants noted additional unexpected benefits from engaging in these activities. RW31 noted that she has more movement in her left frozen shoulder, with the noticeable change after doing batting practice for two sessions with the Wii. An unexpected benefit for MB32 was overall confidence. She noted that it became a non-issue to volunteer to go first in a game, and normally she would not be comfortable in front of a group trying a new activity. She was part of the gaming group that was very positive and encouraging. Therefore, her group members helped to create a safe environment for trying new activities.

Teamwork or support of group members was also part of the mind-body practice group. NR65, a member of the Tai Chi group, saw many benefits in her colleagues, including a shift in attitude to be willing to try the new activities and have fun with them. Another unexpected benefit was voiced by members of the Tai Chi group. They noted feeling less anxious after a session, which carried over to the rest of the day. BW60 commented, "Even after I leave here, I feel relaxed. And sometimes in the evening, I think back to the day and I think about what we did in class" (BW60, personal communication, September 26, 2019). Therefore, those benefits were not necessarily measured in the quantitative exams, but they were perceived by the participants who found the activities meaningful.

## Research Question 7

*In what ways did older adults find meaning in small group participation?*

### Importance of Group and Socialization

A major component of this study was participation in group activity and not performing the tasks in isolation. Each group stated that they enjoyed getting to know the other participants. A few members discussed seeing one another at church on Sundays or even being on the same projects, but it was not until the groups did they have the opportunity to get to know one another. While the Tai Chi members enjoyed one another and became close through sharing personal experiences, it was the gaming groups that exemplified the importance of being together. Two participants noted they had alarms and reminders set on their phones to be at the group. Those were set for two main reasons: 1) get the benefit of the exercise and 2) be with their group members. The gaming group that enjoyed the higher level of competitiveness also stated that it would not have been as enjoyable had the groups changed members. They felt comfortable with one another, which led to the trash talking and joking. These members referred to their group as a team and felt like they grew as a unit.

Part of the group participation was learning from one another. In both gaming groups, there were individuals who owned a Wii and, therefore, had some experience. Although they had not been played recently, those individuals took an initial lead in teaching use of the controls and motions. The members really watched one another and took mental notes of what worked and what did not work. The more competitive gaming group spoke in their focus group about the activity being more of a mental challenge than a physical challenge because of learning the intricacies of each sport. RH75 noted that learning the different aspects was fun. He commented,

"I would agree that was fun – figuring out how to beat the game. Or how to beat whoever you're playing against" (RH75, personal communication, September 26, 2019). Although these participants were very competitive, they also used that for learning, developing a "competitive comradery" as HJ56 referred to the group (HJ56, personal communication, September 26, 2019).

### Socially Engaged Elsewhere in the Community

While question seven focused on the importance of socialization in these particular group activities, it became obvious that engagement elsewhere was extremely important to the participants. Remaining active in the community was a theme that emerged throughout the six weeks and was reinforced in the focus groups. During the six weeks, the researcher became aware of many different avenues where the participants stay active. Some examples included adjunct teaching at a local university, volunteering in schools, managing a farm, engaging in different church committees, exercising daily at the YMCA, and competing in weekly fishing competitions.

While two participants voiced finding peace while sewing or knitting at home, they even expressed importance of also being in the community. Both of those individuals use their talents of sewing and knitting to be part of a quilt making group at church, and one also sings not only the church choir but a community choir as well. So although they voiced being happy in the solitude of the home, they noted the importance of community engagement. The nine other participants expressed a need to be engaged outside of the home regularly. HJ56 stated,

> I have to keep active. I live by myself so I don't have anyone to challenge me. … I've got to do something…This [the church] is my extended family. I enjoy being with the hospitality [committee], the OWLs, the Fruit of the Spirits, all that. It makes it complete. It makes me complete. (HJ56, personal communication, September 26, 2019)

This was reinforced by other participants who found it cognitively engaging to be with other individuals in a variety of activities as well as fun to interact with different people.

During the course of the groups, members shared experiences of either currently being caregivers to parents or having watched parents or other individuals go through the aging process. One participant shared what it was like to go through taking care of her mother during a cognitive decline and she fears those experiences. She stays active to maintain her lifestyle as long as she is able. Another member has an older spouse who is not very active outside the home, so this participant finds a supporting unit in community activities. Watching the changes occur in close family members acts as a motivator for many of the participants to stay engaged in the community.

# CHAPTER V

# SUMMARY AND DISCUSSION

As previously mentioned, this study was designed to assess if modalities that have been successfully used in clinical practice with patients with varying diagnoses would have the same benefits for otherwise healthy older adults. Balance, cognition, and social engagement can all decline with age, and any of these can lead to the need for institutionalization. Body motion gaming has been utilized to improve each of these areas in individuals with Parkinson's disease, MS, and other diagnoses. Mind-body practice has been studied in older adults, and the benefits are documented. This study questioned if one modality was more effective than the other and if older adults found the occupations meaningful. Although the study was limited by a small *N*, there were positive changes that emerged from individuals in both activity groups.

## Statement of the Problem and Study Methodology

Loss of independence due to institutionalization is a fear of many older adults according to Kojima (2018). The greatest predictors for transitioning to a skilled residential setting are impaired cognition, falls, and low body mass index (Salminen et al., 2017). OT and PT have utilized body motion gaming for improving balance, cognition, and socialization in multiple patient populations for nearly a decade with success, as outlined in chapter two. Similarly, mind body practice has shown to have a positive impact on older adults in these same areas. This study was designed to explore if those same benefits would be seen in otherwise healthy community dwelling older adults. The researcher examined if by providing a meaningful occupation, fall risk

would be decreased, memory increased, and socialization improved. Aging is a process, and the risks will not ever be completely removed, but maintaining safety and engagement in older adults should be priorities to decrease the possibility of institutionalization.

As discussed in chapter III, participants were recruited at a local church. The most common reason that subjects self-selected into the study was balance, followed by the groups sounded fun. Subjects were assigned to groups based on their availability, and the activity was then randomly assigned to the group. There were three groups: two that participated in body motion video gaming using Wii Sports and one group that engaged in mind-body practice using YouTube guided Tai Chi and yoga videos. Groups met two times per week for six weeks, lasting one hour each session. Field notes were taken by the researcher at the conclusion of each group.

Five assessments were utilized at three different times over the course of the data collection. The BBS, FGA, and 30 second CST were used to assess fall risk. The MOCA was used as a cognitive assessment, and the SWLS assessed quality of life. These assessments were given in the week prior to the start of the groups, during the last session, and one month post. A focus group was also conducted with each of the three groups on the last day. Data were analyzed using SPSS and QDA Miner.

## Summary of the Results

Pretest, posttest, and one month follow-up scores of each of the five assessments were analyzed to assess for change over time. It is important to note the sample size was small at $N$=11, which impacted the ability to generalize overall results. With that consideration, neither the body motion gaming nor the mind-body practice groups saw a significant change in balance scores when using the BBS, FGA, or 30s CST. However, it is important to note there were

individual improvements. Specifically, two individuals who scored as a high fall risk using the BBS had gains between nine and 14 points, which brought both of them well above the cutoff mark for fall risk. One of those individuals also saw enough change with the 30s CST to no longer be considered a fall risk. Unfortunately, the same dramatic individual gains were not seen with the FGA, which was likely due to the activities being performed. This will be discussed further in the next section.

The results were similar with the cognitive assessment using the MOCA. There was not a significant change in the overall group scores. However, three of the four individuals that tested below the cutoff for cognitive decline improved by the posttest and were no longer in the at risk level. The fourth individual refused a portion of the test, which negatively impacted her overall score. The researcher's field notes were important for also demonstrating positive change with cognition. The participants were actively engaging with one another to problem solve how to be successful in the games, as well as demonstrating carryover to other sessions and different games. In the mind-body practice group, the members were able to recall the sequences, which improved the overall success of the movements. Furthermore, both groups had to deal with distractions and needed to utilize skills for divided attention.

In the area of social engagement, it is important to recall that one limitation of this study was the individuals were recruited from a church. The participants were also active in other community events. Even though their pretest scores were at or above neutral to begin, the body motion gaming group had a significant improvement on the SWLS between the pretest and posttest. This was not the case for the mind-body practice group. Looking again to the researcher's field notes demonstrates a happiness that flowed through all groups. The gaming groups were loud, boisterous, and encouraging. The mind-body practice group was open and

supportive with one another. The members of that group enjoyed the peaceful reflection and use of a yoga devotion to end each session. This typically allowed for intimate conversations between group members as they supported one another through this practice.

The researcher was interested if the results extended beyond the stop date, and nine of 11 participants returned for one-month follow-up assessment. The members of the gaming group saw a statistically significant improvement from posttest BBS to one-month follow-up scores. This could be indicative of carryover benefits from taking the same assessment three times or could demonstrate participants' overall increased activity levels. Members of the gaming group have recruited additional church members and friends to participate in regular gaming groups since the conclusion of the six weeks. This has possibly contributed to the rising scores. All of the other tests remained approximately the same as the posttest scores, which indicates there was no decline. In other words, participants maintained over time their changes.

The final results focused on the qualitative data collected from the field notes and focus groups. Members reported having fun and enjoying not just the company of the group, but also the activities. There were multiple members of both groups that reported having previously used the Wii or done Tai Chi, but had quit in the past for various reasons. RW31 noted it was not enjoyable to do the games alone (RW31, personal communication, September 26, 2019), while RH75 did not enjoy the mind-body class he had previously attempted (RH75, personal communication, September 26, 2019). They found happiness doing these activities now as groups. Likewise, individuals who had never participated in these occupations found them to be engaging and enjoyable. Participants also reported a positive change in balance: one noted increased shoulder range of motion, and others noted improved overall endurance.

The greatest indicator that these occupations were meaningful was noted during the one-month follow-up. As previously noted, some individuals started their own gaming group at the church and were actively recruiting non-research study participants to come because it was fun and beneficial. Additionally, another member joined a Tai Chi class near her home, even convincing her husband to attend with her. Other participants found different community activities since the ending of the group to maintain an active lifestyle. For example, one member now volunteers in a reading program at a local elementary school. This participant felt she had the time to help students with reading, but at the same time this helped her stay active and engaged with many other individuals (MB38, personal communication, October 2019). This not only challenges her endurance and balance to physically attend the classes, but serves also as a cognitive activity to be able to adequately assist the children in their reading skills.

Another aspect of the study results to consider was the focus on the technology. As reported in chapter II, there is a described fear of technology in older adults (Bacha et al., 2017). This fear was not observed in the majority of this study's participants. Out of the 11 members, nine communicated regularly with the researcher via email, one via text, and only one preferred direct phone calls. One member of this study, who never participated in sports outside of physical education or played a video game, demonstrated minimal hesitation with the technology. Three of the four members of the mind-body group requested the researcher send them the YouTube video links used in the class so they could use them at home. Finally, with the start of the gaming group for church members, the members are fully responsible for setting up and taking down the equipment for each session. This could have an impact on how technology is utilized in therapy practice, changing perceptions regarding older adults and technology.

## Discussion of the Results

### Interpretation of the Findings

The sample size limited the generalizability of results, but results were also impacted by the homogeneity of the sample selected. The researcher chose to focus on community dwelling older adults in an effort to explore if these modalities would be meaningful and could positively impact common areas for decline. The participants were all Caucasian, educated, and active in the community. Additionally, scores were also limited by an unexpected finding in the pretest data collection, and that was the number of perfect or near perfect scores. That left little to no room for gains for some individuals. Though that may have impacted the overall changes, it was a positive finding. Between the small group size and high scores of some individuals at the start, it became clear that looking at individual performance would be the most beneficial.

As aforementioned, some individuals who were considered high fall risk at the start moved above that cutoff over time. Likewise, some individuals who were at or below the cutoff for demonstrating cognitive decline rebounded over time. Finally, the one individual who had a neutral score on the SWLS at pretest moved into the slightly satisfied category by posttest. These scores may reflect a carryover effect; only the MOCA offers a different version, which was utilized. However, when assessing these changes through the lens of being an OT, the researcher was encouraged that these positive changes can demonstrate possibilities for community dwelling older adults. All 11 participants had gains in at least one assessment; most saw gains in two or three from pretest to posttest. This reinforces what the literature has found related to benefits of mind-body practice and body motion gaming in patient populations.

Most importantly, however, is that the participants found the activities meaningful. This is important as occupation is addressed in the MOHO. Kielhofner and Burke (1980) described

volition as the internal motivation to drive an individual to participate in an activity. The study participants enjoyed what they were doing so they found value, which led to internal motivation. This is evidenced by the continued practice of both gaming and Tai Chi. By providing safe environments for individuals to explore and try new activities, there could be positive changes in the areas that have been shown to be the largest predictors of institutionalization.

Likewise, providing a safe environment to explore technology could help limit fears in older adults. By providing learning opportunities and support for older adults, the stigma surrounding technology could be reduced. During a focus group at an inpatient rehabilitation hospital in the southeast, a therapist stated,

> We work with a lot of geriatric patients, they're older and they don't have a lot of experience with using games. I have worked in a lot of SNF's [skilled nursing facilities] before coming here, and they didn't feel very comfortable with gaming. (MH3, personal communication, November 2017)

In that same focus group, two other individuals focused on age being a limiting factor when choosing body motion gaming or other technologies (AB3, personal communication, November 2017; TB2, personal communication, November 2017). In the current research study, this was not seen. While one participant had never played a video game and was somewhat nervous at the start, there were no indications of fear or dislike because of the gaming. A few members reported wanting to take the groups on field trips to a bowling alley, batting cage, or golf range to play the games in the physical environment, but those comments were related to the fun they were having performing in the digital environment and wanting more opportunities to be physically challenged and to socialize. This has large implications for therapy practice. It is important to note the benefits of technology and mind-body practice in the literature.

**Recommendations for OT Practice**

Langan, Subryan, Nwogu, and Cavuoto (2018) investigated the use of technology by OTs and PTs in the rehabilitation process of individuals post stroke. They discovered that the technology that is still utilized the most frequently in a clinic is a stopwatch. Even having access to a gaming system did not increase its use, as therapists reported using it less than one time per week (Langan et al., 2018). This is in spite of the growing body of literature that suggests improvements with balance, coordination, cognition, and social engagement. Similarly, in a focus group of OT practitioners at a southeastern rehabilitation hospital, there were multiple comments about not using gaming technology with their patients due to the majority of the patients at the facility are older adults. However, research also indicates that older adults are engaging with technology and digital gaming. Kaufman et al. (2016) cited different studies, including in 2011 29% of digital game players in America were over 50, and 25% of Americans over 65 participated in digital gaming in 2015. This demonstrates clinicians are avoiding the use of technological modalities despite indications that older adults do engage in these types of occupations.

This current research study reinforced that older adults are using technology. Of the eleven participants, nine regularly exchanged email communication with the researcher, one insisted on text messaging, and one required phone call conversations. Of the four participants in the mind-body group, three requested that the researcher send the YouTube links so practice could be maintained outside of the group. Finally, the gaming group that started after the completion of the study required the participants to manage all of the technology, including setting up and taking down, maintenance, and teaching new participants to use the Wii sticks. Not only were the participants not averse to the technology use, it also needs to be noted that the

technology was new for most of them. Three participants noted they had played Wii Sports, but for each it had been years per their report. Additionally, two individuals reported getting on YouTube, but infrequently. Despite the newness of the activities, all participants were eager and willing to learn as evidenced by volunteering to go first on a new game, requesting web links, and expressing disappointment over having to miss sessions. Each of these is offered as evidence that therapists should actively seek to incorporate technology into clinical practice. It is the author's recommendation that therapists should not fear using different technologies with their patients.

**Recommendations for Additional Research**

The individuals selected for this study were from a church community and already active in other community organizations. An opportunity for continuing this research would be to recruit participants who do not currently have a similar support system or regular schedule of community involvement. For example, recruitment at a low income senior housing center may demonstrate different outcomes. Individuals who reside in these apartments are still community dwelling, but may have less access to community activities. Additionally, having participants from various backgrounds, who do not know one another, may also impact the group dynamics.

When considering the mind-body practice group, it would be useful to explore if there is a difference between engaging in the group led by technology, similar to the current study, compared to a group that had an in-person teacher. This could be used to explore if direct teacher feedback made a significant difference to overall gains or if learning through repetition and self-monitoring with technology was as effective. In the current study, each video was presented by the researcher so the participants would know what to expect. After completion of each video led

practice, the group would reflect on the practice and share information from their daily lives with one another. This came about early in the groups, after the video ended, the participants returned to the chairs where they had completed their warm-up exercises, which often was in a circle. The researcher answered any follow-up questions, but also the participants naturally also began chatting casually. This could lend itself further to the question of a teacher led class versus the video led. Although the participants did not have direct feedback from an instructor, they did provide one another feedback. It is interesting to consider if this would also happen in a more structured class setting.

One final area of additional future research would be more specific analysis of individual components of assessments or more specific assessments. For example, the FGA did demonstrate some gains, but scores remained in a large range in both pretest and posttest. This assessment focuses more on activities during gait, which was not a major component of either modality. However, parts of the FGA were seen in the two activities, specifically head turns while moving. A detailed analysis of those scores could be performed. Additionally, the MOCA is a global cognitive assessment, perhaps assessments focused on memory, reaction speed, and problem solving could be used to pinpoint specific cognitive areas. Individual sections of the MOCA could also be analyzed to see if changes occurred over the six weeks.

## Summary

Balance impairments, cognitive decline, and social disengagement can be part of the aging process, and each of these can be linked together. For example, if an individual has a fall or near-fall, that person may be less likely to go back into the community for fear of injury (K.-C. Siu et al., 2017). Similarly, if an individual is demonstrating cognitive impairments, the social

network around that individual may decline, which could lead to decreased activity and muscle weakness (Mavros et al., 2017). These changes could result in a fall. While it is not possible to stop the aging process, this study was designed to explore if the high risk areas of balance, cognition, and social engagement could be improved in community-dwelling older adults.

According to Kielhofner and Burke (1980) in their work concerning MOHO, "Work and play are not merely by-products of the human essence: they are the essence of human existence" (p. 573). This study reinforced this sentiment because the subjects who participated in both the body-motion gaming or mind-body practice found these to be meaningful occupations. They shared positive remarks concerning not only the occupation, but also the companionship and friendships formed in the small groups. This helped the members be accountable to the program and one another.

When considering the volitional subsystem of MOHO specifically, there are three specific components that compose this area. Volition is subdivided into personal causation, valued goals, and interests (Kielhofner & Burke, 1980). These can be used to further support the outcomes of this study. Personal causation is described as the self-image and whether or not that individual expects success (Kielhofner & Burke, 1980). Personal causation develops out of the desire to explore the environment, is shaped by feedback, and through practice a sense of success or failure emerges (Kielhofner & Burke, 1980). Although members of both activity groups demonstrated these characteristics throughout the six weeks, MB32 is an example of developing a self-image that expected success. MB32 noted during the final focus group that she was never someone to volunteer to try something new in front of peers for fear of failure, but in this setting she often wanted to go first (MB32, personal communication, September 25, 2019). By receiving

positive feedback from both peers and the games, and knowing she came to the group with a strong desire to improve her balance, she exemplified personal causation.

The second subdivision of volition is valued goals. Kielhofner and Burke (1980) defined values as committing to action and a means of determining importance of activity engagement. Values that guide behavior are valued goals, and this includes having a plan of action to meet these goals (Kielhofner & Burke, 1980). Each member of the study self-selected to be a participant. Throughout the six weeks and focus groups, members discussed goals of not falling, improving balance, being active, and maintaining cognition. Through activities such as this research study, participants had the opportunity to address goals that are meaningful in their own lives. This is also evident through the continued gaming group and attending mind-body practice in the community after the study finished. The participants who have chosen to maintain those activities have set balance, cognition, and social engagement as high values in their personal lives.

Finally, interests are the last subdivision of the volition subsystem described in MOHO. Simply stated, interests serve to guide individuals to actively participate in and initiate desired activities (Kielhofner & Burke, 1980). Kielhofner and Burke (1980) noted that interests can change over time, which allows individuals to continue to explore new areas. In the mind-body practice group, three of the four participants had not engaged in this type of activity previously. Through practice and community, interest in this occupation grew for all four members. The participants in this group provided one another with regular positive feedback, for example NR65 noted seeing balance improvements and a change in overall attitude towards physical activity of BW60 (NR65, personal communication, September 26, 2019). This positive feedback

from a peer in addition to seeing changes in herself increased the interest of the activity for BW60. This was evidenced by BW60 requesting links to each new video that was introduced.

While there were minimal statistically significant overall findings, each participant demonstrated improvement in at least one area. More importantly, some participants who were initially scored at either a fall risk or below the cutoff for mild cognitive decline, improved with the participation in the six-weeks of activity. The participants were motivated through positive changes they noted in themselves and others over that time. They also voiced repeatedly how much fun they had, and this was consistent with both activities.

Each of the participants in this study remained active after the conclusion of the six-weeks. Some continued with the body-motion gaming and mind-body practices. Others found similarly challenging activities elsewhere in the community. This again reinforces the importance of meaningful occupation, as described in MOHO. The participants in this study each voiced throughout the six-weeks the importance of being active and engaged, and some tied this directly to prolonging a decline seen in older family members or friends. Participant MB38 summarized the importance of finding meaningful occupation in aging:

> After you've been working, you've been around people, your mind has been active on all sorts of different things. And then when you don't have anything to do, you get really stale really fast. … You want to stay healthy to sit in your chair in the house? That doesn't resonate with me. … You need to figure out what your purpose is and there is a reason for you to get up in the morning. There's a reason for you to do these things [social activities]. (MB38, personal communication, September 25, 2019)

In other words, being social disengaged was seen in a negative light for the participants in this study. On multiple occasions during the groups, members noted watching the decline of friends or family, and many of these examples revolved around disengagement.

The results of this study, particularly the qualitative feedback, suggest that older adults can continue to improve their balance, cognition, and social engagement through meaningful

occupation. Additionally, participants did not demonstrate avoidant behavior with regards to technology, and therefore, this is an opportunity for OTs to explore with their patients. Finally, participation and motivation was positively reinforced by the presence of group members. Engaging with peers in new activities was stressful at times, but overall the group members became support systems over time.

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# APPENDIX A

# IRB APPROVAL LETTER

**Appendix A**


**Institutional Review Board**

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TO: Jessica Hackathorne **IRB # 19-086**

Dr. Elizabeth Crawford

FROM: Lindsay Pardue, Director of Research Integrity Dr. Amy Doolittle, IRB Committee Chair

DATE: 7/19/2019

SUBJECT: IRB #19-086: Examining the Relationships Between Body Motion Video Gaming or Mind- Body Practice and Balance, Cognition, and Social Engagement in Community-Dwelling Older Adults

Thank you for submitting your application for research involving human subjects to The University of Tennessee at Chattanooga Institutional Review Board. Your proposal was evaluated in light of the federal regulations that govern the protection of human subjects and approved via the expedited review procedure authorized by 45 CFR 46.110 and 21 CFR 56.110.

You must include the following approval statement on research materials seen by participants and used in research reports:

***The Institutional Review Board of the University of Tennessee at Chattanooga (FWA00004149) has approved this research project #* 19-086.**

Please keep in mind that all research must be conducted according to the proposal submitted to the UTC IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an Application for Changes, Annual Review, or Project Termination/Completion form to the UTC IRB.
Please bear in mind that significant changes could result in having to develop a new application for submission and approval. Your protocol will be automatically closed at the end of the proposed research period unless a change request application is submitted. No research may take place under a closed or expired protocol.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the UTC IRB as soon as possible. Once notified, we will ask for a complete explanation of the event and your response. Other actions also may be required depending on the nature of the event.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval.

For additional information, please consult our web page http://www.utc.edu/irb or email instrb@utc.edu.

Best wishes for a successful research project.

# APPENDIX B

# BERG BALANCE SCALE

## Appendix B

## Berg Balance Scale

**Description:**

14-item scale designed to measure balance of the older adult in a clinical setting.

**Equipment needed:** Yardstick, 2 standard chairs (one with arm rests, one without), Footstool or step, Stopwatch or wristwatch, 15 ft walkway

**Scoring:** A five-point ordinal scale, ranging from 0-4. "0" indicates the lowest level of function and "4" the highest level of function. Score the LOWEST performance. Total Score = 56

**Interpretation:**

**41-56 = independent**
**21-40 = walking with assistance**
**0 –20 = wheelchair bound**

**Berg** K, Wood-Dauphinee S, Williams JI, Maki, B (1992). Measuring balance in the elderly: validation of an instrument. Can. J. Pub. Health July/August supplement 2:S7-11

**Cut Off Scores**:

- Score of < 45 indicates individuals may be at greater risk of falling (Berg, 1992)

  **Berg** K, Wood-Dauphinee S, Williams JI, Maki, B. (1992). Measuring balance in the elderly: validation of an instrument. Can. J. Pub. Health July/August supplement 2:S7-11

- History of falls and BBS < 51, or no history of falls and BBS < 42 is predictive of falls (91% sensitivity, 82% specificity) (Shumway-Cook, 1997)
- Score of < 40 on BBS associated with almost 100% fall risk (Shumway-Cook, 1997)

  (n = 44, mean age = 74.6 (5.4) years for non-fallers, 77.6 (7.8) for fallers)

  **Shumway-Cook,** A., Baldwin, M., et al. (1997). Predicting the probability for falls in community-dwelling older adults. Physical Therapy 77(8): 812-819
  Retrieved 10-5-2014 from Rehab Measures Database. http://www.rehabmeasures.org/Lists/RehabMeasures/PrintView.aspx?ID=888

**Comments:** Potential ceiling effect with higher level patients. Scale does not include gait items

**Minimal Detectable Change:**

"A change of **4 points** is needed to be 95% confident that true change has occurred if a patient scores within 45-56 initially, **5 points** if they score within 35-44, **7 points** if they score within 25-34 and, finally, **5 points** if their initial score is within 0-24 on the Berg Balance Scale."

**Donoghue** D; Physiotherapy Research and Older People (PROP) group, Stokes EK. (2009). How much change is true change? The minimum detectable change of the Berg Balance Scale in elderly people. *J Rehabil Med*. 41(5):343-6.

**Norms:**

**Table 4. Berg Balance Scale Scores: Means, Standard Deviations, and Confidence Intervals by Age, Gender, and Use of Assistive Device**

| Age (y) | Group | N | Mean | SD | CI |
|---|---|---|---|---|---|
| 60-69 | Male | 1 | 51.0 | — | 35.3 – 66.7 |
| | Female | 5 | 54.6 | 0.5 | 47.6 – 61.6 |
| | Overall | 6 | 54.0 | 1.5 | 52.4 – 55.6 |
| 70-79 | Male | 9 | 53.9 | 1.5 | 48.7 – 59.1 |
| | Female | 10 | 51.6 | 2.6 | 46.6 – 56.6 |
| | Overall | 19 | 52.7 | 2.4 | 51.5 – 53.8 |
| 80-89 | Male | 10 | 41.8 | 12.2 | 36.8 – 46.8 |
| | Female | 24 | 42.1 | 8.0 | 38.9 – 45.3 |
| | No Device | 24 | 46.3 | 4.2 | 44.1 – 48.5 |
| | Device | 10 | 31.7 | 10.0 | 28.3 – 35.1 |
| | Overall | 34 | 42.0 | 9.2 | 38.8 – 45.3 |
| 90-101 | Male | 2 | 40.0 | 1.4 | 28.9 – 51.1 |
| | Female | 15 | 36.9 | 9.7 | 32.8 – 40.9 |
| | No Device | 7 | 45 | 4.2 | 40.9 – 49.1 |
| | Device | 10 | 31.8 | 7.6 | 28.4 – 35.2 |
| | Overall | 17 | 37.2 | 9.1 | 32.5 – 41.9 |

**Lusardi**, M.M. (2004). Functional Performance in **Community Living Older Adults**. *Journal of Geriatric Physical Therapy*, 26(3), 14-22.

**Berg Balance Scale**

Name: _____ Date: _____

Location: _____ Rater: _____

ITEM DESCRIPTION SCORE (0-4)

1. Sitting to standing _____
2. Standing unsupported _____
3. Sitting unsupported _____
4. Standing to sitting _____
5. Transfers _____

6. Standing with eyes closed _____
7. Standing with feet together _____
8. Reaching forward with outstretched arm _____
9. Retrieving object from floor _____
10. Turning to look behind _____
11. Turning 360 degrees _____
12. Placing alternate foot on stool _____
13. Standing with one foot in front _____
14. Standing on one foot _____

Total _____

GENERAL INSTRUCTIONS

Please document each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item.

In most items, the subject is asked to maintain a given position for a specific time. Progressively more points are deducted if:

- the time or distance requirements are not met
- the subject's performance warrants supervision
- the subject touches an external support or receives assistance from the examiner

Subject should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring.

Equipment required for testing is a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5, and 10 inches. Chairs used during testing should be a reasonable height. Either a step or a stool of average step height may be used for item # 12.

**Berg Balance Scale**

1. SITTING TO STANDING
INSTRUCTIONS: Please stand up. Try not to use your hand for support.
( ) 4 able to stand without using hands and stabilize independently
( ) 3 able to stand independently using hands
( ) 2 able to stand using hands after several tries
( ) 1 needs minimal aid to stand or stabilize
( ) 0 needs moderate or maximal assist to stand

2. STANDING UNSUPPORTED
INSTRUCTIONS: Please stand for two minutes without holding on.
( ) 4 able to stand safely for 2 minutes
( ) 3 able to stand 2 minutes with supervision
( ) 2 able to stand 30 seconds unsupported
( ) 1 needs several tries to stand 30 seconds unsupported
( ) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

3. SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL INSTRUCTIONS: Please sit with arms folded for 2 minutes.
( ) 4 able to sit safely and securely for 2 minutes
( ) 3 able to sit 2 minutes under supervision
( ) 2 able to able to sit 30 seconds
( ) 1 able to sit 10 seconds
( ) 0 unable to sit without support 10 seconds

4. STANDING TO SITTING
INSTRUCTIONS: Please sit down.
( ) 4 sits safely with minimal use of hands
( ) 3 controls descent by using hands
( ) 2 uses back of legs against chair to control descent
( ) 1 sits independently but has uncontrolled descent
( ) 0 needs assist to sit

5. TRANSFERS
INSTRUCTIONS: Arrange chair(s) for pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.
( ) 4 able to transfer safely with minor use of hands
( ) 3 able to transfer safely definite need of hands
( ) 2 able to transfer with verbal cuing and/or supervision
( ) 1 needs one person to assist
( ) 0 needs two people to assist or supervise to be safe

6. STANDING UNSUPPORTED WITH EYES CLOSED
INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.
( ) 4 able to stand 10 seconds safely
( ) 3 able to stand 10 seconds with supervision
( ) 2 able to stand 3 seconds
( ) 1 unable to keep eyes closed 3 seconds but stays safely
( ) 0 needs help to keep from falling

7. STANDING UNSUPPORTED WITH FEET TOGETHER
INSTRUCTIONS: Place your feet together and stand without holding on.
( ) 4 able to place feet together independently and stand 1 minute safely
( ) 3 able to place feet together independently and stand 1 minute with supervision
( ) 2 able to place feet together independently but unable to hold for 30 seconds
( ) 1 needs help to attain position but able to stand 15 seconds feet together
( ) 0 needs help to attain position and unable to hold for 15 seconds

8. REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING
INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at the end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the fingers reach while the subject is in the most forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)
( ) 4 can reach forward confidently 25 cm (10 inches)
( ) 3 can reach forward 12 cm (5 inches)
( ) 2 can reach forward 5 cm (2 inches)
( ) 1 reaches forward but needs supervision
( ) 0 loses balance while trying/requires external support

9. PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION
INSTRUCTIONS: Pick up the shoe/slipper, which is place in front of your feet.
( ) 4 able to pick up slipper safely and easily
( ) 3 able to pick up slipper but needs supervision
( ) 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently
( ) 1 unable to pick up and needs supervision while trying
( ) 0 unable to try/needs assist to keep from losing balance or falling

10. TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.
( ) 4 looks behind from both sides and weight shifts well
( ) 3 looks behind one side only other side shows less weight shift
( ) 2 turns sideways only but maintains balance
( ) 1 needs supervision when turning
( ) 0 needs assist to keep from losing balance or falling

11. TURN 360 DEGREES INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.
( ) 4 able to turn 360 degrees safely in 4 seconds or less
( ) 3 able to turn 360 degrees safely one side only 4 seconds or less
( ) 2 able to turn 360 degrees safely but slowly
( ) 1 needs close supervision or verbal cuing
( ) 0 needs assistance while turning

12. PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touch the step/stool four times.
( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds
( ) 3 able to stand independently and complete 8 steps in > 20 seconds
( ) 2 able to complete 4 steps without aid with supervision
( ) 1 able to complete > 2 steps needs minimal assist
( ) 0 needs assistance to keep from falling/unable to try

13. STANDING UNSUPPORTED ONE FOOT IN FRONT INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width.)
( ) 4 able to place foot tandem independently and hold 30 seconds
( ) 3 able to place foot ahead independently and hold 30 seconds
( ) 2 able to take small step independently and hold 30 seconds
( ) 1 needs help to step but can hold 15 seconds
( ) 0 loses balance while stepping or standing

14. STANDING ON ONE LEG INSTRUCTIONS: Stand on one leg as long as you can without holding on.
( ) 4 able to lift leg independently and hold > 10 seconds
( ) 3 able to lift leg independently and hold 5-10 seconds
( ) 2 able to lift leg independently and hold ≥ 3 seconds
( ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently.
( ) 0 unable to try of needs assist to prevent fall

( ) TOTAL SCORE (Maximum = 56)

# APPENDIX C

# FUNCTIONAL GAIT ASSESSMENT

## Appendix C

## Functional Gait Asessment

Requirements: A marked 6-m (20-ft) walkway that is marked with a 30.48-cm (12-in) width.

**_____1. GAIT LEVEL SURFACE**

Instructions: *Walk at your normal speed from here to the next mark (6 m [20 ft]).*
Grading: Mark the highest category that applies.
(3) Normal—Walks 6 m (20 ft) in less than 5.5 seconds, no assistive devices, good speed, no evidence for imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside of the 30.48-cm (12-in) walkway width.

(2) Mild impairment—Walks 6 m (20 ft) in less than 7 seconds but greater than 5.5 seconds, uses assistive device, slower speed, mild gait deviations, or deviates 15.24–25.4 cm (6–10 in) outside of the 30.48-cm (12-in) walkway width.

(1) Moderate impairment—Walks 6 m (20 ft), slow speed, abnormal gait pattern, evidence for imbalance, or deviates 25.4–38.1 cm (10–15 in) outside of the 30.48-cm (12-in) walkway width. Requires more than 7 seconds to ambulate 6 m (20 ft).

(0) Severe impairment—Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside of the 30.48-cm (12-in) walkway width or reaches and touches the wall.

**_____2. CHANGE IN GAIT SPEED**
Instructions: *Begin walking at your normal pace (for 1.5 m [5 ft]). When I tell you "go," walk as fast as you can (for 1.5 m [5 ft]). When I tell you "slow," walk as slowly as you can (for 1.5 m [5 ft]).*

Grading: Mark the highest category that applies.

(3) Normal—Able to smoothly change walking speed without loss of balance or gait deviation. Shows a significant difference in walking speeds between normal, fast, and slow speeds. Deviates no more than 15.24 cm (6 in) outside of the 30.48-cm (12-in) walkway width.

(2) Mild impairment—Is able to change speed but demonstrates mild gait deviations, deviates 15.24–25.4 cm (6–10 in) outside of the 30.48-cm (12-in) walkway width, or no gait deviations but unable to achieve a significant change in velocity, or uses an assistive device.

(1) Moderate impairment—Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, deviates 25.4–38.1 cm (10–15 in) outside the 30.48-cm (12-in) walkway width, or changes speed but loses balance but is able to recover and continue walking.

(0) Severe impairment—Cannot change speeds, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width, or loses balance and has to reach for wall or be caught.

**_____3. GAIT WITH HORIZONTAL HEAD TURNS**

Instructions: *Walk from here to the next mark 6 m (20 ft) away. Begin walking at your normal pace. Keep walking straight; after 3 steps, turn your head to the right and keep walking straight while looking to the right. After 3 more steps, turn your head to the left and keep walking straight while looking left. Continue alternating looking right and left every 3 steps until you have completed 2 repetitions in each direction.*

Grading: Mark the highest category that applies.

(3) Normal—Performs head turns smoothly with no change in gait. Deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.

(2) Mild impairment—Performs head turns smoothly with slight change in gait velocity (eg, minor disruption to smooth gait path), deviates 15.24–25.4 cm (6–10 in) outside 30.48-cm (12-in) walkway width, or uses an assistive device.

(1) Moderate impairment—Performs head turns with moderate change in gait velocity, slows down, deviates 25.4–38.1 cm (10–15 in) outside 30.48-cm (12-in) walkway width but recovers, can continue to walk.

(0) Severe impairment—Performs task with severe disruption of gait (eg, staggers 38.1 cm [15 in] outside 30.48-cm (12-in) walkway width, loses balance, stops, or reaches for wall).

**_____4. GAIT WITH VERTICAL HEAD TURNS**

Instructions: *Walk from here to the next mark (6 m [20 ft]). Begin walking at your normal pace. Keep walking straight; after 3 steps, tip your head up and keep walking straight while looking up. After 3 more steps, tip your head down, keep walking straight while looking down. Continue alternating looking up and down every 3 steps until you have completed 2 repetitions in each direction.*

Grading: Mark the highest category that applies.

(3) Normal—Performs head turns with no change in gait. Deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.

(2) Mild impairment—Performs task with slight change in gait velocity (eg, minor disruption to smooth gait path), deviates 15.24–25.4 cm (6–10 in) outside 30.48-cm (12-in) walkway width or uses assistive device.

(1) Moderate impairment—Performs task with moderate change in gait velocity, slows down, deviates 25.4–38.1 cm (10–15 in) outside 30.48-cm (12-in) walkway width but recovers, can continue to walk.

(0) Severe impairment—Performs task with severe disruption of gait (eg, staggers 38.1 cm [15 in] outside 30.48-cm (12-in) walkway width, loses balance, stops, reaches for wall).

**_____5. GAIT AND PIVOT TURN**
Instructions: *Begin with walking at your normal pace. When I tell you, "turn and stop," turn as quickly as you can to face the opposite direction and stop.*

Grading: Mark the highest category that applies.

(3) Normal—Pivot turns safely within 3 seconds and stops quickly with no loss of balance.

(2) Mild impairment—Pivot turns safely in >3 seconds and stops with no loss of balance, or pivot turns safely within 3 seconds and stops with mild imbalance, requires small steps to catch balance.

(1) Moderate impairment—Turns slowly, requires verbal cueing, or requires several small steps to catch balance following turn and stop.

(0) Severe impairment—Cannot turn safely, requires assistance to turn and stop.

**_____6. STEP OVER OBSTACLE**
Instructions: *Begin walking at your normal speed. When you come to the shoe box, step over it, not around it, and keep walking.*

Grading: Mark the highest category that applies.

(3) Normal—Is able to step over 2 stacked shoe boxes taped together (22.86 cm [9 in] total height) without changing gait speed; no evidence of imbalance.

(2) Mild impairment—Is able to step over one shoe box (11.43 cm [4.5 in] total height) without changing gait speed; no evidence of imbalance.

(1) Moderate impairment—Is able to step over one shoe box (11.43 cm [4.5 in] total height) but must slow down and adjust steps to clear box safely. May require verbal cueing.

(0) Severe impairment—Cannot perform without assistance.

**_____7. GAIT WITH NARROW BASE OF SUPPORT**
Instructions: *Walk on the floor with arms folded across the chest, feet aligned heel to toe in tandem for a distance of 3.6 m [12 ft]. The number of steps taken in a straight line are counted for a maximum of 10 steps.*

Grading: Mark the highest category that applies.

(3) Normal—Is able to ambulate for 10 steps heel to toe with no staggering.

(2) Mild impairment—Ambulates 7–9 steps.

(1) Moderate impairment—Ambulates 4–7 steps.

(0) Severe impairment—Ambulates less than 4 steps heel to toe or cannot perform without assistance.

**_____8. GAIT WITH EYES CLOSED**
Instructions: *Walk at your normal speed from here to the next mark (6 m [20 ft]) with your eyes closed.*

Grading: Mark the highest category that applies.

(3) Normal—Walks 6 m (20 ft), no assistive devices, good speed, no evidence of imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width. Ambulates 6 m (20 ft) in less than 7 seconds.

(2) Mild impairment—Walks 6 m (20 ft), uses assistive device, slower speed, mild gait deviations, deviates 15.24–25.4 cm(6–10 in) outside 30.48-cm (12-in) walkway width. Ambulates 6 m (20 ft) in less than 9 seconds but greater than 7 seconds.

(1) Moderate impairment—Walks 6 m (20 ft), slow speed, abnormal gait pattern, evidence for imbalance, deviates 25.4–38.1cm (10–15 in) outside 30.48-cm (12-in) walkway width. Requires more than 9 seconds to ambulate 6 m (20 ft).

(0) Severe impairment—Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width or will not attempt task.

**_____9. AMBULATING BACKWARDS**
Instructions: *Walk backwards until I tell you to stop.*

Grading: Mark the highest category that applies.

(3) Normal—Walks 6 m (20 ft), no assistive devices, good speed, no evidence for imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.

(2) Mild impairment—Walks 6 m (20 ft), uses assistive device, slower speed, mild gait deviations, deviates 15.24–25.4 cm (6–10 in) outside 30.48-cm (12-in) walkway width.

(1) Moderate impairment—Walks 6 m (20 ft), slow speed, abnormal gait pattern, evidence for imbalance, deviates 25.4–38.1 cm (10–15 in) outside 30.48-cm (12-in) walkway width.

(0) Severe impairment—Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width or will not attempt task.

**_____10. STEPS**
Instructions: *Walk up these stairs as you would at home (ie, using the rail if necessary). At the top turn around and walk down.*

Grading: Mark the highest category that applies.

(3) Normal—Alternating feet, no rail.

(2) Mild impairment—Alternating feet, must use rail.

(1) Moderate impairment—Two feet to a stair; must use rail.

(0) Severe impairment—Cannot do safely.

**TOTAL SCORE: _____ MAXIMUM SCORE 30**

# APPENDIX D

# 30-SECOND CHAIR STAND TEST

## Appendix D

## 30-Second Chair Stand Test

Chair height: 17" (43 cm), placed against wall for stability
Starting position: sitting in the middle of the chair, back straight, arms crossed over chest, feet flat on floor.

1. Take resting vital signs.
2. Demonstrate the movement, first slowly, then quickly.
3. Have the patient/client practice one or two repetitions to ensure proper form, and adequate balance
4. On the signal "go" the patient/client rises to a full stand, then returns to a fully seated position, as many times as possible in 30 seconds.
5. If a person is more than half way up at the end of the 30 seconds, count it as a full stand.
6. One trial.
7. Take post exercise vital signs.
8. Document any modifications (chair height, assistance needed)

| Range of scores is between the 25% and 75% percentiles | | |
|---|---|---|
| **Age** | **Men: number of stands** | **Women: number of stands** |
| 60 - 64 | 14 - 19 | 12 - 17 |
| 65 - 79 | 12 - 18 | 11 - 16 |
| 70 - 74 | 12 - 17 | 10 -15 |
| 75 - 79 | 11 - 17 | 10 - 15 |
| 80 - 84 | 10 - 15 | 9 - 14 |
| 85 - 89 | 8 - 14 | 8 - 13 |
| 90 - 95 | 7 - 12 | 4 - 11 |

Scores less than 8 (unassisted) stands were associated with lower levels of functional ability

Population:

- community residing older adults ages 60-94

- n = 7,183 5,048 women, 2,135 men
- years education: 14.5
- chronic conditions: 1.7
- medications: 1.6
- performed moderate exercise ≥3 times/week: 65%

Exclusion criteria:

- advised not to exercise by physician
- CHF, joint pain, chest pain, dizziness, angina during exercise
- BP > 160/100

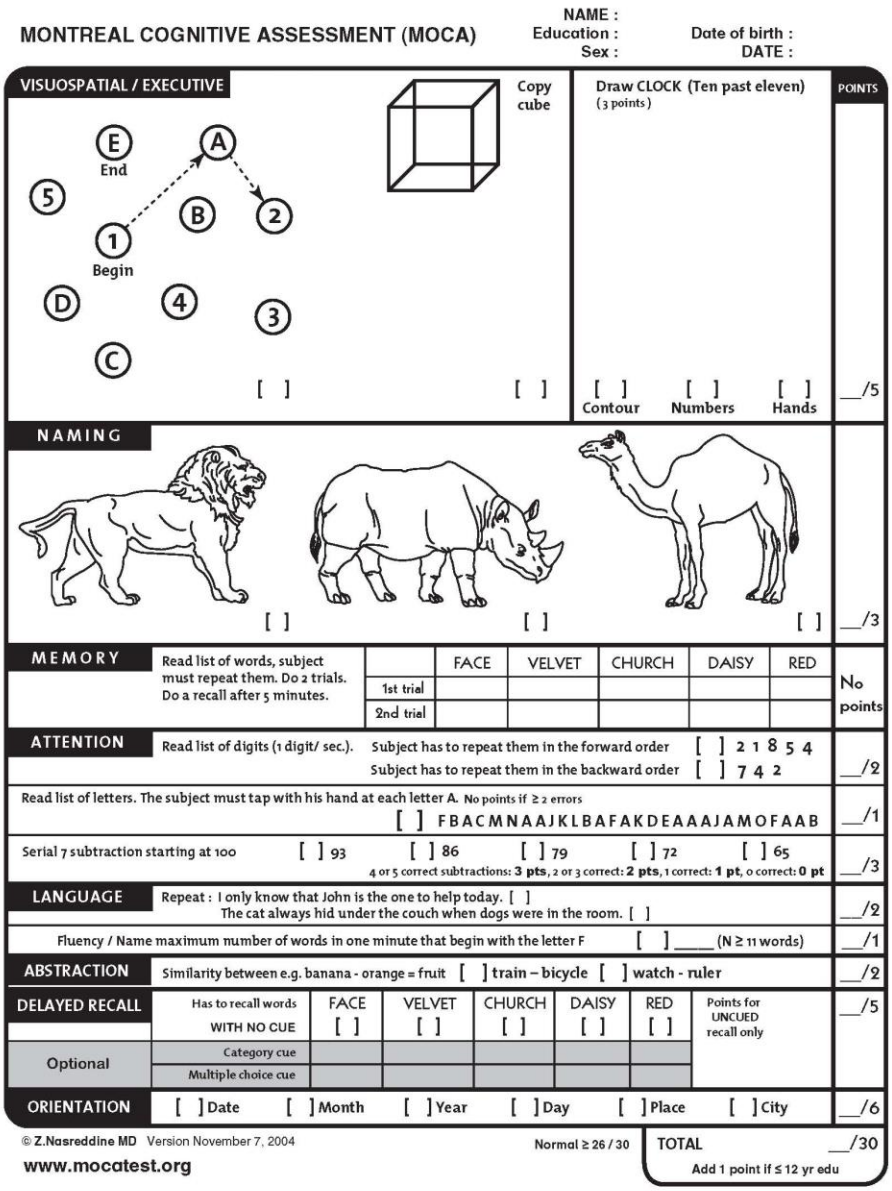
Rikli RE, Jones CJ (1999). Functional fitness normative scores for community residing older adults ages 60-94. Journal of Aging and Physical Activity, 7, 160-179.

# APPENDIX E

# MONTREAL COGNITIVE ASSESSMENT

# Appendix E

## Montreal Cognitive Assessment



MONTREAL COGNITIVE ASSESSMENT (MOCA)

NAME :
Education :
Sex :
Date of birth :
DATE :

**VISUOSPATIAL / EXECUTIVE** — POINTS

Copy cube

Draw CLOCK (Ten past eleven) (3 points)

E End, A, 5, B, 2, 1 Begin, D, 4, 3, C

[ ] [ ]

[ ] Contour [ ] Numbers [ ] Hands

__/5

**NAMING**

[ ] [ ] [ ]

__/3

**MEMORY** — Read list of words, subject must repeat them. Do 2 trials. Do a recall after 5 minutes.

| | FACE | VELVET | CHURCH | DAISY | RED |
|---|---|---|---|---|---|
| 1st trial | | | | | |
| 2nd trial | | | | | |

No points

**ATTENTION**

Read list of digits (1 digit/ sec.). Subject has to repeat them in the forward order [ ] 2 1 8 5 4

Subject has to repeat them in the backward order [ ] 7 4 2

__/2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

__/1

Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt**

__/3

**LANGUAGE** — Repeat : I only know that John is the one to help today. [ ]

The cat always hid under the couch when dogs were in the room. [ ]

__/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] ____ (N ≥ 11 words)

__/1

**ABSTRACTION** — Similarity between e.g. banana - orange = fruit [ ] train – bicycle [ ] watch - ruler

__/2

**DELAYED RECALL**

| | Has to recall words WITH NO CUE | FACE [ ] | VELVET [ ] | CHURCH [ ] | DAISY [ ] | RED [ ] | Points for UNCUED recall only |
|---|---|---|---|---|---|---|---|
| Optional | Category cue | | | | | | |
| | Multiple choice cue | | | | | | |

__/5

**ORIENTATION** [ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City

__/6

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Normal ≥ 26 / 30

TOTAL __/30

Add 1 point if ≤ 12 yr edu

**Montreal Cognitive Assessment (MoCA)**

**Administration and Scoring Instructions**

The Montreal Cognitive Assessment (MoCA) was designed as a rapid screening instrument for mild cognitive dysfunction. It assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation. Time to administer the MoCA is approximately 10 minutes. The total possible score is 30 points; a score of 26 or above is considered normal.

**1. Alternating Trail Making:**

Administration: The examiner instructs the subject: *"Please draw a line, going from a number to a letter in ascending order. Begin here* [point to (1)] *and draw a line from 1 then to A then to 2 and so on. End here* [point to (E)]."

Scoring: Allocate one point if the subject successfully draws the following pattern:
1 □A- 2- B- 3- C- 4- D- 5- E, without drawing any lines that cross. Any error that is not immediately self-corrected earns a score of 0.

**2. Visuoconstructional Skills (Cube):**

Administration: The examiner gives the following instructions, pointing to the **cube**: *"Copy this drawing as accurately as you can, in the space below".*

Scoring: One point is allocated for a correctly executed drawing.

- Drawing must be three-dimensional
- All lines are drawn
- No line is added
- Lines are relatively parallel and their length is similar (rectangular prisms are accepted)

A point is not assigned if any of the above-criteria are not met.

**3. Visuoconstructional Skills (Clock):**

Administration: Indicate the right third of the space and give the following instructions:
*"Draw a **clock**. Put in all the numbers and set the time to 10 after 11".*

Scoring: One point is allocated for each of the following three criteria:

- Contour (1 pt.): the clock face must be a circle with only minor distortion

acceptable (e.g., slight imperfection on closing the circle);

- Numbers (1 pt.): all clock numbers must be present with no additional numbers; numbers must be in the correct order and placed in the approximate quadrants on the clock face; Roman numerals are acceptable; numbers can be placed outside the circle contour;
- Hands (1 pt.): there must be two hands jointly indicating the correct time; the hour hand must be clearly shorter than the minute hand; hands must be centred within the clock face with their junction close to the clock centre.

A point is not assigned for a given element if any of the above-criteria are not met.

**4. Naming:**

Administration: Beginning on the left, point to each figure and say: *"Tell me the name of this animal".*

Scoring: One point each is given for the following responses: (1) camel or dromedary, (2) lion, (3) rhinoceros or rhino.

**5. Memory:**

Administration: The examiner reads a list of 5 words at a rate of one per second, giving the following instructions: *"This is a memory test. I am going to read a list of words that you will have to remember now and later on. Listen carefully. When I am through, tell me as many words as you can remember. It doesn't matter in what order you say them".* Mark a check in the allocated space for each word the subject produces on this first trial. When the subject indicates that (s)he has finished (has recalled all words), or can recall no more words, read the list a second time with the following instructions: "*I am going to read the same list for a second time. Try to remember and tell me as many words as you can, including words you said the first time."* Put a check in the allocated space for each word the subject recalls after the second trial.

At the end of the second trial, inform the subject that (s)he will be asked to recall these words again by saying, "*I will ask you to recall those words again at the end of the test."*

Scoring: No points are given for Trials One and Two.

**6. Attention:**

Forward Digit Span: Administration: Give the following instruction: "*I am going to say some numbers and when I am through, repeat them to me exactly as I said them".* Read the five number sequence at a rate of one digit per second.

Backward Digit Span: Administration: Give the following instruction: "*Now I am going to say some more numbers, but when I am through you must repeat them to me in the backwards order."* Read the three number sequence at a rate of one digit per second.

Scoring: Allocate one point for each sequence correctly repeated, (*N.B.:* the correct response for the backwards trial is 2-4-7).

Vigilance: Administration: The examiner reads the list of letters at a rate of one per second, after giving the following instruction: "*I am going to read a sequence of letters. Every time I say the letter A, tap your hand once. If I say a different letter, do not tap your hand".*

Scoring: Give one point if there is zero to one errors (an error is a tap on a wrong letter or a failure to tap on letter A).

Serial 7s: Administration: The examiner gives the following instruction: "*Now, I will ask you to count by subtracting seven from 100, and then, keep subtracting seven from your answer until I tell you to stop."* Give this instruction twice if necessary.

Scoring: This item is scored out of 3 points. Give no (0) points for no correct subtractions, 1 point for one correction subtraction, 2 points for two-to-three correct subtractions, and 3 points if the participant successfully makes four or five correct subtractions. Count each correct subtraction of 7 beginning at 100. Each subtraction is evaluated independently; that is, if the participant responds with an incorrect number but continues to correctly subtract 7 from it, give a point for each correct subtraction. For example, a participant may respond "92 – 85 – 78 – 71 – 64" where the "92" is incorrect, but all subsequent numbers are subtracted correctly. This is one error and the item would be given a score of 3.

**7. Sentence repetition:**

Administration: The examiner gives the following instructions: "*I am going to read you a sentence. Repeat it after me, exactly as I say it* [pause]*:* ***I only know that John is the one to help today.*****"** Following the response, say: "*Now I am going to read you another sentence. Repeat it after me, exactly as I say it* [pause]*:* ***The cat always hid under the couch when dogs were in the room.****"*

Scoring: Allocate 1 point for each sentence correctly repeated. Repetition must be exact. Be alert for errors that are omissions (e.g., omitting "only", "always") and substitutions/additions (e.g., "John is the one who helped today;" substituting "hides" for "hid", altering plurals, etc.).

**8. Verbal fluency:**

Administration: The examiner gives the following instruction: "*Tell me as many words as you can think of that begin with a certain letter of the alphabet that I will tell you in a moment. You can say any kind of word you want, except for proper nouns (like Bob or Boston), numbers, or words that begin with the same sound but have a different suffix, for example, love, lover, loving. I will tell you to stop after one minute. Are you ready?* [Pause] *Now, tell me as many words as you can think of that begin with the letter F*. [time for 60 sec]. *Stop."*

Scoring: Allocate one point if the subject generates 11 words or more in 60 sec. Record the subject's response in the bottom or side margins.

**9. Abstraction:**

Administration: The examiner asks the subject to explain what each pair of words has in common, starting with the example: "*Tell me how an orange and a banana are alike"*. If the subject answers in a concrete manner, then say only one additional time: "*Tell me another way in which those items are alike"*. If the subject does not give the appropriate response (*fruit*), say, "*Yes, and they are also both fruit.*" Do not give any additional instructions or clarification.

After the practice trial, say: "*Now, tell me how a train and a bicycle are alike".* Following the response, administer the second trial, saying: "*Now tell me how a ruler and a watch are alike".* Do not give any additional instructions or prompts.

Scoring: Only the last two item pairs are scored. Give 1 point to each item pair correctly answered. The following responses are acceptable:

Train-bicycle = means of transportation, means of travelling, you take trips in both; Ruler-watch = measuring instruments, used to measure.

The following responses are **not** acceptable: Train-bicycle = they have wheels; Ruler-watch = they have numbers.

**10. Delayed recall:**

Administration: The examiner gives the following instruction: "*I read some words to you earlier, which I asked you to remember. Tell me as many of those words as you can remember*. Make a check mark (✓) for each of the words correctly recalled spontaneously without any cues, in the allocated space.

Scoring: **Allocate 1 point for each word recalled freely without any cues**.

**Optional:**

Following the delayed free recall trial, prompt the subject with the semantic category cue provided below for any word not recalled. Make a check mark (✓) in the allocated space if the subject remembered the word with the help of a category or multiple-choice cue. Prompt all non-recalled words in this manner. If the subject does not recall the word after the category cue, give him/her a multiple choice trial, using the following example instruction, "*Which of the following words do you think it was, NOSE, FACE, or HAND?"*

Use the following category and/or multiple-choice cues for each word, when appropriate: FACE: category cue: part of the body multiple choice: nose, face, hand VELVET: category cue: type of fabric multiple choice: denim, cotton, velvet CHURCH: category cue: type of building multiple choice: church, school, hospital DAISY: category cue: type of flower multiple choice: rose, daisy, tulip

RED: category cue: a colour multiple choice: red, blue, green

Scoring: **No points are allocated for words recalled with a cue.** A cue is used for clinical information purposes only and can give the test interpreter additional information about the type of memory disorder. For memory deficits due to retrieval failures, performance can be improved with a cue. For memory deficits due to encoding failures, performance does not improve with a cue.

**11. Orientation:**

Administration: The examiner gives the following instructions: "*Tell me the date today"*. If the subject does not give a complete answer, then prompt accordingly by saying: *"Tell me the [year, month, exact date, and day of the week]."* Then say: *"Now, tell me the name of this place, and which city it is in."*

Scoring: Give one point for each item correctly answered. The subject must tell the exact date and the exact place (name of hospital, clinic, office). No points are allocated if subject makes an error of one day for the day and date.

**TOTAL SCORE:** Sum all subscores listed on the right-hand side. Add one point for an individual who has 12 years or fewer of formal education, for a possible maximum of 30 points. A final total score of 26 and above is considered normal.

# APPENDIX F

# SATISFACTION WITH LIFE SCALE

## Appendix F

## Satisfaction with Life Scale

Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

- 7 - Strongly agree
- 6 - Agree
- 5 - Slightly agree
- 4 - Neither agree nor disagree
- 3 - Slightly disagree
- 2 - Disagree
- 1 - Strongly disagree

____ In most ways my life is close to my ideal.
____ The conditions of my life are excellent.
____ I am satisfied with my life.
____ So far I have gotten the important things I want in life.
____ If I could live my life over, I would change almost nothing.

- 31 - 35 Extremely satisfied
- 26 - 30 Satisfied
- 21 - 25 Slightly satisfied
- 20 Neutral
- 15 - 19 Slightly dissatisfied
- 10 - 14 Dissatisfied
- 5 - 9 Extremely dissatisfied

# APPENDIX G

# DEMOGRAPHIC FORM

## Appendix G

## Demographic form

**Participant ID:**

**Date of Birth**: _____/_____/_____

**Gender**: Male / Female

**Ethnic/Racial Background:**

- African American/Black
- Hispanic
- Caucasian
- Asian
- Indian
- American Indian
- Middle Eastern
- Unknown or not reported
- More than one race
- Prefer not to answer

**Handedness**:

- Left-handed
- Right-handed
- Ambidextrous

**Vision**:

- 20/20 Uncorrected Vision
- Corrected vision with contact lenses
- Corrected vision with glasses
- Uncorrected visual problems

**Education**

- Did not finish high school
- High school graduate
- Some college
- Graduated college or technical school

- Some graduate school
- Masters
- Doctorate

**Marital Status**

- Single (never married)
- Married
- Divorced
- Widowed

**Gaming Experience (including gaming systems and computer or online games)**

- Never participated in computer or digital gaming
- Sometimes participate in computer or digital gaming (1-2x/week)
- Occasionally participate in computer or digital gaming (3-5x/week)
- Frequently participate in computer or digital gaming (near daily)

**Mind-Body Practice Experience (including Tai Chi or yoga)**

- Never participated in mind-body practice
- Sometimes participate in mind-body practice (1-2x/week)
- Occasionally participate in mind-body practice (3-5x/week)
- Frequently participate in mind-body practice (near daily)

**Community Involvement (including religious affiliations, exercise groups, social activities, meals with friends, etc)**

- Never participate in community activities
- Sometimes participate in community activities (1-2x/week)
- Occasionally participate in community activities (3-5x/week)
- Frequently participate in community activities (near daily)

# VITA

Jessica Hackathorne grew up as an Army brat and the middle child of Bob and Sabina Wank. She attended the University of Michigan for her undergraduate degree, studying in the Division of Kinesiology. She opted to stay close to Ann Arbor to pursue her Masters of Occupational Therapy at Eastern Michigan University. During her 20 year OT career, she has worked in outpatient neurological settings, inpatient acute rehabilitation hospitals, and acute care settings. She specialized in working with individuals with neurological disorders, and her passion is working with individuals with spinal cord injury or stroke. After moving with her spouse and two boys to Chattanooga, TN, she embarked on a new professional challenge and became an instructor in a doctorate of occupational therapy program. She maintains clinical practice in an inpatient rehabilitation center. During this time of transition from clinic to classroom, she began to pursue her Ph.D. in Learning and Leadership at the University of Tennessee at Chattanooga.