
Electronic Theses and Dissertations, 2004-2019

2017

The Influences of Mindfulness and Neuromotor Exercise Mode on Balance in Healthy Older Adults

Maxine Hicks
University of Central Florida



Part of the [Nursing Commons](#)

Find similar works at: <https://stars.library.ucf.edu/etd>

University of Central Florida Libraries <http://library.ucf.edu>

This Doctoral Dissertation (Open Access) is brought to you for free and open access by STARS. It has been accepted for inclusion in Electronic Theses and Dissertations, 2004-2019 by an authorized administrator of STARS. For more information, please contact STARS@ucf.edu.

STARS Citation

Hicks, Maxine, "The Influences of Mindfulness and Neuromotor Exercise Mode on Balance in Healthy Older Adults" (2017). *Electronic Theses and Dissertations, 2004-2019*. 5739.

<https://stars.library.ucf.edu/etd/5739>

THE INFLUENCES OF MINDFULNESS AND NEUROMOTOR EXERCISE MODE
ON BALANCE IN HEALTHY OLDER ADULTS

by

MAXINE M. HICKS

B.Sc. University of Toronto, 1986

B.S.N. University of Central Florida, 1993

M.S.N. University of South Florida, 1995

A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the College of Nursing
at the University of Central Florida
Orlando, Florida

Fall Term
2017

Major Professor: Susan K. Chase

©2017 Maxine M. Hicks

ABSTRACT

This study investigated the roles of mindfulness and balance to optimize strategies for fall prevention in healthy older adults. The purpose of this study was to examine the association of mindfulness with respect to balance in healthy older adults who are experienced in meditative versus non-meditative modes of neuromotor exercise. This was a comparative descriptive study that used a convenience sample of N=86 older adults (20 male; mean age = 69.33 ± 7.24 ; range: 60 – 93 years). The sample included experienced participants of meditative (e.g., yoga, Tai chi) and non-meditative (e.g., partnered dance) neuromotor exercise recruited from community yoga, Tai chi, and dance studios, respectively. The variables of mindfulness, age, and sex were examined as predictors of the outcome variable of balance. Dispositional mindfulness was measured with the Mindful Attention Awareness Scale, and postural balance was assessed using the One-legged Stance Test, a measure of the number of seconds a participant can stand on one with eyes closed. Multiple regression analyses were used to answer the research questions. The results did not reveal either mode of neuromotor exercise to predict balance better; neither age nor sex was a moderator of mindfulness, and mindfulness did not act as a mediator between age, sex, and balance. What the findings did reveal were higher levels of balance and mindfulness amongst study participants compared to normative community-dwelling populations from the published literature. Next, balance was found to decrease with increasing age and was greater in males than females. Most remarkably, dancers were found to have significantly higher levels of mindfulness than Tai chi and yoga participants, which suggests that formal meditation may not be an essential component of neuromotor exercise for the cultivation of mindfulness. The results have important implications for theory, research, practice, and policy.

I dedicate this dissertation to my parents. To my mother for encouraging me, from the age of six, to follow the same path as Mike and ultimately become Dr. Bear; to my father for buying me a desk and a chair with the hopes that I would someday use them to write my dissertation.

ACKNOWLEDGMENTS

Now that all is done, I can take a moment and appreciate how the knowledge of each course that I took and each book and article that I read, culminates to contribute to this fantastic final product. While I often thought this journey would last forever, I now realize there are a few things that I am going to miss. The most valued will be the guidance and support that I had received from my chair and committee members. These were exceptional individuals that enriched my experience. First, I would like to extend my gratitude to my advisor, Dr. Susan Chase. I was pleased that she was open to ideas that some would consider unconventional, she often offered valuable insights and together we enjoyed some fascinating discussions. Dr. Chase is an excellent educator; I benefited from her guidance as I began my teaching career halfway through my program. I also had the good fortune of having Dr. Angeline Bushy on my committee. I enjoyed her vibrant energy, and I am deeply indebted to her for all the invaluable feedback and suggestions she provided throughout the dissertation process. Dr. Lori Forlaw, a guru of mindfulness, provided me the opportunity to spend an entire summer with her for my independent study. During this time, she let me pick her brain about a variety of topics and offered me some interesting perspectives. Dr. Jennifer Mundale was my external committee member from the department of philosophy. How can one have a Ph.D. committee without a philosopher? Dr. Mundale had a provocative way of looking at things; she was a master at opening one's mind and then adding a twist.

In addition, I would like to acknowledge Dr. Linda Miles of Daytona State College for her tremendous support and encouragement over the past three years. I would also like to thank Marta Pascale for going above and beyond in helping me to reach out to so many dancers.

Finally, I would like to extend my deepest and most loving gratitude to my amazing husband, Eugene, for supporting me in every possible way and never giving up.

TABLE OF CONTENTS

LIST OF FIGURES	xii
LIST OF TABLES	xiii
LIST OF DEFINITIONS	xiv
CHAPTER 1: INTRODUCTION	1
1.1 Background	1
1.2 Neuromotor Exercise and Balance	2
1.3 Mindfulness and Exercise	2
1.4 Knowledge Gaps	3
1.5 Aims	4
1.6 Research Questions	6
1.7 Significance of the Study	6
1.8 Outline of the study	7
CHAPTER 2: REVIEW OF THE LITERATURE	9
2.1 Balance	9
2.1.1 Proprioceptive System	10
2.1.2 Visual System	10
2.1.3 Vestibular System	10
2.1.4 Sensorimotor System Comparative Studies	11

2.1.5	Motor System.....	12
2.1.6	The Measurement of Balance	12
2.1.7	Attention and Balance.....	14
2.2	Mindfulness.....	15
2.3	Neuromotor Exercise.....	17
2.3.1	Mind-Body Practices	18
2.3.2	Proprioceptive Balance, Mindfulness, and Neuromotor Exercise	20
2.4	Conceptual Framework	22
2.4.1	Mindfulness Based Stress Reduction Model	22
2.4.2	Self-Determination Theory	27
2.4.3	An Integrated Approach.....	31
2.4.4	The Mindfulness Cultivation Model.....	31
2.5	Issues of Debate	36
2.5.1	Attentional focus.....	36
2.5.2	Mindfulness induction	37
2.5.3	Related Research.....	38
2.6	Conclusion.....	40
CHAPTER 3: METHODOLOGY		41
3.1	Design.....	41

3.2	Sample.....	41
3.2.1	Eligibility and Exclusionary Criteria	42
3.3	Participant Recruitment.....	42
3.4	Measures for Protection of Human Subjects.....	43
3.5	Setting.....	44
3.6	Instruments	44
3.6.1	Demographic Questionnaire	44
3.6.2	Mindful Attention Awareness Scale (MAAS).....	45
3.7	Data Collection Procedures	46
3.7.1	Questionnaires.....	46
3.8	Physiological Measures.....	46
3.8.1	Body Composition	46
3.8.2	One-Legged Stance Test (OLST)	47
3.9	Limitations	48
3.10	Data Analysis Procedures.....	50
3.10.1	Variables	50
3.10.2	Preliminary Data Analysis	50
3.10.3	Principal Data Analysis.....	51
CHAPTER 4: RESULTS		53

4.1	Introduction	53
4.2	Data Collection.....	53
4.3	Preliminary Data Analysis	53
4.3.1	Outliers.....	54
4.3.2	Descriptive statistics	57
4.3.3	Reliability analysis.....	59
4.4	Principal Data Analysis.....	59
4.4.1	Assumptions of multiple regression analysis.....	59
4.4.2	Research Question One.....	62
4.4.3	Research Question Two	68
4.4.4	Research Question Three	71
4.5	Summary	73
CHAPTER 5: DISCUSSION.....		75
5.1	Introduction	75
5.2	Summary of the Findings	75
5.3	Interpretation of the Findings.....	77
5.4	Limitations of the Study.....	82
5.5	Recommendations	84
5.5.1	Theoretical Implications	84

5.5.2	Research.....	87
5.5.3	Practice.....	88
5.5.4	Policy	89
5.6	Conclusions	91
APPENDIX A: BALLROOM DANCE FLYER.....		92
APPENDIX B: TAI CHI & YOGA FLYER		94
APPENDIX C: CONSENT FORM		96
APPENDIX D: DEMOGRAPHIC INFORMATION FORM		102
APPENDIX E: PERMISSION TO USE THE MINDFUL ATTENTION AWARENESS SCALE		106
APPENDIX F: MINDFUL ATTENTION AWARENESS SCALE		108
APPENDIX G: CITI TRAINING CERTIFICATE		111
APPENDIX H: IRB APPROVAL LETTER		113
APPENDIX I: SUPPLEMENTARY TABLES		118
APPENDIX J: SUPPLEMENTARY FIGURES		125
REFERENCES		134

LIST OF FIGURES

Figure 1 Mediator model	5
Figure 2 Moderator model	5
Figure 3 Mindfulness Motivation Model.....	35
Figure 4 Histograms of the variable OLST by frequency.....	56
Figure 5 Scatterplot Graph.....	60

LIST OF TABLES

Table 1 Attitudes that Ground the Mindfulness Based Stress Reduction Model	24
Table 2 Self-Determination Theory (SDT) Sub-theories.....	28
Table 3 Zero-order Pearson Correlations Between the Study Variables (N=86)	61
Table 4 Summary for the Regression of OLST on Predictor Variables	64
Table 5 Hierarchical Regression Analysis Summary for the Main Study and Demographic Variables Predicting OLST.....	65
Table 6 Hierarchical Regression Analysis Summary for the Main Study and Demographic Variables Predicting OLST (Concise Model).....	66
Table 7 Multiple Regression Summary for the Mediation Model.....	69
Table 8 Hierarchical Multiple Regression Summary for OLST Predicted from Age, MAAS, and Age X MAAS	72
Table 9 Hierarchical Multiple Regression Summary for OLST Predicted from Sex, MAAS, and Sex X MAAS	73

LIST OF DEFINITIONS

Balance

- Theoretical Definition For the purpose of this study, balance will pertain specifically to postural balance, which is defined as the ability of the body to regulate its center of mass within its base of support while maintaining stability (Alexander, 1994; Tyson & Connell, 2009).
- Operational Definition Balance will be operationally defined as the number of seconds a participant can stand on one leg with their eyes closed without touching the floor with the opposite leg (Springer, Marin, Cyhan, Roberts & Gill, 2007).

Mindfulness

- Theoretical Definition For the purpose of this study, mindfulness is defined as an open awareness that evolves from attention in the present moment, to physical, psychological, and environmental cues, integrated with the self-regulation of behavior for optimal well-being outcomes (Brown & Ryan, 2003; Kabat-Zinn, 1990)
- Operational Definition Mindfulness will be operationally defined as a high mean score on the Mindful Attention Awareness Scale.

Meditative Movement Exercise

- Theoretical Definition In this study, meditative movement neuromotor exercise is based on Larkey (2009) who defined it as the integration and conscious regulation of breathing with movement postures that can be either dynamic or static leading to a state of deep relaxation.
- Operational Definition For the purpose of this study, meditative movement neuromotor exercise is operationally defined as the practice of Tai chi or yoga.

Non-Meditative Movement Exercise

- Theoretical Definition In this study, non-meditative neuromotor exercise will be defined as forms of neuromotor exercise that do not involve meditative movement. In contrast to Tai chi, ballroom dance is an example of a form of neuromotor exercise not conventionally associated with meditation.
- Operational Definition For the purpose of this study, non-meditative movement neuromotor exercise is operationally defined as classes of dance limited to partnered dance (e.g. ballroom, tango, salsa).
-

CHAPTER 1: INTRODUCTION

1.1 Background

Globally, falls are a leading cause of injury-related mortality and morbidity (World Health Organization [WHO], 2017) and in the United States, affect one of every four adults over the age of 65, annually (Centers for Disease Control and Prevention [CDC], 2016). As the aging population continues to grow, the burden of fall-related injuries on societal and healthcare systems present an immediate concern. It is predicted in the U.S. that medical costs associated with falls adults aged 65 and older, will be close to \$67.7 billion by 2020 (CDC, 2017). Fractures and brain trauma are reported to be the most common fall-related injuries in older adults (CDC, 2016).

Common risk factors associated with falling include increased age, female sex, balance impairments, disability associated with chronic illness, obesity, medication use, ethnicity, and psychosocial factors, such as anxiety and depression (Painter, Dhingra, Daughtery, Cogdill, & Trujillo, 2012). Obesity has been reported to be associated with functional disability and falls in older adults (Batsis et al., 2014; Himes & Reynolds, 2012). While a relationship between obesity and falls has been found in older adults, obesity may not be a direct factor in a person falling. Potential mediators include chronic illness, physical inactivity, and pain (Mitchell et al., 2015). Medication side effects have been found particularly problematic when an individual takes four or more medications daily (O'Halloran et al., 2011; Chang & Do, 2015).

A unique relationship exists between falls and ethnicity, with lower fall rates reported among African Americans compared to Caucasians (Alamgir, Muazzam & Nasullah, 2012; Nicklett & Taylor, 2014). Remarkably, a recent examination of data from the National Health

and Aging Trends Study (NHATS) revealed that African Americans have a 30 to 40% lower fall risk than Caucasians (Sun et al., 2016). In comparison, Hispanic and Caucasian fall rates have been found to be similar (Han et al., 2014). Finally, it is important to note that although female sex is commonly reported as a fall risk factor, conflicting results across recent studies (see Chapter Two) warrant further investigation on the association between the factors of sex, age, and balance for predicting falls in older adults.

1.2 Neuromotor Exercise and Balance

Despite the growing prevalence of falls, research has shown that falls can be preventable. One effective fall prevention strategy recommended by the American College of Sports Medicine (ACSM) is the regular practice of neuromotor exercise (e.g. Tai chi, yoga, qigong). Neuromotor exercise, formerly known as functional fitness, is defined as a combination of motor skills, such as balance, agility, coordination, gait and proprioceptive training, to enhance functional ability in older adults (Garber, 2011). Neuromotor exercise has been found to be associated with improvements in balance, a protective factor against falls. (Chung et al., 2013; Lu et al., 2013; Tiedemann et al., 2013). Balance, as an outcome, has been studied using Tai chi (Jones, Dean, & Scudds, 2005), which is a neuromotor exercise described as a mindfulness-based form of meditative movement (Wayne et al., 2013).

1.3 Mindfulness and Exercise

The regular practice of meditative movement activities has been found to enhance the acquisition of mindfulness (Elder et al., 2007). Mindfulness is defined as an open awareness that evolves from attention in the present moment, to physical, psychological, and environmental

cues that are integrated with the self-regulation of behavior for optimal well-being outcomes (Brown & Ryan, 2003; Kabat-Zinn, 1990). With respect to mindfulness and exercise, meditative movement activities focus attention on sensations in the body and mind described as mindfulness, while facilitating the physical movements in progress (Wayne et al., 2013). In general, mindfulness-based interventions have been found to improve balance (Lu, Siu, Fu, Hui-Chan, & Tsang, 2013; Manor et al., 2014). Recent reports on demographic trends in complementary health approaches from the U. S. National Health Interview Survey (NHIS) of adults (n=88,962), aged 18 years and older, revealed the use of mindfulness practices (i.e., Tai chi, yoga, & qigong) to be low in older adults (Clarke et al., 2015), yet high in females (Olano et al., 2015). Remarkably, as discussed earlier, the results of studies of female sex on balance are conflicting, although older adult females are reported to engage in more mindfulness practices compared to males. The relationship between sex and age on postural balance remains unclear; however, little information is available regarding the influences of sex and age in mindfulness-based therapy (Greeson et al., 2015). Consequently, further study is needed of mindfulness practices, and in particular, the influence of sex and age on balance and mindfulness.

1.4 Knowledge Gaps

While mindfulness is commonly associated with meditative movement modalities of neuromotor exercise (National Center for Complementary and Integrative Health [NCCIH], 2013), it is unknown if it is also a component of non-meditative modalities of exercise, such as dance, including social dancing. It is important to explore whether mindfulness may function differently in non-meditative neuromotor activities. Although no known studies have investigated the association between mindfulness and balance through dance, the effectiveness of

dance as a strategy to improve balance is proposed in the literature. For instance, dance researchers suggest the increased value of mindfulness for improving position sense along with other factors related to a reduced fall risk for persons engaged in this activity (Batson, 2010; van Vugt, 2014). Gaining an understanding of the unique manner in which mindfulness may influence different modes of neuromotor exercise with respect to balance, may offer insights into programs that could reduce falls given the prevalence among older adult populations. Dance activities could be included as a strategy for reducing the risk for falls in older adults.

1.5 Aims

The overall aim of this study was to examine the influences on balance in healthy older adults. Specifically, it involved investigating the relationship between modes of neuromotor exercise and balance. Of specific interest is developing a greater understanding of mindfulness in mind-body exercise, particularly bringing to light the concept of mindfulness in neuromotor activities that lack “formal” meditative activity. At present, only one study has examined mindfulness in non-meditative movement neuromotor activity (Pinniger, Thorsteinsson, Brown, & McKinley, 2013), and no studies are known to have extended applications to balance. Thus, the purpose of this comparative descriptive study was to examine the association of mindfulness with respect to balance in healthy older adults who are experienced in meditative versus non-meditative modes of neuromotor exercise. Subsequently, mindfulness was studied in the role of a mediator to examine its influence on neuromotor exercise mode and balance (see Figure 1).

Associated with sex and age, a secondary goal was to determine if the relationships, if any, between neuromotor exercise mode, mindfulness and balance vary with sex and age. Demographic variables of sex and age were examined as moderators of neuromotor exercise

mode, mindfulness, and balance (see Figure 2). Another aim of this study was to examine predictors of balance and their interrelationships when considering modes of neuromotor exercise and mindfulness.

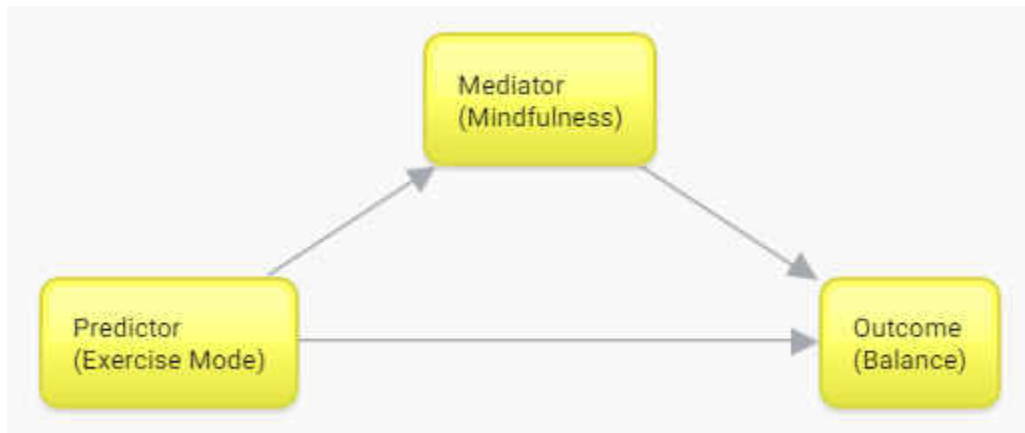


Figure 1 Mediator model

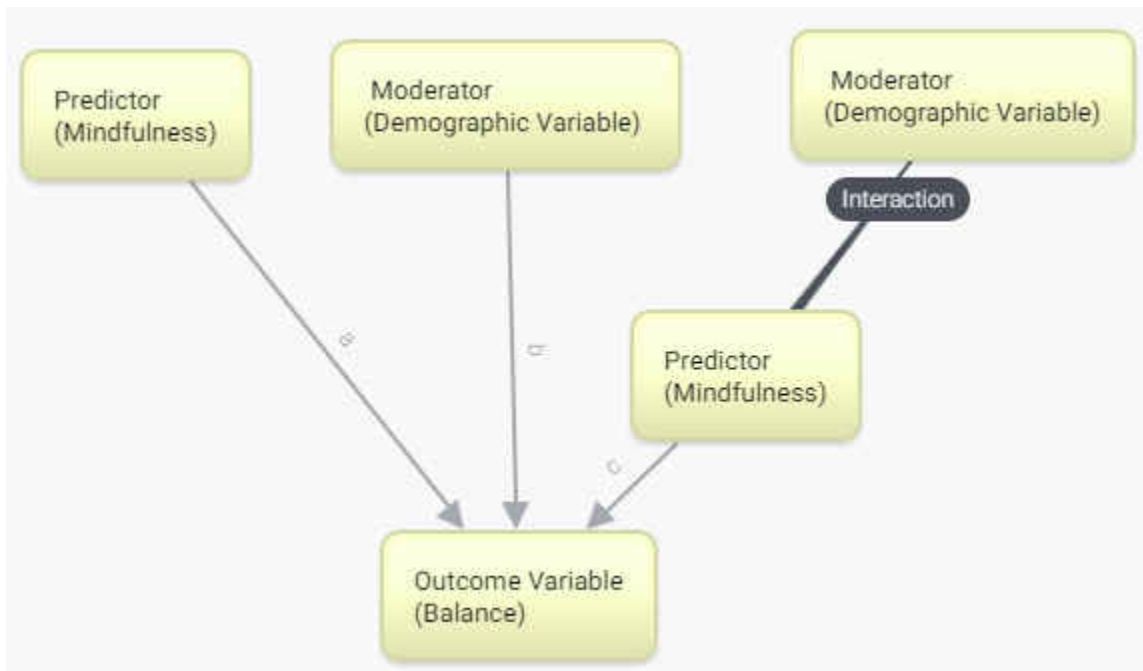


Figure 2 Moderator model

1.6 Research Questions

1. Does exercise mode predict balance in older adults who regularly practice neuromotor exercise?
2. Does mindfulness mediate the relationship, if any, between exercise mode and balance?
3. Do the demographic variables of age and sex moderate the relationship, if any, between mindfulness and balance?

1.7 Significance of the Study

This research contributes unique information focusing on mindfulness and its relationship to balance, along with the association of mindfulness to balance in neuromotor exercise modes that are not traditionally identified as a mindfulness or meditative activity (e.g., ballroom dance). Findings from this study offer insight into the proclivity to be mindful while practicing non-meditative neuromotor exercise. The results facilitate understanding how mindfulness that is cultivated through neuromotor exercise could translate into activities of daily life, which in turn opens new avenues for research.

Second, the findings have clinical relevance with regards to tailoring neuromotor activities to optimize balance and contribute to fall reduction in older adults. For instance, assessments could easily be performed in the clinical setting using mindfulness and balance scales to guide prescribing practices regarding the mode of neuromotor exercise most suited for individuals, including special considerations for age and sex.

Third, the study results provide knowledge to support policy changes, particularly regarding third party reimbursement for prescribed classes. Typically, classes for Tai chi, yoga

and dance are not covered by third party providers (Frankel, Bean, & Frontera, 2006). Further, research evidence provides support for neuromotor exercise as an important fall prevention strategy with demonstrable cost-effective benefits. More specifically, the evidence could influence the shaping of policies related to third party reimbursement for individual and community neuromotor exercise classes that are prescribed by healthcare providers as a strategy for fall prevention. In the long term, more efficient fall prevention strategies should lessen the burden of illness and healthcare costs, and improve the quality of life for older adults. Future research areas include the development of tailored exercise interventions for older adults diagnosed with cognitive impairment (e.g. Parkinson's disease, Alzheimer's disease).

1.8 Outline of the study

To summarize, this chapter provided an overview of mindfulness activities that can reduce falls among older adults, and theoretical definitions are identified. The second chapter presents a review of the literature that offers an interdisciplinary perspective through the integration of research from the areas of physical activity, dance, philosophy, psychology, neuroscience, and aging. The review focuses on the concepts of mindfulness defined in the first chapter, neuromotor exercise and balance and the synthesis of research on issues and factors associated with these concepts specific to healthy older adult populations. In addition, a conceptual framework is introduced, which is an integration of principles from Kabat-Zinn's (1990) Mindfulness-Based Stress Reduction (MBSR) model and Deci and Ryan's (1985) Self-Determination Theory (SDT). This integrated framework, the Mindfulness Cultivation Model (MCM), guides this study. The third chapter presents the research design and approach that was utilized in this study. Chapter Four includes analyses of the data as prescribed by the methods

outlined in Chapter Three. Finally, Chapter Five presents a discussion of the results, along with implications for research, practice and policy.

CHAPTER 2: REVIEW OF THE LITERATURE

This chapter includes a review of the relevant literature and proposes the Mindfulness Cultivation Model (MCM), an integrated framework based on the principles of Kabat-Zinn's (1990) Mindfulness Based Stress Reduction Model (MBSR) and Deci and Ryan's (1985) Self-Determination Theory (SDT). The MCM is used to derive an operational definition of mindfulness. Also, the MCM is applied to study the constructs of balance, neuromotor exercise, and mindfulness.

2.1 Balance

A commonly used definition for human balance is not available in the literature (Berg, 1989). Generally, the term balance is used in reference to posture and physical stability (Pollock, 2000). Balance refers to a person's postural stability and an ability to regulate one's center of mass within its base of support (Alexander, 1994; Tyson & Connell, 2009). Balance involves input from the sensory and motor systems that is integrated by the central nervous system (CNS) (Shumway-Cook & Horak, 1986). For instance, CNS sensory information is contributed by visual, vestibular, and proprioceptive systems. Of these systems, the CNS processes the most precise information received. Consequently, if one sensory system fails, an alternate system will counterbalance the other systems (Pasma et al., 2014). Over time, all three systems within a person lose precision with age. The next section presents the physiological function of each system with attention given to age-related changes.

2.1.1 *Proprioceptive System*

Early work by Laidlaw & Hamilton (1937) found proprioceptive deficits tend to occur after the fifth decade of life. Proprioceptive functions receive information regarding movement, position and tactile sense from receptors found collectively in the joints, tendons, and muscles. The hip, knee and ankle joints are the most commonly affected proprioceptive deficiencies associated with falls in older adults (Ribeiro et al., 2011). Physical activity interventions have been found to attenuate age-related deteriorations in proprioception (Maitre, Jully, Gasnier, & Paillard, 2013; Marmeleira et al., 2009; Tsang & Hui-Chan, 2003).

2.1.2 *Visual System*

Visual disturbances also can affect balance including perceived glare and contrast sensitivity, visual acuity, accommodation and dark adaptation (Horak, Shupert, & Mirka, 1989). Visual age-related impairment commonly begins in the fourth decade of life (Faraldo-García, Santos-Pérez, Crujeiras-Casais, Labella-Caballero, & Soto-Varela, 2012). Deterioration in depth perception was found to be the strongest visual predictor of loss of balance (Sturnieks, St George, & Lord, 2008). Strategies to improve vision in older adults include the recommendations of single-lens over multifocal-lens prescriptions and corrective cataract surgeries. Both approaches have been found to be effective for fall prevention in older adults (Lord, 2006).

2.1.3 *Vestibular System*

The vestibular system senses the position and motion of the head from input received from the semicircular canals and otolith organs contained within the temporal bone. Vestibular changes with aging occur after the fourth decade of life (Faraldo-Garcia et al. 2012; Agrawal et

al., 2009), with decreases in vestibular hair cells and the degeneration of vestibular nerves and structures (Barin and Dodson, 2011). Corrections to balance are made through the vestibulospinal and vestibulo-ocular reflexes (Agrawal, Carey, Della Santina, Schubert, & Minor, 2009). Physical exercise has been found to be successful for older adults with known vestibular pathology (e.g. vestibular hypofunction, vertigo) (Baloh, Enrietto, Jacobson, & Lin, 2001; Jung et al., 2009; Verdecchia et al., 2014).

2.1.4 *Sensorimotor System Comparative Studies*

Comparing the reliance on the three sensorimotor systems, healthy older adults are more responsive to proprioceptive compared to visual and vestibular information, respectively (Lord et al., 1991). One study contrasted the use of visual, vestibular and proprioceptive cues for postural balance control in older (mean age 74 years), middle-aged (mean age 48), and younger adults (mean age 28 years). This study supported that older adults had a greater sensitivity and preference for proprioceptive cues compared with younger adults (Wiesmeier, Dalin & Maurer, 2015).

Focusing specifically on proprioceptive balance, comparisons on cross-sectional studies having the same outcome measure (i.e. One-legged Stance Test) yielded conflicting results. For instance, young adult females had lower proprioceptive acuity than males (Lee et al., 2015; Jola, 2010). Likewise, Riva et al. (2013) found poorer balance outcomes among females (75 years of age and older) compared with male counterparts. In contrast, Ko et al. (2015) noted minimal sex differences in proprioception with older adults (51- 95 years of age); while other studies found no differences with respect to sex or age (Faraldo-García et al., 2012; Springer et al., 2007).

Consequently, the variables of sex, age, and balance, especially since these impact proprioceptive balance, are conflicting and require greater study.

2.1.5 *Motor System*

Motor system changes in balance are associated with the musculoskeletal system contributing to the loss of physical strength, ranging from 20-40%, in the seventh decade of life (Faulkner, Larkin, Claflin, & Brooks, 2007). Muscular strength, function, and flexibility diminish with aging attributable to the decrease in muscle mass in sarcopenia (Cruz-Jentoft et al. 2010), which is identified as a primary risk factor for falls (Girgis, 2015; McLean & Kiel, 2015). Sarcopenia is defined as “the age-associated loss of skeletal muscle mass and function” (Fielding et al., 2011, p. 1). Recommended interventions for the prevention of sarcopenia include regular physical exercise (Montero-Fernandez & Serra-Rexach, 2013). Other age-related motor system changes contributing to impaired balance include an increase in postural sway, decreased gait speed, and diminished postural perturbation recovery. All of these physical conditions can be improved with exercise (Concannon, Grierson, & Harrast, 2012; Maitre, Jully, Gasnier, & Paillard, 2013; Merom et al., 2013).

2.1.6 *The Measurement of Balance*

Associated with the complexity of systems involved in maintaining balance, several outcome assessment measures have been developed. Balance can be measured while standing (i.e. static) or during movement (i.e. dynamic) (Clemson, 2012). Standing balance is essential for functional mobility and fall prevention (Sibley et al., 2015). To date, no gold standard measure exists for the measurement of standing balance. However, the One-Legged Stance Test (OLST)

is reported to be the most studied standing balance measure in older adult populations (Bohannon et al., 2006). Especially in older adult exercise research, functional measures, such as the OLST are valued as associated with its close applicability to activities of daily living, can readily be administered in any setting, and do not require specialized training or lab-based equipment (Podsiadlo & Richardson, 1991). The OLST is both reliable and easy to use (Lewis, 2006). Moreover, the OLST has been used in studies that target the proprioceptive component of balance (Riva et al., 2013; Clark, Røijezon, & Treleaven, 2015).

The rationale for using the OLST, in this study, is associated with its capacity as a non-specific measure of proprioception (Clark et al., 2015). The ability to isolate distinct sensory components of balance is difficult, as each element works in an integrated fashion (Sturnieks, St George, & Lord, 2008). While the performance of the OLST with eyes closed eliminates visual cues, further methods that inform specifically on vestibular or proprioceptive cues would be more challenging to use. Although techniques have been developed that isolate proprioception through the use of specialized equipment in uniquely designed lab settings (e.g. JPS tests, TTDPMP & AMEDA methods), these techniques vary widely in their validity and applicability (Han, Waddington, Adams, Anson, & Liu, 2015), and are not reliable when used with children and older adults (Roijezon et al., 2015).

The OLST is said to “bias proprioception” (Clark et al., 2015, p. 379), but has been used in studies to quantify proprioception (Riva et al., 2013; Son et al., 2009). Accordingly, the OLST would be the most appropriate for this study, as meditative movement and non-meditative neuromotor exercise studies have been found to have improved balance outcomes that mainly target proprioception (Lu, Siu, Fu, Hui-Chan, & Tsang, 2013; Marmeleira, J.F., Pereira, C., Cruz-Ferreira, A., Fretes, V., Pisco, R., Fernandes, 2009).

2.1.7 *Attention and Balance*

Attentional requirements to maintain balance increase with age. For example, dual task outcome measures have been used to provide information on both attention and postural control. Dual tasks require the performance of a postural control task (primary task) together with a secondary task, which may be a cognitive or motor task (Woollacott & Shumway-Cooke, 2002), as opposed to having only the primary task, alone as in a single task condition. Dual-task conditions inform on the person's ability to integrate the sensory, cognitive and motor information that is necessary to maintain balance during movement (Assayag et al., 2015). Some of the challenges associated with dual task measures include the lack of a gold standard measure. The selection of secondary tasks by the researcher varies widely leading to difficulties in reliably interpreting results across studies. Researchers disagree with respect to the selection of tasks, as more difficult tasks (motor focal tasks) may compete for attentional resources. Nevertheless, the dual task approach does not align with the aims of this study, which will examine how mindfulness facilitates attention through awareness for positive balance outcomes. Alternatively, since dual task conditions focus on the influence of stress on attentional resources and its effect on balance, this study will therefore use only single task measures.

In summary, age-related deterioration occurs in the sensory and motor systems that contribute to balance. Contradictory results have been found in studies focusing on proprioceptive balance, comparing sex and age, indicating this gap in the literature and the need for additional research. A variety of balance outcome measures exist, and functional balance is the most frequently studied. Finally, research has reported the use of physical exercise to produce significant improvements in the proprioceptive, vestibular and motor systems associated with balance. Physical exercise that has been recommended by the American College of Sports

Medicine (ACSM) and has been found to be most successful in maintaining and improving balance outcomes are neuromotor exercises (Garber et al., 2011).

2.2 Mindfulness

Mindfulness was originally interpreted by Rhys Davids in 1910, from the Pali (Theravada Buddhism) word *sati*, to mean memory. In Buddhist contexts mindfulness is a “way of paying attention” (Gethin, 2015, p. 10). Although multiple studies have examined the concept of mindfulness, there is no consensus on a definition of the term (Chiesa, 2013). To date, the most frequently cited operational definition for mindfulness in the literature is based on the principles of Kabat-Zinn’s (1990) Mindfulness Based Stress Reduction Model (MBSR). Mindfulness is defined as “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment.” (Kabat-Zinn, 2003, p. 145). Western theorists have divergent views on how mindfulness should be operationalized; however, most perspectives are based on Kabat-Zinn’s definition, and emphasize the mechanism of the self-regulation of attention (Bishop et al., 2004; S. L. Shapiro, Carlson, Astin, & Freedman, 2006). Variations in mindfulness approaches revolve around the methods used for mindfulness induction to the recognition of mindfulness as a trait or disposition, to be discussed further in later sections of this chapter.

With regards to the measurement of mindfulness, the Western conceptualization of the Eastern philosophical concept of mindfulness has been controversial, especially with respect to attempts targeted at determining the validity of the concept. On the one hand, Western researchers (Baer et al., 2003; Kabat-Zinn, 2003) agree that the development of instruments to quantify the measurement of mindfulness has facilitated its integration into Western research.

Alternatively, challengers of this view claim that translation of this unique Eastern construct based on a Western psychological perspective would be not only difficult but also impracticable. Rather this approach may affect the substance of the fundamental essence of mindfulness (Grossman, 2008). The intent of the mindfulness measures is not to trivialize the integrity of this Eastern philosophical construct through Western interpretation, but rather to clarify ambiguity surrounding the term to enhance its assimilation into Western science.

Mindfulness-based interventions have been effectively used to address issues in areas of physical, cognitive, and psychosocial health. While the majority of the studies, particularly in older adults, examined the relationship between mindfulness and psychosocial wellbeing and cognition, only a small number of studies have focused on physical outcomes (e.g., blood pressure, chronic pain) (Geiger et al., 2016). Likewise, mindfulness has been associated with improvements in measures of postural balance; however, very few studies have been conducted (Hewett et al., 2012; Howie-Esquivel et al., 2010; Kee et al. 2012).

Deteriorations in balance occur concomitantly with age-associated physical declines in cognitive function, stimulating an increase in the attentional regulation of balance (Huxhold et al., 2006). Physical activities that facilitate attentional focus may be helpful to improve deteriorating balance associated with aging. There is evidence that mindfulness may also enhance focused attention (Chiesa, Calati, & Serretti, 2011; O'Halloran et al., 2011; Teper & Inzlicht, 2013). Studies focusing on executive attention have been conducted using mindfulness-based approaches, with activities such as Tai chi and yoga. For instance, multiple studies have found executive attention function in older adults to be significantly improved with the practice of Tai chi (Mortimer et al., 2012; Nguyen et al., 2012; Tsang et al., 2013; Taylor-Piliae et al., 2010). Mixed results, however, have been found for yoga practice. While a cross-sectional study

revealed executive function to be significantly higher in experienced Hatha yoga practitioners (i.e., 3-years of experience) than individuals in a meditation control group (Froeliger, Garland, & McClernon, 2012), no significant differences were found in a Randomized Controlled Trial (RCT) between participants that initiated the practice of Hatha yoga over 6-months when compared to walking and wait-list control groups (Oken et al., 2006). Albeit changes in executive attention have been found using Tai chi, in as few as six months (Nguyen et al., 2012; Taylor-Piliae et al., 2010), it is possible that such changes may take longer to become evident with yoga practice.

2.3 Neuromotor Exercise

The American College of Sports Medicine (ACSM) defines neuromotor exercise as physical activity that enhances motor control, balance, proprioception, agility, gait, and coordination, to support functional ability in older adult populations (Garber et al., 2011). Although neuromotor exercise is recommended by the ACSM to be a facilitator of balance, there is a need for further Randomized Controlled Trials (RCT) that target balance to establish therapeutic dose (i.e. frequency, duration, intensity), as well as to determine which forms of neuromotor exercise are most effective. Examples of neuromotor exercise include Tai chi, qigong, yoga (Garber et al., 2011) and dance (Kiefer et al., 2013; Nastase, 2012; Jola et al., 2011).

Although Tai chi is the most frequently studied neuromotor exercise for improved outcomes in postural stability (Lu et al., 2013; Wayne et al., 2014); yoga studies conducted in older adults have led to significant improvements in both static balance as measured by the One-Legged Stance Test (Schmid et al., 2010; Brown et al., 2008), and dynamic balance with respect

to gait stride improvements (Tiedmann et al., 2013; Culos-Reed et al., 2006; DiBenedetto et al., 2005). Moreover, interventions using the neuromotor fitness mode of dance contributed to positive changes in postural balance in older adults (Granacher et al. 2012; Federici et al. 2012; Trombetti et al. 2011). More specifically, ballroom dance has been found to improve measures of both static and dynamic balance in older adults (da Silva Borges et al., 2014; Kattenstroth, Kalisch, Holt, Tegenthoff, & Dinse, 2013). Remarkably, Cepeda et al., (2015) found an 8-week program of ballroom dance significantly enhanced the muscle architecture (i.e., length and thickness of muscles) of the lower extremities in older adult females. Along with ballroom dancing, a variety of other partner dance styles have been studied using older adult populations (e.g. Caribbean, salsa, contemporary). Several researchers used dance as an intervention to enhance the functional aspects of dynamic balance, which is also useful for increasing stride length (Krampe, 2011; Verghese, 2006), leg extensor power (Granacher, 2012); and gait speed in an individual (Pichierri, Murer, & de Bruin, 2012).

2.3.1 *Mind-Body Practices*

Tai chi, qigong, and yoga are examples of neuromotor exercises recommended by the National Center for Complementary and Integrative Health (NCCIH). These activities integrate the mind, body, brain and behavior, which can influence physical health and function. Mind-body practices, such as Tai chi, qigong, and yoga, are referred to as meditative movement, a term coined by Larkey et al., (2009), and recently adopted by the NCCIH (2013).

Although dance is not traditionally considered to be a meditative movement exercise, dance researchers suggest the augmentation of dance with other techniques to facilitate awareness, executive attention, and motor control (Batson, 2010; Pinniger, 2014). Other methods

developed and used in Western society to enhance attention to movement, and postural stability include the Alexander Technique, Ideokinesis, and Feldenkrais Awareness Through Movement. Ideokinesis is described as a mind-body technique that combines thought (ideo) visual images with movement (kinesis) to facilitate posture and muscle movement (Bernard, 2006). The Alexander Technique (AT) is a hands-on method, whereby a specially trained instructor guides individuals with improvements in both movement and posture (Woodman, 2012). Comparable with the AT, the Feldenkrais method also involves hands-on therapy with the goal of developing improved self-awareness of movement (Hopper et al., 1999). Each of these mind and body practices has the goal of an individual using attentional focus to facilitate awareness that can enhance postural stability, which is an approach compatible with mindfulness-based practices. Further study of movement techniques like these may shed new light on the relationship of mindfulness with balance in non-meditative modes of exercise, which previous studies have not addressed.

Mind-body practices such as the Alexander technique play a significant role in the cultivation of attention and awareness (Schmalzl et al., 2014). The Alexander technique enhances motor learning for postural balance (Soriano & Batson, 2011). These methods are used to refine and modify postural balance by stimulating sensory awareness (Batson, 2008). Although meditative movement activities (e.g. yoga, Tai chi) are referred to as ancient approaches, the Alexander technique is a modern or contemporary method, which refines visual and proprioceptive feedback to improve postural balance.

The need to use additional methods along with dance activities (to enhance awareness or attention to the performance) can increase mindfulness and improve performance. Alternatively, Tai chi and yoga are considered to be mindful activities that integrate meditation, and

consequently, do not require additional activities. Thus, an established need for supplementary techniques (e.g. AT), created specifically to enhance awareness and attention, may warrant further investigation into the capacity of non-meditative activities to stand alone, as mindful. Moreover, the development and use of these techniques highlight the need for older adults to focus their attention on activities that promote improved balance, a function that was once considered automatic. Consequently, a knowledge gap emerges regarding the presence of mindfulness in dance and the potential for variations in levels of mindfulness associated with meditative exercise modes.

2.3.2 Proprioceptive Balance, Mindfulness, and Neuromotor Exercise

Researchers have examined the proprioceptive aspect of balance in the context of both meditative and non-meditative movement activities (Perrin, Deviterne, Hugel, & Perrot, 2002; Rahal et al., 2015). Studies with older adults revealed proprioceptive stimulating exercise to be associated with the attenuation of age-related sensorimotor decline in postural balance (Maitre et al., 2013). Proprioceptive abilities are highly repetitive and typically occur without focused conscious control (Batson, 2009; Huxhold, Li, Schmiedek, & Lindenberger, 2006). The literature suggests that proprioceptive ability in dance may be exceptional as a result of continued practice or repetition (Batson, 2009).

Research comparing ballet dancers with non-dancers found that proprioception was greater in experienced dancers (Simmons, 2005). Alternatively, a proprioceptive advantage for dance has not consistently been found in studies that control for visual ability. For instance, Perrin's et al. (2002) study of young adults (N=73; aged 20-35 years), compared non-meditative movement (i.e., ballet) with meditative movement exercise (i.e. judo). They found meditative

movement to be associated with significantly better performance on proprioceptive measures in an eyes closed condition. They further suggest that individuals using judo (i.e., meditative movement) might have greater levels of proprioceptive ability and rely less on visual cues than those that dance (i.e., non-meditative movement).

Contradictory findings were found in a more recent study (Rahal et al., 2015) that examined balance, in older adults (n=76, aged 60 + years) who practiced Tai chi compared to those that participated in ballroom dance. Their findings revealed the Tai chi group to have better bilateral (i.e. two leg stance) static balance with eyes open than the dance group; however, the dancers performed better with eyes closed on a unilateral (i.e. one leg stance) test. In this study, dancers (non-meditative movement) relied less on visual cues than the Tai chi (meditative movement) participants. Consequently, further research is needed that compares proprioceptive ability in meditative and non-meditative forms of neuromotor exercise, specifically in older adult populations.

Overall, the practice of both meditative and non-meditative forms of neuromotor exercise have been found to increase static and dynamic postural balance, and more specifically, improvements have been reported in proprioceptive ability. Mehling et al. (2011) describe proprioception as a conscious awareness of bodily sensations that can be modified by the mind through attention. The purposeful use of attention to enhance sensory awareness has been recommended using mindfulness practices (Batson, 2008; Rejeski & Gauvin, 2013; Wu et al., 2014). Essentially, the research suggests there may be a link between the proprioceptive component of balance, which can be improved with neuromotor exercise, and mindfulness in older adults. A conceptual framework will be presented, to guide the study of the influences of mindfulness and neuromotor exercise mode with respect to balance.

2.4 Conceptual Framework

The following section will present a conceptual framework that integrates the principles of Kabat-Zinn's (1990) Mindfulness Based Stress Reduction Model (MBSR) with Deci and Ryan's (1985) Self-Determination Theory (SDT). Brown & Ryan (2003) used SDT to develop their Mindful Attention Awareness Scale (MAAS), which will be used to measure mindfulness in this study. Each theory is discussed separately, inclusive of their respective strengths and limitations. This integration of relevant concepts from both theories provides an expanded framework to target behavioral change processes (e.g. acquisition of neuromotor exercise practice) as well as develop knowledge regarding the health outcome of improved postural balance progressing towards the ultimate goal of fall prevention for older adults.

2.4.1 *Mindfulness Based Stress Reduction Model*

In a seminal study, Kabat-Zinn (1982) implemented the Stress Reduction and Relaxation Program (SR&RP) as an outpatient intervention for patients with chronic pain. This study generated the beginning of a popular trend regarding the empirical study of mindfulness meditation programs for use in clinical settings (Bishop, 2004). Further research and development of the SR&RP extended the practice into what is now known as Mindfulness Based Stress Reduction (MBSR). The MBSR method uses mindfulness meditation, a form of meditation based on Theravada & Mahayana Buddhism and yogic philosophy. In contrast to Transcendental Meditation, which involves the focus of attention on one object, mindfulness meditation begins with focused attention to one entity (e.g. breath), and then evolves and fluctuates, moment by moment, to include a broader range of experiences (Kabat-Zinn, 1982).

The MBSR model is grounded by seven attitudes, non-judging, patience, beginner's mind, trust, non-striving, acceptance, and letting go (Table 2). While these attitudes are essential for the cultivation of mindfulness, motivation is identified as a vital antecedent. Kabat-Zinn (1990) claims that motivation is necessary for both the initiation and maintenance of mindful practice. Motivation in the MBSR model is comprised of three constructs, intentionality, commitment, and self-discipline.

Intentionality is the purposeful adoption of the seven attitudes that ground mindfulness. Also, Kabat-Zinn (1990) describes the function of intention as the ability to envision within each moment the reasons for practicing. It is important to note that intentionality (motivational component) and non-striving (attitude) are non-conflicting. In other words, intentionality does not characterize the individual striving for a particular goal. Instead, intentionality describes the person's attempt to remain open and accepting of the reasons for action. Furthermore, to achieve successful practice, the role of intention is to integrate and attend consciously to the attitudes of mindfulness (Shapiro, 2000).

Next, the individual must possess a commitment to the regular practice of mindfulness. The ability of a person to overcome obstacles is a measure of commitment. For one to be committed, they must first acknowledge the reasons for practice (Kabat-Zinn, 1990). The maintenance of commitment is propelled by the power of regular practice, through self-discipline. Finally, self-discipline in the form of motivation is supported by the individual's intrinsic desire to achieve optimal health. For example, participants of the MBSR program would consider successful stress reduction as a motivating factor for maintaining self-discipline. Finally, the components of intentionality, commitment, and self-discipline are all necessary for

an individual to develop knowledge of the quantity of mind and body energy required for successful mindfulness practice.

After a person adopts the antecedents of mindfulness (i.e. attitudes and motivation), the individual can then proceed to cultivate mindfulness through practice. Kabat-Zinn (1990) identifies yoga as an example of a mindful, meditative practice. Mind-body practices through which formal meditation can take place can be considered vehicles for the cultivation of mindfulness. For instance, Tai chi is a form of mindful meditation that synchronizes graceful movements with deep breathing (Lee, 2012). The capacity to focus on sensations in the body and mind facilitates attention on the physical movements in progress leading to mindful awareness (Wayne et al., 2013).

Table 1 *Attitudes that Ground the Mindfulness Based Stress Reduction Model*

Attitude	Description
Non-judging	The ability to pay attention, in the moment, to both internal and external experiences. These experiences are acknowledged and allowed to pass without evaluation or further engagement. Consequently, this ability will provide a perspective that is all-encompassing, free of the preconceptions and fear associated with judging.
Patience	Through patience, the individual accepts that the cultivation of mindfulness will occur naturally, over time, unaffected by attempts made to force or hasten the process.
Beginner's Mind	The attitude of beginner's mind is described as an openness to all possibilities. The individual adopts this attitude by disengaging themselves from past associations they may have had with an experience. In other words, the individual will attempt to encounter each experience from a new perspective.
Trust	The individual adopts the attitude of trust by honoring themselves. This is accomplished through developing an appreciation for one's own feelings, favoring respect for one's personal knowledge and acceptance of responsibility for oneself.

Attitude	Description
Non-striving	Non-striving is described by Kabat-Zinn (1990, p. 26) as “non-doing.” More specifically, the individual remains openly aware of everything going on in the moment without the need to target or alter any one thing to satisfy the desired intention.
Acceptance	Kabat-Zinn (1990) advises that acceptance not be a passive giving in, or agreement to tolerate adverse situations. However, all experiences, negative or positive, must be acknowledged in their current state to appreciate fully and act in the present moment with open awareness and clarity.
Letting Go	The attitude of letting go will enable the individual to acknowledge the experience without attaching themselves for further evaluation. Attachment to experiences in the moment prevents the individual from moving on to the next moment.

(Kabat-Zinn, 1990)

2.4.1.1 *Strengths*

The MBSR offers some advantages to the study of neuromotor exercise. First, the greatest strength of MBSR is that it was developed specifically for the practice of meditative mindfulness practice. Unlike behavioral change theories used to explain why an individual adopts and maintains a behavior, the MBSR model can be used to understand the mind-body exercise connection. Moreover, the multifaceted perspective of MBSR is harmonious with the diverse nature of mind-body exercise and its all-encompassing effect on both the mind and body. Second, the highly integrated relationship among each of the MBSR constructs supports the internal consistency of this framework, further reinforcing the overall structural integrity of the model (Smith & Liehr, 2008). Third, MBSR has pragmatic value as a micro-range theory (Fawcett, 1993). In other words, MBSR is more concrete and narrow in its focus; can be applied in a straightforward manner to practice and to guide the development of intervention studies.

Fourth, the MBSR model received extensive empirical support over the past two decades. For instance, Teasdale, Segal & Williams (1995) merged MBSR with cognitive therapy principles in the development of Mindfulness-Based Cognitive Therapy (MBCT) for use with depression related disorders. Another mindfulness theory, Shapiro's (2000) Mechanisms of Mindfulness, extended the seven fundamental attitudes of the MBSR to include attitudes of emotion. While, Kabat-Zin (1990) also recognizes attitudes that possess emotional properties (e.g. generosity, compassion, forgiveness), emotional attitudes are not regarded as fundamental (Table 2). Rather, emotional attitudes have the potential to develop in an individual as an extension of the fundamental attitudes.

2.4.1.2 Limitations

One limitation is the empirical adequacy of the MBSR model for use in dance. The MBSR was originally developed as a stress reduction program using mindfulness meditation techniques. To date, Pinniger's et al. (2013) ballroom dance intervention is the only known study that has applied principles of the MBSR to an activity that lacked a formal meditation component. This study is discussed later in this section of the paper.

Another limitation revolves around the conceptual clarity of the motivational constructs of intentionality, commitment, and self-discipline. More specifically, the definitions provided by Kabat-Zinn (1990) are broad, such that clear distinctions between the constructs are not well articulated (Morse, Mitcham, Hupcey, & Tasón, 1996). For instance, the constructs of intentionality, commitment, and self-discipline can collectively refer to an individual's ability to attend consciously to actions. Consequently, it could be difficult to discern how each construct corresponds with specific behavior. Strong commonalities between constructs require operational

definitions that uniquely differentiate each construct (Sutton, 2001). Conceptual clarity can be refined through concept analysis. Alternatively, to enhance the structural integrity of the motivational component of the MBSR, an integrated approach could be considered with Deci and Ryan's (1985) Self-Determination Theory, a widely studied motivational model.

2.4.2 *Self-Determination Theory*

Self-Determination Theory (SDT) was developed over 40 years ago as the theory of intrinsic motivation (Deci, 1971). Advanced by the ongoing efforts of psychologists Deci & Ryan (1985), SDT eventually expanded into a meta-theory, composed of five sub-theories (Table 3). Self-determination theory targets aspects of human motivation and personality; more specifically, it focuses on motivations that affect an individual's actions and decisions. The emphasis of the model is placed on the individual's choices, to ascertain if they are self-determined or self-motivated (Ryan & Deci, 2000). Self-determined behaviors are defined as free from control and are autonomous and intrinsically motivated (Deci & Ryan, 1985).

Although the title, self-determination theory, highlights the importance of self-determination as a concept, self-determination functions as an antecedent of intrinsic motivation. The construct of intrinsic motivation is the phenomenon that is central to SDT. It has been operationally defined as eliciting behavior that is performed without the need for any external reinforcement; the behavior itself acts as reinforcement (Deci & Ryan, 1985). As a theoretical construct, intrinsic motivation is defined as "the innate, natural propensity to engage one's interests and exercise one's capacities...it emerges spontaneously from internal tendencies and can motivate behavior without the aid of extrinsic rewards or environmental controls" (Deci & Ryan, 1985, p.43).

The assumptions of the SDT are as follows: intrinsic motivation is distinct and not synergistic with extrinsic motivation (Deci, 1972); self-determination is expressed as the freedom of behavioral control and choice (Deci & Ryan, 1985); that the three basic psychological needs for autonomy, competence and relatedness are universal (Deci & Ryan, 2008). These assumptions are clear and support the focus of the theory, which is the extent that the behavior of an individual can be self-determined, and self-motivated (Deci & Ryan, 1985).

A further assumption consistent with mindfulness was added by Brown & Ryan (2003) with the development of the Mindful Attention Awareness Scale (MAAS). They claim that open awareness fosters behavioral choice in harmony with personal ideals. More specifically, an open awareness of personal values and needs leads to greater autonomy, which enables the individual to better self-regulate behavior (Deci, Ryan, Schultz & Niemiec, 2015).

Table 2 Self-Determination Theory (SDT) Sub-theories

Sub Theory	Description
Cognitive Evaluation Theory (CET)	The CET focuses on intrinsic motivation and how it is affected by three basic needs: autonomy, competence, and relatedness.
Organismic Integration Theory (OIT)	The OIT is concerned only with extrinsic motivation and how behaviors become internalized across the four levels of extrinsic motivation. Highly internalized behaviors provide greater autonomy.
Causality Orientations Theory (COT)	The COT addresses motivational level according to orientations towards autonomous, control determined, or impersonal behaviors. An internal locus of causality is associated with autonomous behavior that is internalized and self-integrated. External causality behaviors are not self-determined or autonomous and impede intrinsic motivation.

Sub Theory	Description
Basic Psychological Needs Theory (BPNT)	The BPNT claims that the satisfaction of all three basic psychological needs, autonomy, competence, and relatedness, has a positive effect on an individual's wellbeing. Conversely, thwarted needs result in detrimental effects on health status.
Goal Contents Theory (GCT)	GCT focuses on goals and how they affect an individual's wellbeing. Intrinsically motivated goals (e.g., sense of community, personal growth, and personal relationships) have a positive influence on psychological and physical health. Extrinsically motivated goals (e.g., financial, appearance, fame) increase health risk factors.

(Deci & Ryan, 2000)

2.4.2.1 Strengths

The SDT is broad in scope and demonstrates strong empirical value across age groups, domains, and cultures. For instance, the theory has been studied and found to be feasible for use in populations of children and older adults (Ferrand et al., 2014; Pannekoek et al., 2014). Researchers also apply this theory to a variety of research modalities: physical activity, education, healthcare, and addictions (Choi et al., 2014; Neys et al., 2014; Parastatidou et al., 2014). Moreover, SDT has been translated into multiple languages, and the constructs have been empirically tested for use in various measurement scales (Gnambs et al., 2014; Hui et al., 2011).

While SDT is often incorporated into research studies as a whole, each of the five sub-theories has been studied independently. Scholarly interest in SDT remains active as recent studies have been conducted using Cognitive Evaluation Theory (Matosic, Cox & Amorose, 2014; Raufelder et al., 2015), Organismic Integration Theory (Grunnell et al., 2014), Causality Orientations Theory (Solberg et al., 2013; Silva et al., 2010) and Goal Contents Theory (Gaston et al., 2013). The most studied sub-theory, the Basic Psychological Needs Theory (BPNT) (Felton & Jowett, 2015; Tian, Tian, & Huebner, 2015), was used to ground the MAAS (Brown & Ryan, 2003) and is of particular relevance to this study.

2.4.2.2 *Limitations*

Self-determination theory is not parsimonious. The concepts within the five sub-theories of the multidimensional SDT do present some redundancies, which may lead to confusion. For instance, Basic Psychological Needs Theory (BPNT) addresses the same three basic psychological needs (autonomy, competence, and interrelatedness), as does Cognitive Evaluation Theory (CET). Unlike the CET, the BPNT places an emphasis on the adverse effects that can occur to wellbeing if the needs are left unsatisfied.

Another limitation of the SDT with regards to this study is that the SDT is primarily a behavioral change theory. Although SDT has been used in some mindfulness studies, a primary limitation of SDT is that the focus of the theory is in the acquisition and regulation of behavior and not on the health outcome. In other words, a theory developed to predict behavioral changes would be limited in ability to explain health outcomes.

To summarize, two theoretical approaches were presented to understand the impact of neuromotor exercise on the improvement of overall health and wellbeing. The advantages and limitations were discussed for each approach. For instance, SDT provides a beneficial motivational component that ensues from satisfying the basic psychological needs of autonomy, interrelatedness, and commitment. Conversely, SDT is a behavioral change theory that targets behavioral acquisition and regulation, which shifts the focus away from providing a direct understanding of health outcomes. The MBSR model may contribute to the understanding of outcomes as it was developed specifically to study the cultivation of mindfulness through meditation practices that influence the body and mind. However, the empirical adequacy of MBSR is limited, as studies have not been found that apply MBSR to non-meditative movement activities, and the motivational component requires further conceptual clarification.

2.4.3 *An Integrated Approach*

An integration of the SDT with MBSR, as an expanded framework, targets both behavioral change processes as well as health outcomes. Moreover, with an integrated approach, the conceptually similar MBSR constructs (i.e. intentionality, commitment, & self-discipline) are replaced with the more empirically studied constructs of SDT's Basic Psychological Needs Theory (i.e. autonomy, interrelatedness, and competence). The constructs have been substituted to strengthen the structural integrity of the motivational component, as they enhance both conceptual clarity and empirical adequacy. In an attempt to advance the understanding of the unique ways that the combination of approaches offers, the Mindfulness Cultivation Model (MCM) is proposed. The two theories have been integrated to enhance conceptual clarity and ultimately facilitate the study of the comprehensive role of mindfulness in both meditative and non-meditative modes of neuromotor exercise.

2.4.4 *The Mindfulness Cultivation Model*

The constructs of both Kabat-Zinn's (1990) MBSR model and Deci and Ryan's (1985) Basic Psychological Needs Theory (BPNT) were brought together to form the Mindfulness Cultivation Model (MCM), a streamlined approach to the study of mindfulness (Figure 3). First off, mindfulness must be cultivated. Kabat-Zinn (1990) introduces the cultivation process by emphasizing the importance of adopting seven attitudes (Table 2). The individual can develop the motivation to adopt these attitudes through intentionality, commitment, and self-discipline. As discussed earlier, these three motivational constructs were replaced with the basic psychological needs (i.e. autonomy, interrelatedness, and competence) of Deci and Ryan's (1985) BPNT. Accordingly, attitude and motivation are antecedents of the MCM.

The process of mindfulness can be described as consistent with the constructs Brown & Ryan (2003) use to underpin the Mindful Attention Awareness Scale (MAAS). In essence, the MAAS constructs of attention, self-regulation, and awareness, are proposed as core attributes to mindfulness practice, are compatible with MBSR and BPNT frameworks, and are identified as relevant by other mindfulness researchers (Jankowski & Holas, 2014; Langer, 1992; Malinowski, 2013; Shapiro & Schwartz, 2000). The action of the core attributes involves the integration of attention with the self-regulation of behavior, which leads to awareness. To illustrate, attention can focus on internal and external cues. Controlled breathing is an example of an internal attentional cue recommended for beginners of mindful meditation practice. In the practice of Tai chi, individuals typically self-regulate their movements with their breathing. Alternatively, dancers self-regulate their steps with external attentional cues within the environment (e.g. music, partner, floor). Both examples demonstrate the integration of the core attributes of attention and self-regulation.

Shapiro (2000) differentiates the self-regulation aspect of mindfulness from a systems perspective based on Wiener's (1948) cybernetics model. Wiener notes that the system continually adapts to change while maintaining stability through positive and negative feedback loops. Consistent with the cybernetic approach, theorists emphasize the interdependence of attention and self-regulation, and the importance of this connection to the mindfulness process (Brown & Ryan, 2003; J. Shapiro et al., 1999). Subsequently, this dynamic interaction facilitates the cultivation of awareness, the third core attribute.

The attribute of awareness, in the MCM, is arranged to follow the integration of attention and self-regulation. Buddhist philosophers regard attention as a precursor of awareness (Gethin, 2015). In further support of this sequence, Kabat-Zinn (1990, p. xxvii) states we “cultivate our

relationship to that *awareness*...cultivation through paying attention in a particular way: on purpose, in the present moment, and non-judgmentally.” Moreover, Brown & Ryan (2003) describe awareness as facilitating attention and self-regulation; consequently, a bidirectional arrow is placed between these attributes. Interestingly, Brown & Ryan (2003) consider behaviors that do not rely on awareness and attention as automatic or unconscious and refer to these as mindless.

The MCM identifies mindfulness as a predictor and as a mediator. The role of mindfulness as a mediator has been supported in a number of studies (Bränström, Kvillemo, Brandberg, & Moskowitz, 2010; Lima, Gago, Garrett, & Pereira, 2016; Perona-Garcelán, Rodríguez-Testal, Senín-Calderón, Ruiz-Veguilla, & Hayward, 2016). Mediators are used to express how “external physical events take on internal psychological significance” (Baron & Kenny, 1986, p. 1176). In this study, mindfulness was examined as a mediator of the relationship between neuromotor exercise mode and balance. The variables of sex and age were studied as moderators of the relationships between mode of exercise and mindfulness and of balance. Baron and Kenny (1986, p. 1174) define a moderator as a “variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable.” For example, considering sex as a proposed moderator, the association between mindfulness and balance may be stronger for females than for males.

Lastly, the consequence of the process of mindfulness is well-being (Brown & Ryan, 2003). Early studies of mindfulness using the MAAS examined psychological well-being, but recent work extends to physical, cognitive and emotional outcomes. For example, this study used balance as a proxy for well-being. Based on the constructs in the MCM, mindfulness is defined as an open awareness that evolves from attention in the present moment, to physical,

psychological, and environmental cues, integrated with the self-regulation of behavior for optimal well-being outcomes.

The diagram of the MCM (Figure 3) displays the constructs in the model, which can be adapted for application to various contexts. While the antecedents of attitude and motivation are invariable, the ‘core attributes’ and ‘consequence’ have been tailored to fit the needs of the study. Along these lines, the MCM was used to guide understanding of the process of mindfulness as cultivated through the practice of mind-body exercise. The MCM was also used to facilitate the interpretation of similarities and differences between meditative and non-meditative modes of neuromotor exercise. For instance, examination of the outcomes associated with dance activities presenting differently from neuromotor exercise activities that include a formal meditative component, such as Tai chi or yoga.

The Mindfulness Cultivation Model

(Antecedents, Attributes & Consequence)

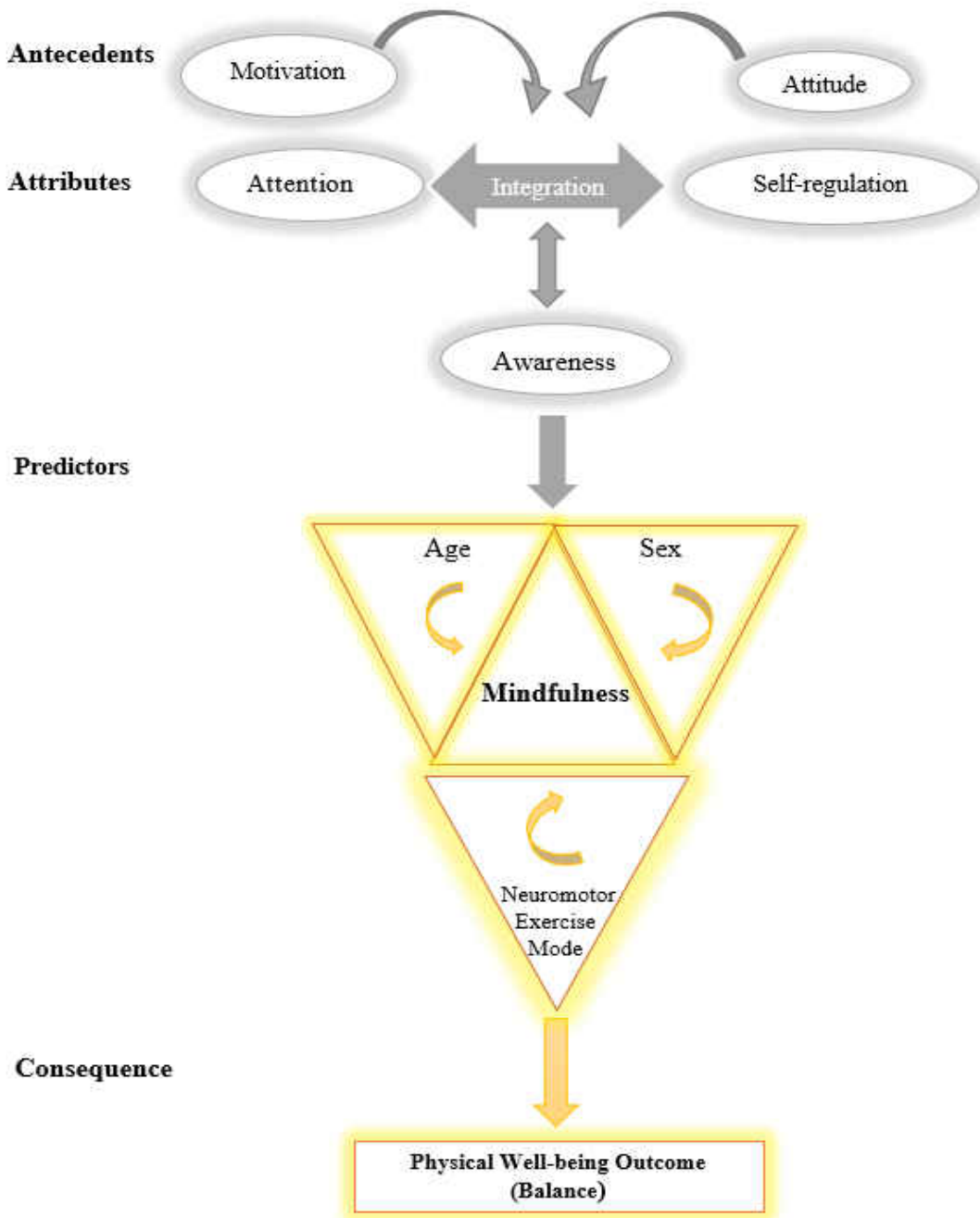


Figure 3 Mindfulness Motivation Model

2.5 Issues of Debate

2.5.1 *Attentional focus*

Attentional focus is conceptually defined as the direction of concentration on cognitive, physical or environmental cues that may be perceived from an internal or external context (Chun et al., 2011). Controversy exists regarding whether an internal or external focus of attention is more important for postural stability. For instance, the meditative movement exercise of Tai chi has been described as involving the attentional awareness of internal processes such as the balance of breathing and energy within the body (Wayne & Fuerst, 2013). In contrast, individuals that practice non-meditative movement activities, such as ballroom dancing, are reported to have more of an external attentional focus dependant upon environmental cues, such as music or their dance partner (Hackney & Earhart, 2010). Although dancers may depend mainly on visual cues, tests of proprioception have been found to be greater in dancers than non-dancers (Simmons, 2005).

Over the past decade, the majority of attentional focus studies support Wulf's et al., (2001) Constrained Action Hypothesis (CAH), which proposes that an external focus of attention is optimal for motor movement control. However, it is uncertain if Wulf's et al., (2001) CAH is convincing with respect to moving meditative activities, whereby attention is directed inward with the practitioner focusing on the body and mind (Wayne & Fuerst, 2013; Schmid, van Puymbroeck, & Koceja, 2010). Moreover, studies on non-meditative movement dance forms have found that the perspective of attentional focus can be dependent on the skill level of the dancer or the type of dance activity. For instance, beginning dancers have been found to have an internal focus of attention, which enhanced skill mastery (Peh, Chow, & Davids, 2011). Moreover, activities such as gymnastic dance may require an internal focus of attention

(Lawrence, Gottwald, Hardy, & Khan, 2011) whereas ballet relies more on visual cues with an external focus (Batson, 2009). Alternatively, it is possible that both perspectives are necessary for optimal postural stability.

2.5.2 *Mindfulness induction*

The requirement of regular meditation for the successful cultivation of mindfulness skills is another issue of debate. Well-known approaches to mindfulness (e.g. MBSR, MBCT, and Mechanisms of Mindfulness) commonly involve a meditative component (Kabat-Zinn, 1990; Teasdale, Segal & Williams, 1995; Shapiro, 2000). In contrast, Langer & Moldoveanu (2000) claim that meditation is unnecessary, as mindfulness induction can also be achieved by performing a behavior that requires attention. Unlike conventional mindfulness approaches, Langer employs attentional focus as a cognitive approach, whereby attention is actively used to search for distinctions and alternative perspectives. This method is compatible with learning, creativity, and problem-solving, and is described as a way of knowing (Langer & Moldoveanu, 2000).

Although studies that apply mindfulness induction without meditation have had successful outcomes (Chong et al., 2015; Ie et al., 2012; Kee et al., 2012); most focus on the acquisition of state rather than trait mindfulness, which may not be useful long term. For instance, in a between-subjects experimental design, Delizonna, Williams & Langer (2009) examined the effect of mindfulness for controlling heart rate variability. Participants (n=43; aged 19-62 years) were informed on how to monitor their heart rates at set intervals for a one-week period. Participants instructed to attend to fluctuations (i.e. novel distinctions) in their heart rate at frequent intervals were compared to participants attending at less frequent intervals,

participants attending to stable heart rate patterns, and participants not attending to heart rate. Consequently, participants attending to frequent fluctuations performed significantly better than other participants in the study, when asked to increase their heart rates on demand over a 50-second interval the following week. Remarkably, Delizonna, Williams & Langer (2009) explain that the frequent practice of non-meditative mindfulness induction enables enhanced behavioral self-regulation. In essence, mindfulness was found to be successfully induced without meditation. These findings suggest the potential for mindfulness induction in other non-meditative activities, such as dance.

2.5.3 *Related Research*

To date, no studies have been found that have compared meditative, and non-meditative movement approaches with respect to mindfulness on balance. However, several studies will be discussed that discovered significant improvements in both mindfulness and balance based on a particular approach (e.g. yoga, mindfulness induction). Moreover, these investigations approached the study of balance from the perspective of mindfulness. For instance, researchers using yoga interventions suggest that body awareness increases with the mindful practice of yoga, by enhanced proprioceptive awareness leading to improved balance outcomes (Howie-Esquivel, Lee, Collier, Mehling, & Fleischmann, 2010). While these approaches examined balance through the development of disposition (i.e. trait) mindfulness over time, Kee et al. (2012) discovered that immediate improvements in balance could also arise through the induction of state mindfulness. In this approach, the induction of mindfulness was through activity that was cognitive rather than physical. As previously mentioned, the long-range value of state induced mindfulness is uncertain.

In consideration of non-meditative movement, Pinniger, Thorsteinsson, Brown, & McKinley (2013) conducted the only known published research that investigated mindfulness as an outcome of dance. The outcome of balance was not assessed. The psychosocial outcome of improved mood, instead, was examined from a mindfulness perspective based on Kabat-Zinn's principles (e.g. attention, awareness, trust, and acceptance), and were found to be consistent with dance (Pinniger et al., 2013). The recognition of Kabat-Zinn's mindfulness principles in the practice of dance provides support for the use of the MCM for the study of non-meditative movement exercise.

Favorable balance outcomes have also resulted from non-meditative movement dance interventions. Recently, dance research has taken a neurocognitive approach (Bläsing et al., 2012). While dance interventions targeting balance outcomes have not directly measured mindfulness, research studies support outcomes consistent with components of mindfulness (e.g. attentional control, attentional cues, and awareness) (Kattenstroth, Kalisch, Holt, Tegenthoff, & Dinse, 2013; Kiefer et al., 2013; Pichierri, Coppe, Lorenzetti, Murer, & de Bruin, 2012). There is increasing research focusing on mindfulness in non-meditative movement activities through recommendations and suggestions for study (Batson, 2009; Schmalzl, Crane-Godreau, & Payne, 2014); however, the construct remains under-investigated. Questions persist regarding the need for mind-body techniques (e.g. Alexander technique, Feldenkrais method, & Ideokinesis) that can facilitate attention and awareness of movement during dance in contrast to meditative movement activities that incorporate a mindfulness component.

2.6 Conclusion

Knowledge obtained from this study may reveal the potential for the presence of mindfulness in neuromotor activities that do not contain a formal meditative component, which would suggest that mindfulness could be cultivated through the practice of any mode of neuromotor exercise. This knowledge would also be beneficial for compliance, providing the older adult a greater range of exercises from which to choose. Conversely, if mindfulness is neuromotor mode specific, then the prescribed activity can be tailored according to the individual's mindfulness level. Moreover, discovery and empirical support for the presence of an association between mindfulness and balance, regardless of neuromotor exercise mode, may translate outside of neuromotor practice to activities of daily living. Ultimately, this finding would increase the value of regular neuromotor exercise as a fall prevention strategy.

CHAPTER 3: METHODOLOGY

3.1 Design

The purpose of this study was to examine the association of mindfulness with respect to postural balance as experienced by healthy older adults participating in meditative versus non-meditative types of neuromotor exercise. Additionally, this study examined if there is a relationship between mindfulness and balance and if it varied with sex or age. A comparative descriptive design was used to compare mindfulness levels and balance outcomes in older adults with at least one year of participation in meditative (i.e. Tai chi, yoga) vs. those participating in non-meditative movement neuromotor exercise (i.e. ballroom dance).

3.2 Sample

A power analysis was calculated using G*Power (Faul, Erdfelder, Buchner & Lang, 2009) to determine sample size. Assuming a power of 0.80 and an alpha of 0.05, 86 participants are essential to detect a moderate size effect for a multiple regression equation with four predictors. Given that sample sizes for comparative and correlational designs typically use a minimum of 30 participants per group in order to detect a relationship (Gay, Mills, & Airasian, 2014) and provided that there was no attrition, as measures were taken at one point in time, each group contained n=43 participants for a total sample size of N=86.

The convenience sample of healthy older adults, 60-years of age or older (N=86), were recruited from the Central Florida region of the South Eastern United States. For the two self-selected groups, the meditative movement group consisted of 43 experienced practitioners of Tai chi or yoga, and the non-meditative movement group had 43 experienced partnered dancers (e.g.

ballroom, tango, salsa). The term older adult, as used in this study, reflects the United Nation's definition as an individual 60-years of age or older (WHO, 2017).

3.2.1 *Eligibility and Exclusionary Criteria*

Inclusion criteria for participants involved a) individuals 60-years-of age and older; (b) able to read and speak English (c) self-report of at least 1-year participation in partnered dancing, Tai chi, or yoga (Dania, Koutsouba, & Tyrovola, 2014; Fong & Ng, 2006; Rahal et al., 2015) (d) self-report of engaging in at least three times per week of partnered dancing, Tai chi, or yoga (Li et al., 2005; Rahal et al., 2015). Exclusion criteria targeted individuals who had participated in both forms of regular meditative (e.g. Tai chi, Yoga, qigong) and non-meditative (e.g. ballroom dance) neuromotor exercise within the past 6-months (Lam et al., 2012), those diagnosed with a known disturbance in balance (i.e., uncorrected visual problems, and vestibular and sensorimotor deficits), or a neurological disorder (e.g., Parkinson's disease, multiple sclerosis). Individuals who met the inclusion criteria were screened by the investigator to determine eligibility.

3.3 Participant Recruitment

Participants were recruited from diverse areas within East Central Florida with promotional flyers posted in martial arts centers, dance clubs/studios, and senior centers that offered classes in Tai chi, yoga, and ballroom dance. The flyers contained details about the study, and investigator contact information (Appendices A & B). Further recruitment efforts to enroll interested participants occurred through repeated visits by the researcher to scheduled Tai chi, yoga and ballroom dance events (e.g. classes, dances), along with snowball sampling techniques to generate the target sample of 86. Recruitment attempts focused on achieving a

demographic composition that was comparatively similar for both groups; however, differences remained since this was a self-selected convenience sample. Individuals that chose to sign up for the study were screened and consented prior to data collection within one visit. The principal investigator was responsible for obtaining all measures. The physiological assessments were conducted in private areas at each site, with minimal sensory distractions.

3.4 Measures for Protection of Human Subjects

Approval for research involving human subjects was obtained from the University of Central Florida College Institutional Review Board before initiating the proposed research. Permission to recruit and conduct the study at specific sites was obtained from site managers. Verbal informed consent was obtained from each participant before data collection, at which time they were informed about the purpose, procedure, and all potential risks (Appendix C). A copy of the consent was provided to each participant. As part of the screening process, participants were verbally informed of the requirement to stand on one leg with eyes closed. All participants were given the opportunity to withdraw from the study at any time. The risks involved in this study were no greater than participation in the community activity programs in which subjects were currently engaged (e.g. Tai chi, yoga, ballroom dance). Minimal risks included the possibility of falling and loss of time. The investigator was a nurse with training in fall safety.

Thus, risks were minimized with instruction, guidance and vigilant monitoring of each testing session by the investigator. The investigator stood at close range to the participant during the OLST and instructions were given to participants to open their eyes and use the investigator's arm for support if felt unstable. This method to prevent adverse events while performing the

OLST had been established in prior studies (Balogun et al., 1994; Briggs et al., 1989). As a safety precaution, a Universal Gait Belt with two handles was worn by all participants (Agrawal et al., 2009). No adverse events occurred during the study.

3.5 Setting

Data collection occurred at respective exercise locations for the convenience of the participants. At each site, all research measures were conducted in a separate area away from other participants. Prior permission to test at the practice locations was obtained from site management staff at each designated neuromotor exercise location.

3.6 Instruments

3.6.1 *Demographic Questionnaire*

The first two pages of the tool consisted of demographic information (Appendix D) that contains 11-questions regarding sex, self-reported ethnicity (i.e. Caucasian, African American, Hispanic, Asian, other), age in years, medications (i.e. number of medications used daily), history of falls and balance disorders, and the preferred neuromotor exercise (i.e., Tai chi, yoga or ballroom dance) inclusive of the number of minutes per week and total number of years practiced.

The third page of the tool consisted of three fill-in-the-blank questions. Specifically, this information was used to record the physiological data collected regarding body composition, number of seconds the subject can stand on one leg with their eyes closed, and the total MAAS score.

3.6.2 *Mindful Attention Awareness Scale (MAAS)*

The fourth page of the tool consisted of the Mindful Attention Awareness Scale (MAAS), as described in detail in the literature review. Briefly, the MAAS is a 15-item self-report questionnaire developed by Brown & Ryan (2003) that measures dispositional mindfulness (Appendix E). Responses on this Likert-type scale range between 1 to 6 (1 indicates a response of ‘almost always’ and 6 indicates ‘almost never’). The average is taken of each score, and higher scores are associated with mindfulness. An example of an item on the scale would be, “I find it difficult to stay focused on what’s happening in the present” (Brown & Ryan, 2003, p. 826).

Internal consistency of the MAAS was reported to have a Cronbach’s Alpha of greater than or equal to .82 and an interclass test-retest reliability of .81 (Brown & Ryan, 2003). A high rating for construct validity was determined by the examination of the convergent and discriminant correlations of the MAAS with other scales that focused on attention and awareness. For instance, significant convergent correlations were found with scales that measured compatible constructs: the Mindfulness/Mindlessness Scale ($r=.31, p<0.001$) and the Trait Meta-Mood Scale ($r=.46, p<.001$). Discriminant correlations were found with measures that examined discordant constructs: the Reflection Rumination Questionnaire ($r= -.39, p<0.001$) and the social anxiety subscale of the Self-Consciousness Scale ($r=-.36, p<.001$) (Brown & Ryan, 2003).

3.7 Data Collection Procedures

3.7.1 *Questionnaires*

All questionnaires were printed in Times New Roman size 14-point font, which has been identified as an effective size for older adult readers (National Institute of Health, 2016). After signing an informed consent form, each participant completed a demographic survey. The variables of sex, age, ethnicity, multiple medications, history of falls and balance disorders, and specific neuromotor exercise inclusive of the frequency and duration of practice per week and number of years practiced were assessed in the survey (Appendix D). Participants were then administered the Mindful Attention Awareness Scale (MAAS) (Appendix E), which is a self-report, paper, and pencil test, estimated to take 5-minutes (Brown & Ryan, 2003).

3.8 Physiological Measures

3.8.1 *Body Composition*

In this study, anthropometry included measures of Body Mass Index (BMI) (i.e., weight (kg)/ height (cm²)) and WC (cm). Body composition is known to have an influence on balance and were included in the statistical analysis as a covariate. The use of at least two indicators of body composition (e.g. BMI and WC) is recommended in older adults (National Institute of Health [NIH, 1998]; Santos et al., 2012). Weight was measured with a digital Health o meter scale (HDM171DQ-60, Health o meter, St. Louis, MO), self-reported height was taken from the demographic questionnaire, and waist circumference was assessed with a tape measure. Measurements of waist circumference followed the protocol of the National Health and Nutrition Examination Survey III (NHANES III 1988-1994 [NIH, 1998]). A non-elastic, flexible tape

measure was placed around the participant's abdomen, parallel to the floor, and directly superior to the iliac crest. The measure was taken at the end of exhalation, and recorded to the nearest 0.1 centimeter. The NIH (1998) guidelines were used to define BMI (i.e., normal weight BMI < 24.9 kg/m²; overweight BMI=25 – 29.9 kg/m²; obesity BMI >30 kg/m²), and WC (Normal WC: males ≤ 102 cm/females ≤ 88 cm; High WC: males ≥ 102 cm/females ≥ 88 cm) cutoffs.

3.8.2 *One-Legged Stance Test (OLST)*

This study used the One-Legged Stance Test (OLST), a functional test of static balance commonly selected to measure proprioception. The OLST measured the number of seconds an individual was able to stand on one leg, without touching the floor with the opposite leg (Springer, Marin, Cyhan, Roberts & Gill, 2007). The measure has good inter-rater reliability with Intraclass Correlations (ICC) =0.75 to 0.99 (Mancini & Horak, 2010). The predictive validity of the OLST was found to have a relative risk of 2.13 with a 95% CI [1.04, 4.34] (Vellas, 1997) for injurious falls in older adults. The OLST was performed in the eyes closed condition, only.

Before completing this assessment, each individual was instructed to cross their arms over their chest during the trial. The OLST measured the number of seconds each person could stand on one extremity (dominant) without touching the floor with the opposite extremity, uncrossing the arms, opening the eyes, or moving the supporting extremity to maintain balance (Springer, Marin, Cyhan, Roberts & Gill, 2007). Unlike the protocol used by Springer et al. (2007), this study did not use a maximal balance time, but instead provided the total time the participant was able to perform the OLST. A digital stopwatch was used to measure balance for the OLST; the time was rounded to the nearest tenth of a second. Three trials were repeated,

and the best of the three results were recorded. Finally, each individual that attempted the study received compensation for their participation in the form of a \$10.00 Publix gift card.

3.9 Limitations

The study had the following limitations. First, as the study used a convenience sample, sampling bias could occur as subjects will be recruited using flyers placed at each site and self-select their group (Polit & Beck, 2012). Moreover, the demographic characteristics of the sample population consisted of robust, healthy older adults, homogeneous with respect to sex and ethnicity, who were recruited from a localized region of Central Florida. Although these demographic characteristics do not reflect the broader population, this approach attempted to take into account the sex and ethnicity of physical activity studies targeting older adults. For instance, Rogers, Larkey, & Keller's (2009) review of Tai chi and qigong clinical trials noted their study populations to be predominantly female and lacked ethnic diversity. Thus, to minimize these limitations, recruitment strategies such as described in the methodology were taken to provide a sample that was balanced and included participants from different areas of the region.

Data for this study was obtained from self-reported information on the questionnaires, which could lead to recall bias (Polit & Beck, 2012). Shumaker and Ockene (2009) report that the cognitive changes associated with aging may reduce the quality of self-report data. Also, physical activity recall can be affected by "forward telescoping," defined as an inaccuracy in recalling events, which had occurred later in time than the participant reports (Durante & Ainsworth, 1996). Forward telescoping can be reduced by providing cues or prompts to

memorable events (e.g., significant life events) that occurred within the specified time frame (Sobell, Toneatto, Sobell, Schuller, & Maxwell, 1990).

Other issues that could affect self-reporting include demand characteristics and social desirability (Shumaker & Ockene, 2009). Demand characteristics occur when a participant's responses are in alignment with their belief of the study's purpose. Similarly, social desirability involves attempts by the participant to respond to questions in a favorable manner. These issues were not anticipated to be of major concern in this study, as they probably are consistently common to both groups given the inclusion criteria. Moreover, it was an assumption that subjects would respond openly and honestly to the self-report questions on the MAAS and demographic questionnaires.

Environmental noise and distractions (e.g., music, laughter, loud conversation) are commonplace in dance venues, but would be unusual in Tai chi and yoga class settings and could pose a threat to the internal validity of the study. Attempts were made to control for environmental noise by matching setting conditions for all participants (MacDonald, 2014). Test measures for dance participants were conducted around dance classes rather than at the dance events to better match the setting environment of the Tai chi and yoga participants more carefully.

Finally, greater difficulty has been associated with One-Legged Stance Test (OLST) performance among severely obese males (Body Mass Index [BMI] ≥ 35) and severe and moderately obese females (BMI ≥ 30) (Sergi et al., 2007). Since, obesity has been identified as a risk factor for falls in older adults (Mitchell et al., 2007), body composition was controlled for in

the regression analyses. In like manner, an adjustment was also be made for participant's self-report of multiple medications, another risk factor reported for falls in older adults.

3.10 Data Analysis Procedures

3.10.1 *Variables*

The major study variables included the continuous dependent variable of balance (seconds) and the continuous independent variables of age in years, and mindfulness (i.e., MAAS score). The categorical independent variables were neuromotor exercise mode (meditative movement neuromotor exercisers/ non-meditative neuromotor exercisers) and sex (females/males). In addition, demographic variables known to have an influence on balance were included as covariates (i.e., body composition, multiple medications, and fall history). Other descriptive variables, not included in the model, were measured to compare the similarity of study participants with older adults in the U.S. population, overall. These variables were employment, ethnicity, neuromotor exercise practice duration (hours per week), and history of neuromotor exercise practice (number of years).

3.10.2 *Preliminary Data Analysis*

All data were analyzed using IBM SPSS version 24 software. Preliminary data analysis involved frequencies, central tendencies, descriptive, and correlation statistics to check for any outliers or missing data, and to summarize participant characteristics and measures of all study variables. In addition, the internal consistency of the Mindful Attention Awareness Scale was investigated with Cronbach's Alpha.

3.10.3 *Principal Data Analysis*

Zero-order Pearson correlations were conducted to determine if there were any associations between mindfulness with balance, age with balance, and mindfulness with age. To follow were tests of the assumptions of linearity, normality, and homoscedasticity. Variables that were not normally distributed or that had extreme outliers, were managed with strategies such as transformation or score alteration (Tabachnick & Fidell, 2007) to create a form of the variable that could be entered into the linear model. Once the assumptions had been met, research question one was examined using multiple linear regression to determine if the independent variables of mindfulness, neuromotor exercise mode, sex, and age predicted balance. The analyses were then repeated to control for the effect of the demographic factors of body composition, multiple medications, and fall history, which have been revealed to have an association with balance in older adults.

The examination of research question two assessed mindfulness as a mediator between neuromotor exercise mode and balance. Three multiple linear regression equations were tested. Equation one had neuromotor exercise mode as the predictor and balance as the outcome. Neuromotor exercise mode was also the predictor in equation two and mindfulness was the outcome. Equation three used both neuromotor exercise mode and mindfulness, as predictors of the outcome of balance. Baron and Kenny (1986) inform that a mediational model must meet four conditions. For instance, neuromotor exercise mode must be a significant predictor in both equations one and two. Mindfulness must be a significant predictor of balance in equation three. Lastly, neuromotor exercise mode should be a weaker predictor of balance in equation three than in equation two.

Finally, data for research question three were analyzed with Baron and Kenny's (1986) moderator model; each demographic moderator variable (i.e., age and sex) was examined individually. The predictor variables for the first moderator regression model were mindfulness, age, and the interaction between mindfulness and age. The second moderator regression model used the demographic variable sex. The outcome variable for both regression models was balance. All continuous predictor variables (i.e., mindfulness and age) were centered to have a mean of zero, which should diminish the potential for multicollinearity with the interaction variable (Afshartous & Preston, 2011). For instance, the predictor variables of mindfulness and age were centered, and then the multiplication of the centered variables of mindfulness and age produced the interaction variable (mindfulness X age). Significant interactions indicate support for moderation.

CHAPTER 4: RESULTS

4.1 Introduction

The purpose of this study was to examine the association of mindfulness with respect to balance in healthy older adults who are experienced in meditative versus non-meditative modes of neuromotor exercise. This chapter provides an analysis of the data in accordance with the research questions proposed in chapter one.

4.2 Data Collection

Recruitment coincided with data collection, which began July 9th, 2017 and continued until August 26th, 2017. A sample of N=86 participants was recruited at a total of seven sites, inclusive of yoga, Tai chi, and dance studios in Central Florida. There were no deviations from the data collection plan outlined in Chapter 3. Each of the participants was successful in completing the study, with no withdraws. Moreover, no instances of missing data are reported as the principal investigator reviewed each participant's demographic and MAAS surveys to ensure that every question had a response prior to obtaining the physiological measures.

4.3 Preliminary Data Analysis

All data were analyzed using IBM SPSS version 24 software. A preliminary data analysis of frequencies, central tendencies, descriptive, and correlation statistics was conducted to check for any outliers or missing data and to summarize participant characteristics and measures of all study variables. Although there were no cases of missing data, a few univariate outliers were discovered.

4.3.1 *Outliers*

Tukey's (1977) criteria for labeling outliers was applied on the main continuous study variables (i.e., MAAS, age, and balance). While no outliers were found for the MAAS, one outlier was discovered for the variable of age, and eight outliers were found for balance, with values greater than the 75th percentile or less than the 25th percentile of the respective variable. These extreme outliers were confirmed in the boxplot graphs for each variable (see Figures J1, J2 & J3). First off, no errors were found to be associated with data entry. Further evaluation of the outliers revealed each to be suitable for the study population; consequently, all cases were left in the analysis. The cases were extreme because they were located within the tails of the distribution and beyond three standard deviations from the mean (Osborne & Overbay, 2004). Tabachnick and Fidell (2007) recommend strategies (e.g., transformation, score alteration) to decrease the influence of extreme outliers, which can inflate error variance and interfere with normality increasing the potential for Type I or II errors.

Age had a negatively skewed distribution, as would be expected with a sample of older adults. For the management of outliers, a transformation of the entire data set would be unnecessary, as age was within the parameters of a normal distribution at ± 2 (skewness = 1.01, SE=0.26; kurtosis =0.94, SE=0.51) (George & Mallery, 2016). Instead, the influence of the extreme case was reduced using the strategy of score alteration. Rather than deleting the outlier as in the method of trimmed means, the outlier was Winsorized. The method of Winsorization was preferred as more effective for use in samples that approximate normal distributions than the use of trimmed means (Dixon & Yuen, 1974). Thus, with the technique of Winsorization, the extreme age of 93 was modified to 89, the next closest value in the data set (Tabachnick & Fidell, 2007). The effect of this change decreased the skew from 1.01(SE=0.26) to 0.90

(SE=0.26) and kurtosis from 0.94 (SE=0.51) to 0.48 (SE=0.51); distributions with skewness and kurtosis values within plus or minus one are regarded as optimal for most psychometric applications (George & Mallery, 2016).

The outcome variable of balance had eight outliers and elevated levels of skewness and kurtosis, at 3.64 (SE=0.26) and 14.84 (SE=0.51), respectively. In cases of high skewness, Tabachnick and Fidell (2007) advise that transformations be performed before assessing for outliers, as transformations decrease the influence of outliers by drawing them inward to the distribution's center. A log transformation was selected for the variable of balance because of the high skew. After transformation, the number of outliers decreased from eight to four as revealed by the boxplot graphs (see Figure J4). Next, an examination of the distribution using the Kolmogorov-Smirnov and Shapiro Wilk's tests of normality was conducted. The resulting distribution was close to normal as reflected by a non-significant value for the Kolmogorov-Smirnov test ($p > 0.05$). However, the Shapiro-Wilk test, preferred over the Kolmogorov-Smirnov test because of greater power (Razali & Wah, 2011), remained significant at 0.04, $p < 0.05$. The method of Winsorization was then applied to the remaining four extreme outliers, which lead to a loss of significance in the Shapiro-Wilk test ($p > 0.05$). Thus, after Winsorization and log transformation, the variable of balance acquired a normal distribution. Moreover, the final skewness and kurtosis values for the transformed variable had decreased to -0.02 (SE=0.26) and -0.21(SE=0.51), respectively. All analyses that follow use the log-transformed Winsorized dataset for balance. Figure 4 below illustrates the variable of balance, as measured by the OLST, pre-and post-transformation, and Winsorization.

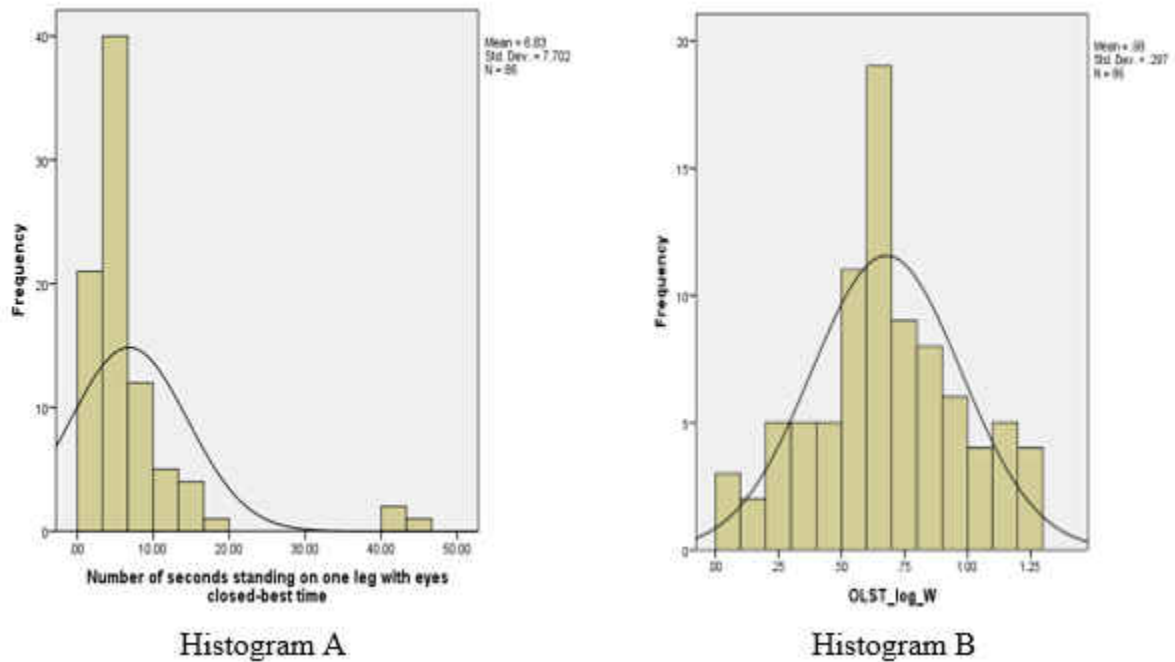


Figure 4 Histograms of the variable OLST by frequency.

The demographic control variables were also inspected for outliers. The continuous variable of waist circumference had one extreme outlier (Figure J5). Like the variable of age, waist circumference was normally distributed, as observed in the histogram (see Figures J6 & J8), with a skewness of 0.68 (SE=0.26) and a kurtosis of 0.75 (SE=0.51). Consequently, rather than transforming the complete data set, the extreme waist circumference value of 139.70 cm was Winsorized to the next lowest value of 124.46 cm.

The variable of ethnicity, as a whole, was identified as an outlier. Ethnicity, a categorical variable, presented with an uneven split of 90% for Caucasians to 10% for the other ethnicities combined (i.e., African American/black, Asian, Latino/Hispanic, & other). It is recommended that variables with highly uneven splits be removed from analyses to avoid deflated correlations (Tabachnick & Fidell, 2007); more specifically, deceptively small correlations with other variables (Rummel, 1970). Consequently, ethnicity was dropped from the analysis.

4.3.2 *Descriptive statistics*

Descriptive statistics for the demographic and main study variables are presented in the appendix (Tables I1 and I2). Chi-square and t-test analyses were conducted to compare the two groups of meditative vs. non-meditative neuromotor exercisers. No significant differences ($p > 0.05$) were found between the groups for the demographic characteristics.

The sample ($N= 86$) included females ($n = 66, 77\%$) and males ($n = 20, 23\%$); over 90% of the participants self-identified as Caucasian. While the study population was composed mainly of white females, this was expected as reviews of dance (Keogh et al., 2009) and Tai chi (Rogers, Larkey, & Keller, 2009) research on older adults reveal respective study samples typically do not reflect a broad range with respect to sex and ethnicity. The mean age of the sample was 69 years ($SD = 7.24$) ranging from 60 to 93 years, the majority ($n=65, 75.6\%$) of whom were retired. A further breakdown for age revealed that 16.10% of study participants over the age of 65 ($n=62, 72\%$) were employed, which was higher than the national average of 11.26% based on 2014 U.S. census data (United States Census Bureau, 2016).

The sample was evenly divided into a non-meditative movement ($n=43$) and a meditative movement ($n=43$) group. With respect to practice history, the non-meditative group consisted of dancers with a mean of 13.34 years ($SD=12.92$) of experience; the meditative group included practitioners of yoga ($n=25$) and Tai chi ($n=18$) who had a mean of 10.24 years ($SD=9.48$) of experience. Participants of both the non-meditative ($M = 3.40, SD = 1.58$) and meditative groups ($M = 3.42, SD = 1.87$) practiced a little more than 3 times per week.

Overall, the sample reflected a healthy, robust group of older adults. Notably, fewer than 20% ($n=17, 19.8\%$) experienced a fall in the past year. Next, almost one-third ($n = 28, 32.6\%$) reported taking no daily medications. With respect to body composition, the mean BMI ($M =$

25.32, SD = 4.65) was discovered to be slightly above the healthy weight range cut point of 24.9 (NIH, 1998). However, the waist circumference values obtained for both females (M = 86.59, SD = 13.52) and males (M = 101.35, SD = 11.45) were found to be less than the sex-specific cutoffs defined by the NIH (1998) for elevated risk of hypercholesterolemia, hypertension, type 2 diabetes, and cardiovascular disease of 88 cm and 102 cm, respectively.

Next, the main study variables of mindfulness and balance were compared across neuromotor exercise modes (Table I2). The independent sample t-test results for balance, as measured by the OLST, revealed no significant difference ($t(84) = -1.38, p=0.17$) between meditative (M=7.63, SD=8.68) and non-meditative movement (M=6.03, SD=6.58) groups. Alternatively, the MAAS scores were found to be significantly greater ($t(84) = 2.75, p < 0.01$) in the non-meditative (M=4.87, SD=0.61) vs. the meditative movement (M=4.48, SD=0.71) group. Notably, these results suggest that levels of mindfulness were greater in the older adult population of this study that practiced dance rather than those that practiced Tai chi or yoga.

In addition, the mean OLST results for participants of this study (M=6.83, SE=0.83) was found to be greater than the normative values (M= 4.40, SE=5.1) obtained from a study sample of community-dwelling older adults (n=101; age 60 to 69 years) (Springer, Marin, Cyhan, Roberts, & Gill, 2007). Similarly, the mean MAAS score obtained from participants of this study (M=4.67, SD=0.68) was greater than the mean score (M= 4.33, SD=0.69) obtained from a normative sample of community-dwelling older adults (n=134; mean age= 65.43 years, SD=9.5) (de Frias & Whyne, 2015). Remarkably, the older adults of this study who regularly practice neuromotor exercise were more mindful and had better balance than two normative populations of community-dwelling older adults from the published literature.

4.3.3 *Reliability analysis*

Finally, a reliability analysis was conducted on the MAAS scale which revealed a Cronbach's alpha of good internal consistency reliability, $\alpha = 0.85$ (Nunnally, 1978). The item-total statistics table revealed each of the 15-items to be important to the scale. Consequently, it was not necessary to remove any of the items, as this would lead to a decrease of α (Table I3).

4.4 Principal Data Analysis

4.4.1 *Assumptions of multiple regression analysis*

All three research questions were answered using multiple linear regression. Before conducting the regression analyses, tests of the assumptions of normality, linearity, and homoscedasticity were performed on all continuous predictor variables and control variables of interest. The normality of the main study variables of age and balance was addressed in the discussion on outliers. The study variable of the MAAS and the control variable of waist circumference were both found to have normal distributions as revealed by non-significant ($p > 0.05$) Shapiro Wilk's tests (Shapiro & Wilk, 1965), normally distributed histogram plots (see Figures J7 & J8), and skewness and kurtosis values of -0.33 (SE=0.26) and -0.52 (SE=0.51) for the MAAS, and 0.68 (SE=0.26) and 0.75 (SE=0.51) for waist circumference, respectively. The values for skewness and kurtosis for both variables were within the parameters of plus and minus one, consistent with normally distributed data (George & Mallery, 2016).

The variable of fall history was initially intended to be a continuous variable; however, the dataset was found to have only four levels of data, and these levels were unevenly divided. For instance, 80% of the participants reported no falls and the remaining 20% of the responses were distributed over three cells. Consequently, fall history was dichotomized into participants that

fell within the past year vs. participants that did not. Similarly, the ordinal variable of multiple medications had only six levels of data, which could be integrated into two categories with a meaningful cut point of those that took four or more medications, considered to be multiple medications (O’Halloran et al., 2011; Chang & Do, 2015), versus no medications.

Linearity was investigated, after the transformation and score alterations discussed above, using the scatterplot of the regression standardized residuals versus the standardized predicted values. There was a random distribution of positive and negative values across the entire range of the data set plotted on the horizontal and vertical planes, the points were scattered, and there was no obvious pattern, which is consistent with the assumption of linearity (Figure 5). The randomly scattered dots also illustrated that the data met the assumption of homoscedasticity as the errors were normally distributed, and the variances of the residuals were constant. The assumption of independence of errors was assessed by a Durbin-Watson statistic of 1.634, which was greater than 1.5 indicating that the residuals were not autocorrelated (Hutcheson & Sofroniou, 1999).

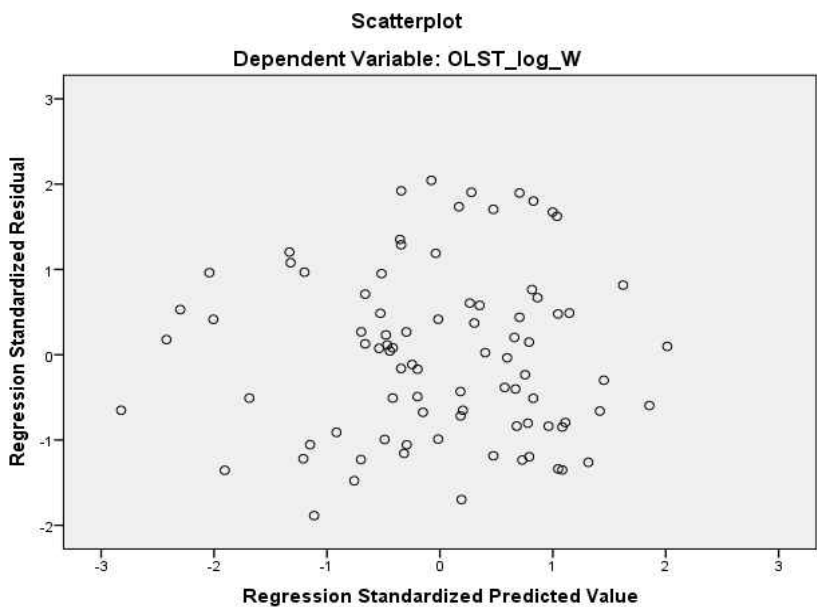


Figure 5 Scatterplot Graph

Multicollinearity was examined using zero-order Pearson correlations and the collinearity statistics of tolerance and the Variance Inflation Factor (VIF). It was discovered that waist circumference and BMI had tolerance values close to 0.1 corresponding to 0.194 (VIF = 5.14) and 0.243 (VIF =4.14), respectively, and the variables were highly correlated ($r = 0.81$, $p < 0.01$), indicating potential difficulties with multicollinearity (Keith, 2005). To prevent problems with multicollinearity, waist circumference was used in place of BMI to represent body composition. Waist circumference has been found to be a consistent measure of overweight and obesity in older adults (de Hollander et al., 2012) compared to BMI measures. In older adults, BMI has been discovered to be unreliable due to the losses in lean body mass and decreases in height associated with aging (Takata, Ansai, & Soh, 2007).

The next steps included coding the categorical variables of sex, neuromotor exercise mode, and fall history into dummy variables to facilitate interpretation using a linear model approach (Table I4). A matrix was then created using Zero-order Pearson correlations of the main study variables and the demographic control variables to determine if there were any associations between the variables (Table 4). With the assumptions met, multiple regression analyses were used to answer the following research questions.

Table 3 *Zero-order Pearson Correlations Between the Study Variables (N=86)*

Variable	1	2	3	4	5	6	7	8
1. OLST	-----	-.157	-.267**	-.199*	-.510**	-.062	.176*	.149
2. Waist Circumference		-----	.374**	.119	.157	.178*	.458**	-.107
3. Multiple Medications			-----	.138	.358	-.101	.161	.060
4. Fall History				-----	.150	-.170	-.135	.029

Variable	1	2	3	4	5	6	7	8
5. Age					-----	.113	.158	-.165
6. MAAS						-----	.106	-.287**
7. Sex							-----	-.110
8. Exercise Mode								-----

Notes. *Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level .

4.4.2 *Research Question One*

1. Does exercise mode predict balance in older adults who regularly practice neuromotor exercise?

Research question one was addressed in two parts. First, the entire sample (N=86) was examined, using a general multiple regression equation that included the main study variables. The dependent variable of balance was regressed on the independent variables of mindfulness, neuromotor exercise mode, sex, and age (Table 5). The analyses were then repeated using hierarchical regression to control for the effect of the demographic factors of body composition, multiple medications, and fall history revealed to be associated with balance (Table 6).

A standard multiple regression was conducted with the predictor variables of age, sex, MAAS, and exercise mode entered at the same time; the dependent variable was OLST (Table 5). Model one was significant, $F(4, 81) = 10.225, p < 0.001$, and accounted for 34% of the variance. Overall, increases in age were significantly ($B = -0.022, SE B = 0.004, p < 0.001$) associated with decreases in OLST and male participants had significantly ($B = 0.189, SE B = 0.064, p < 0.01$) greater OLST times than female participants (see Table I4 for coding). While age

and sex were significant predictors of OLST, the variables of MAAS and exercise mode were not significant (Table 5).

The importance of predictor variables to regression equations can be assessed through direct effects (i.e., zero-order correlations), total effects (i.e. β weights), and partial effects (i.e., squared semi-partial correlation coefficients) (Lebreton, Ployhart, & Ladd, 2004; Nathans, Oswald, & Nimon, 2012). For instance, exercise mode ($r= 0.149$, $p = 0.09$) and MAAS ($r= 0.149$, $p = 0.09$) were not significantly correlated with the OLST (Table 5), did not have significant regression weights $B = 0.053$ ($SE B = 0.056$, $p = 0.353$) and $B = -0.002$ ($SE B = 0.041$, $p = 0.967$), respectively, and the sum of their squared semi-partial correlations contributed to only 0.77% of the variance on OLST. Accordingly, MAAS and exercise mode were not important variables to the regression analysis. In response to research question one, exercise mode was not a predictor of balance, as measured by the OLST.

4.4.2.1 A More Efficient Model

The most efficient and accurate regression models aim to explain the highest amount of variance using the least number of predictors (Pedhazur, 1997). Consequently, a second regression model was created without the variables of exercise mode and MAAS. The revised model could predict participants' balance based on their age and sex. The regression equation was found to be statistically significant ($F(2, 83) = 20.221$, $p < .001$), with an R^2 of 0.328. Both age and sex were significant predictors of OLST ($p < 0.001$) (Model 2, Table 5) and were significantly correlated with OLST ($p < 0.05$) (Table 4); the change in variance between model one and two was minimal, R^2 change = 0.008. Also, model two had a lower Standard Error of

Estimate (SEE) (0.23908) than model one (0.24270), indicating a greater level of predictive accuracy (Palmer & Connell, 2009).

Table 4 Summary for the Regression of OLST on Predictor Variables

Variable	B	SE B	β	t	p
Model 1					
Constant	2.175	.330		6.596	.000***
Age	-.022	.004	-.538	-5.785	.000***
MAAS	-.002	.041	-.004	-.042	.967
Sex	.189	.064	.271	2.938	.004**
Exercise Mode	.053	.056	.089	.934	.353
Model 2					
Constant	2.235	.264		8.477	.000***
Age	-.023	.004	-.552	-6.051	.000***
Sex	.184	.064	.263	2.886	.005**

Notes. Model 1, $R^2 = .336$ (N=86, $p < .001$); Model 2, $R^2 = 0.328$ (N=86, $p < .001$); * $p < .05$, ** $p < .01$, *** $p < .001$

4.4.2.2 Hierarchical Regression

Next, a hierarchical regression analysis was conducted to control for the demographic variables of waist circumference, multiple medications and fall history. The demographic variables were entered in block one, and the main study variables of sex and age were entered in block two. The hierarchical regression model (Table 6) revealed that sex and age remained significant ($F(7, 78) = 6.619$, $p < 0.001$), with an R^2 of 0.379 after controlling for the demographic variables, the R^2 change was 0.278. While waist circumference was significant ($B =$

-0.005, SE B = 0.002, $p < 0.05$), multiple medications (B = -0.043, SE B = 0.076, $p = 0.573$) and fall history (B = -0.031, SE B = 0.068, $p = 0.653$) were not significant predictors of OLST. A second regression model was then developed to achieve a more efficient and accurate model (Table 7). The new model did not include the variables of multiple medications and fall history.

Table 5 Hierarchical Regression Analysis Summary for the Main Study and Demographic Variables Predicting OLST

Variable	B	SE B	β	t	p
Model 1					
Block 1					
Constant	.838	.213		3.927	.000***
Waist Circumference	-.001	.002	-.054	-.480	.632
Multiple Medications	-.170	.086	-.224	-1.976	.051
Fall History	-.120	.079	-.162	-1.529	.130
Block 2					
Constant	2.517	.340		7.413	.000***
Waist Circumference	-.005	.002	-.216	-2.020	.047*
Multiple Medications	-.043	.076	-.057	-.565	.573
Fall History	-.031	.068	-.042	-.451	.653
Age	-.021	.004	-.506	-5.281	.000***
Sex	.250	.072	.358	3.499	.001**

Notes. Model 1, Block 1, $R^2 = .101$ (N=86, $p = .033$); Block 2, $R^2 = .379$ with R^2 change = 0.278 (N=86, $p < .001$); * $p < .05$, ** $p < .01$, *** $p < .001$

Table 6 *Hierarchical Regression Analysis Summary for the Main Study and Demographic Variables Predicting OLST (Concise Model)*

Variable	B	SE B	β	t	p
Model 2					
Block 1					
Constant	0.981	.209		4.688	.000***
Waist Circumference	-.003	.002	-.157	-1.462	.148
Block 2					
Constant	2.625	.300		8.738	.000***
Waist Circumference	-.005	.002	-.245	-2.479	.015*
Age	-.022	.004	-.530	-5.969	.000***
Sex	.260	.069	.372	3.766	.000***

Notes. Model 2, Block 1, $R^2 = 0.025$ (N=86, $p = .148$); Block 2, $R^2 = 0.375$ with R^2 change = 0.350 (N=86, $p < .001$); * $p < .05$, ** $p < .01$, *** $p < .001$

In the second hierarchical regression model (Table 7), the dependent variable OLST was regressed on the independent variables of age, sex, and waist circumference. Waist circumference was entered in block one, then age and sex were entered in block two. This revised hierarchical regression model (Table 7) was significant, $F(3, 82) = 16.365$, $p < 0.001$, and accounted for 37.5% of the variance; the R^2 change was 0.350. After controlling for waist circumference, the regression coefficient for sex increased from $B = 0.184$ (SE B = 0.064, $p < 0.001$) (Model two, Table 5) to $B = 0.260$ (SE B = 0.069, $p < 0.001$) (Table 7); the regression coefficient was also greater than the zero-order correlation of sex with OLST ($r = 0.176$, $p < 0.05$) (Table 4). Consequently, waist circumference acted in the role of a traditional suppressor.

4.4.2.3 Suppressors

Conger (1974, p. 36) defined a suppressor as “a variable which increases the predictive validity of another variable by its inclusion in a regression equation.” Typically, suppressor variables are not correlated with the dependent variable, are highly correlated with another predictor variable, and enhance the value of the regression weight of the predictor (Conger, 1974). For example, waist circumference made a minimal contribution to the model ($B = -0.005$, $SE B = 0.002$, $p < 0.05$) (Table 7) and had a non-significant correlation with the dependent variable, OLST ($r = -0.157$, $p > 0.05$) (Table 4); however, waist circumference was significantly correlated with sex ($r = 0.458$, $p < 0.01$) (Table 4). Thus, waist circumference had a suppression effect on sex leading to an increase in the absolute value of the regression coefficient from $B = 0.184$ ($SE B = 0.064$, $p < 0.001$) (Model two, Table 5) to $B = 0.260$ ($SE B = 0.069$, $p < 0.001$) (Table 7) (Conger, 1974). Male waist circumferences are typically greater than females, as male fat distribution is central compared to the peripheral fat distribution pattern common for females (Karastergiou et al., 2012). Male OLST scores were higher than female scores, but the values were underestimated as a result of the higher male waist circumference. The inclusion of waist circumference in the final model suppressed unessential variance in the variable of sex, which facilitated an increase in the variance explained by sex from 6.76 to 10.82%.

In conclusion, research question one was answered. Exercise mode was not found to predict balance, as measured by the OLST, in older adults that regularly practice neuromotor exercise. Next, a regression model was discovered that remained statistically significant after controlling for the demographic variables associated with balance risk factors. The revised model contained the predictor variables of age and sex; this model was controlled for waist circumference. After controlling for waist circumference, the overall variance of the model

increased from 32.8 to 37.5%. The final model explained greater than one-third of the variability in balance, as measured by the OLS. Consequently, balance was predicted by age and sex, where waist circumference acted as a suppressor of sex.

4.4.3 *Research Question Two*

2. Does mindfulness mediate the relationship, if any, between exercise mode and balance?

Research question two involved the examination of mindfulness as a mediator between neuromotor exercise mode and balance. Three multiple linear regression equations were analyzed following Baron and Kenney's (1986) mediation protocol detailed in Chapter Three.

4.4.3.1 *Regression Equation One*

A simple linear multiple regression equation was conducted with exercise mode as the predictor and OLS as the outcome. The regression model was not significant, $F(1, 84) = 1.914$, $p = 0.170$, with an R^2 of 0.022 (Table 8). Neuromotor exercise mode was not a significant predictor of balance, as measured by OLS ($B = 0.088$, $SE B = 0.064$, $p > 0.05$).

4.4.3.2 *Regression Equation Two*

A second simple linear multiple regression analysis was performed with exercise mode as a predictor of the outcome, MAAS. Regression model two was significant, $F(1, 84) = 7.545$, $p < 0.01$, with an R^2 of 0.082 (Table 8). Exercise mode ($B = -0.390$, $SE B = 0.142$, $p > 0.01$) was a significant predictor of MAAS.

4.4.3.3 Regression Equation Three

Equation three included both exercise mode and MAAS as predictors and OLST, as the outcome. Regression model three was not significant, $F(2, 83) = 0.963$, $p = 0.386$, with an R^2 of 0.023 (Table 8). Exercise mode ($B = 0.085$, $SE B = 0.067$, $p = 0.209$) and MAAS ($B = -0.009$, $SE B = 0.049$, $p = 0.856$) were not significant predictors of OLST. Neither neuromotor exercise mode nor mindfulness are associated with changes in balance.

Table 7 Multiple Regression Summary for the Mediation Model

Variable	B	SE B	β	t	p
Equation 1 ^a					
Constant	.635	.045		14.091	.000***
Exercise Mode	.088	.064	.149	1.383	.170
Equation 2 ^b					
Constant	4.868	.101		48.426	.000***
Exercise Mode	-.390	.142	-.287	-2.747	.007**
Equation 3 ^c					
Constant	.678	.244		2.784	.007**
Exercise Mode	.085	.067	.143	1.265	.209
MAAS	-.009	.049	-.021	-.182	.856

Notes. ^a OLST was regressed on exercise mode. ^b MAAS was regressed on exercise mode. ^c OLST was regressed on exercise mode and MAAS. * $p < .05$, ** $p < .01$, *** $p < .001$

4.4.3.4 Mediation Test Results

Baron and Kenny's (1986) four conditions of mediation were tested. First, exercise mode should be a significant predictor of OLST in regression equation one but failed to meet this first condition. The second condition, however, was met as exercise mode was a significant predictor of MAAS in regression equation two. The third condition was not met, MAAS was not a significant predictor of OLST in regression equation three. The fourth condition was met as exercise mode was not a predictor of OLST in the regression equation three. Consequently, with only two of the four conditions for mediation satisfied, MAAS did not satisfy complete or partial (i.e., three of the four conditions) mediation. With respect to research question two, mindfulness, as measured by the MAAS, did not perform successfully as a mediator between exercise mode and balance.

Although the analysis did not support the role of mindfulness as a mediator, the analysis did reveal exercise mode to be an important predictor of mindfulness. In other words, significantly higher levels of mindfulness were found in non-meditative rather than meditative neuromotor exercisers; mindfulness was greater in dance participants compared to Tai chi and yoga participants. The importance of exercise mode, as a predictor, could also be demonstrated through direct, total, and partial effects with the outcome (Lebreton et al., 2004; Nathans et al., 2012). For instance, the direct effect of exercise mode on the dependent variable of mindfulness was revealed by a significant regression weight ($B = -0.390$, $SE B = 0.142$, $p > 0.01$); the total effect of exercise mode on mindfulness was supported by a significant zero-order Pearson correlation ($r = -0.29$, $p < 0.01$). Finally, the partial effect of exercise mode on the regression equation contributed to 8% of the variance in the outcome.

4.4.4 *Research Question Three*

3. Do the demographic variables of age and sex moderate the relationship, if any, between mindfulness and balance?

Finally, research question three involved the application of Baron and Kenny's (1986) moderator model; an overview of the model is outlined in Chapter Three. First, the continuous variables of age and MAAS were centered to a mean of zero to decrease the chance of multicollinearity between age, MAAS and the interaction variable (i.e., age X MAAS). Next, a hierarchical regression analysis was conducted to determine if age was a moderator between MAAS and OLST. In the first block, the variables of age and MAAS were entered. The first model was statistically significant, $F(2, 83) = 14.594, p < 0.001$, with an R^2 of 0.260 (Table 9). While age was a significant predictor of OLST ($B = -0.151, SE B = 0.028, p < 0.001$), MAAS was not ($B = -0.001, SE B = 0.028, p = 0.965$). In block two, the interaction term, age X MAAS, was entered to determine if the predictive ability model one would increase. Model two was also significant, $F(3, 82) = 9.620, p < 0.001$, with an R^2 of 0.260 and R^2 change of 0.000 ($p = 0.894$) (Table 12). Age remained a significant predictor ($B = -0.151, SE B = 0.028, p < 0.001$); however, MAAS ($B = -0.001, SE B = 0.028, p = 0.962$) and the interaction variable, age X MAAS ($B = 0.004, SE B = 0.028, p = 0.894$), were not significant. Consequently, age did not act as a moderator between MAAS and OLST.

A second hierarchical regression analysis was performed to examine the role of sex as a moderator between MAAS and OLST. In block one, the variables of sex and MAAS were entered. The resulting model was not significant, $F(2, 83) = 1.618, p = 0.204$, with an R^2 of 0.038 (Table 10). Moreover, the variables of sex ($B = 0.129, SE B = 0.076, p = 0.092$) and MAAS ($B = -0.024, SE B = 0.032, p = 0.455$) were not significant. Block two contained the interaction

variable, sex X MAAS. Once again, the second hierarchical regression model (Table 10) was not significant, $F(3, 82) = 1.126$, $p = 0.343$, with an R^2 of 0.040, and R^2 change of 0.002. The variables of sex ($B = 0.124$, $SE B = 0.077$, $p = 0.110$), MAAS ($B = -0.031$, $SE B = 0.036$, $p = 0.395$), and sex X MAAS ($B = 0.034$, $SE B = 0.081$, $p = 0.677$), were not significant. Thus, sex was not a moderator between MAAS and OLST. In response to research question three, neither age nor sex were significant in the role of moderators between mindfulness and balance, as measured by the MAAS and OLST, respectively.

Table 8 *Hierarchical Multiple Regression Summary for OLST Predicted from Age, MAAS, and Age X MAAS*

Variable	B	SE B	β	t	p
Block 1					
Constant	.679	.028		24.352	.000***
Age ^a	-.151	.028	-.510	-5.363	.000***
MAAS ^a	-.001	.028	-.004	-.043	.965
Block 2					
Constant	.678	.028		24.046	.000***
Age ^a	-.151	.028	-.510	-5.330	.000***
MAAS ^a	-.001	.028	-.005	-.048	.962
Age X MAAS ^a	.004	.028	.013	.133	.894

Notes. ^a Variable has been centered. Block 1, $R^2 = 0.260$ ($N=86$, $p < .001$); Block 2, $R^2 = 0.260$ with R^2 change = 0.000 ($N=86$, $p = 0.894$); * $p < .05$, ** $p < .01$, *** $p < .001$

Table 9 Hierarchical Multiple Regression Summary for OLST Predicted from Sex, MAAS, and Sex X MAAS

Variable	B	SE B	β	t	p
Block 1					
Constant	.649	.036		17.854	.000***
Sex	.129	.076	.185	1.705	.092
MAAS ^a	-.024	.032	-.081	-.751	.455
Block 2					
Constant	.648	.037		17.748	.000***
Sex	.124	.077	.178	1.615	.110
MAAS ^a	-.031	.036	-.104	-.855	.395
Sex X MAAS ^a	.034	.081	.051	.418	.677

Notes. ^a Variable has been centered. Block 1, $R^2 = 0.038$ (N=86, $p = 0.204$); Block 2, $R^2 = 0.040$ with R^2 change = 0.002 (N=86, $p = 0.343$); * $p < .05$, ** $p < .01$, *** $p < .001$

4.5 Summary

Chapter four presented an examination of the data using both descriptive and multiple regression analyses. The results were addressed for each research question. A few brief outcomes are highlighted here. First, mindfulness levels were found to be greater in dancers than those that practiced Tai chi and yoga. Second, levels of balance decreased with increasing age and were greater in males than in females. Third, levels of both balance and mindfulness were found to be higher in study participants than in community-dwelling normative populations reported from the literature. Chapter Five will provide a more detailed summary and interpretation of the

findings. The next chapter will also describe the study limitations and discuss the implications of the findings for theory, research, practice, and policy.

CHAPTER 5: DISCUSSION

5.1 Introduction

Falls are reported to be the number one cause of injury-related morbidity and mortality in older adults in the U.S (CDC, 2016), and the second highest cause of death, globally (WHO, 2017). Medicare expenditures in the U.S. from fall-related injuries were over 31-billion dollars in 2015 (Burns, Stevens, & Lee, 2016), corresponding to European annual medical costs reported to be 25 billion euros (i.e., 30 billion USD) (Turner, Kisser, & Rogmans, 2015). Participation in physical exercise, particularly neuromotor exercise, has been found to significantly improve balance in older adults (Gobbo, Bergamin, Sieverdes, Ermolao, & Zaccaria, 2014). Unlike, conventional forms of physical exercise (strength training, aerobic exercise), neuromotor exercises are multi-modal activities that target cognitive motor skills associated with balance, agility, proprioception, coordination, and gait (Garber et al., 2011). Different classes of neuromotor exercise include moving meditative (e.g., Tai chi, yoga) and non-meditative styles (e.g., ballroom dancing). While mindfulness is a factor commonly associated with moving meditative neuromotor exercises, it is unknown if mindfulness is also present in non-meditative forms of neuromotor exercise that lack a meditative component. The purpose of this study was to examine differences in mindfulness and balance in meditative and non-meditative forms of neuromotor exercise in older adults.

5.2 Summary of the Findings

Overall, the sample reflected a healthy, robust group of older adults, most of whom were white females. The descriptive analysis also revealed that older adults of this study who regularly

practice neuromotor exercise were more mindful and had better balance than when compared to normative populations of community-dwelling older adults in the published literature.

For research question one, exercise mode was not found to predict balance in older adults that regularly practice neuromotor exercise. Instead, a regression equation was developed that remained statistically significant after controlling for the demographic variables associated with balance risk factors. The equation was revised to a more precise and efficient model that revealed, both age and sex predicted balance, and waist circumference acted as a suppressor of sex. In other words, when waist circumference was included, waist circumference served to decrease the unnecessary error variance associated with sex, which in turn led to an increase in the ability of sex to predict balance. With regards to suppression, the OLS times of males were underestimated, as males typically have greater waist circumferences than females. Overall, balance decreased with increased age and was greater in males than in females. This finding suggests that while strategies to improve balance could include either meditative or non-meditative neuromotor exercise, one could expect different benefits of exercise based on age or sex.

Concerning research question two, mindfulness, as measured by the MAAS, did not perform successfully as a mediator between neuromotor exercise mode and balance. It was found that while non-meditative neuromotor exercisers had significantly higher levels of mindfulness than meditative neuromotor exercisers, this relationship was not significantly associated with balance. This result indicates a need for further study of the association of mindfulness and balance.

Finally, in response to research question three, hierarchical regression analyses revealed that there were no significant moderator effects for either age or sex between mindfulness and

balance, as measured by the MAAS and OLST, respectively. Thus, the relationship between mindfulness and balance was not significantly different between males and females and did not become significantly stronger or weaker with changes in age. The result that either sex or age did not moderate mindfulness and balance may have broad implications for prescriptive practices that target mindfulness and balance.

5.3 Interpretation of the Findings

1. Does exercise mode predict balance in older adults who regularly practice neuromotor exercise?

The result that balance was not significantly different between meditative and non-meditative exercise modes indicates that both dancers and practitioners of Tai chi and yoga had similar levels of balance, as measured by the OLST. This finding conflicted with Rahal's et al. (2015) cross-sectional study, which is the only known study also to have examined balance in older adult practitioners (N=76; age= 60 + years) of Tai chi versus ballroom dance. Rahal et al. (2015) found balance, as measured with the OLST (eyes closed), to be significantly ($p < 0.001$) better in dancers than Tai chi participants. A notable distinction of Rahal's et al. (2015) study, was that balance was measured using a force platform system that provided three indices of sway data, which may be a consideration for future studies.

The multiple regression analyses for research question one did reveal that measures of balance were found to decrease with increases in age and males were found to have significantly higher levels of balance than females. The results are consistent with previous studies that used static balance measures, which support that decreases in postural balance occur with increases in age (Coelho et al., 2016; Nakagawa et al., 2017; Springer et al., 2007), and with Riva's et al.

(2013) finding that females (age = 75 years and older) had lower levels of balance than males. Most of the studies that have investigated sex as a predictor of balance using the OLST have found no significant differences between males and females (Nakagawa et al., 2017; Faraldo-García et al., 2012; Springer et al., 2007). The conflicting findings in this study may be a result of preexisting differences between populations. The sample of this study consisted of older adults that regularly practice neuromotor exercise, which has been associated with increased levels of postural balance (Lu et al., 2013; Wayne et al., 2014). Further studies that target sex as a predictor of balance in selected samples of older adults experienced in neuromotor exercise may provide insight.

On another note, while the majority of values for balance, as measured by the OLST, were normally dispersed after a logarithmic transformation of the data, there remained three extreme outliers for balance recorded as 40.00, 40.93, and 46.15 seconds, which corresponded to participants of Tai chi, dance, and yoga, respectively. As there were only three cases, the values were Winsorized to prevent an increase in error variance. It is interesting to note that the three cases reflected a narrow range of scores, between 40 to 46 seconds, at the upper limit of the balance data set. Given that these cases had values close to the recommended cut off time of 45-seconds (Hurvitz et al., 2000; Springer et al., 2007), it is possible that the scores may have reflected a ceiling effect.

Alternatively, ceiling effects have been discovered in some studies as a consequence of imposed 30-second time limits, adopted to facilitate the measure of the OLST (Althomali & Leat, 2017; Bohannon, 2006). Other researchers extended the 30-seconds to 45-seconds as a strategy to decrease the consequence of ceiling effects resulting from time limits (Hurvitz et al., 2000; Springer et al., 2007). Ceiling effects unrelated to forced cut off times have not been found

in the literature for older adults using the OLST (eyes closed condition). Future studies may obtain a sample size, large enough to support a statistical analysis, of cases with OLST values greater than 40-seconds in older adults experienced in neuromotor exercise. These future studies could evaluate the potential of a ceiling effect by examining the cases as a subpopulation (Keith, 2005).

2. Does mindfulness mediate the relationship, if any, between exercise mode and balance?

Although this is the only study known to have examined the role of mindfulness as a mediator between exercise mode and balance, a few recent studies have found mindfulness to successfully mediate a range of psychosocial relationships (Akin, Akin, & Ugur, 2016; Arslan, 2017; Perona-Garcelán et al., 2017). The mediation analysis for this study did not reveal mindfulness to be a mediator but did show that exercise mode significantly predicted mindfulness. Remarkably, mindfulness was found to be greater in older adults that practiced non-meditative than meditative neuromotor exercise. More specifically, not only were the dancers mindful, they were significantly more mindful than practitioners of yoga and Tai chi. The only known study to measure the influence of ballroom dance on levels of mindfulness with the MAAS, was Pinniger's et al. (2013) study on a sample of depressed adults (N=64; age range= 18 to 68 years). As the participants self-reported as depressed, the MAAS scores after the dance intervention, although significantly improved, were still low (i.e., $M=3.84$, $SD =0.81$) compared to de Frias & Whyne's (2015) normative population of community-dwelling older adults (i.e., 4.33 , $SD=0.69$), which in turn were lower than the dance participants of this study (i.e., 4.87 , $SD=0.69$).

To date, this is the only study known to investigate and compare mindfulness levels between those that practice meditative versus non-meditative forms of neuromotor exercise.

However, studies can be reviewed from both the non-meditative and meditative movement literature to place the findings of this study into context with related research. Concerning non-meditative movement literature, Pinniger's et al. (2013) study mentioned above compared a ballroom dance group to meditation and exercise groups. Details of the intervention describe how mindfulness concepts, consistent with Kabat-Zinn's (1990) principles (e.g., paying full attention in the moment, awareness) were emphasized to participants at the beginning and during each dance session. The study results revealed improvements in mindfulness and measures of depression for the ballroom dancers. While it was found that mindfulness improved in dancers, it does not necessarily follow that mindfulness was influenced by dance, the levels may have increased as a consequence of the mindfulness principles participants were encouraged to follow with each session. Finally, no non-meditative movement neuromotor exercise studies have been found that have investigated mindfulness with respect to balance.

In the meditative movement research, two intervention studies were found that led to improvements in balance, yet had conflicting results for mindfulness. For instance, researchers found significant increases in balance ($p < 0.05$) as measured by the OLST, but no significant improvements in mindfulness levels as measured by the Kentucky Inventory of Mindfulness (Baer et al., 2004) after an eight-week yoga intervention (Howie-Esquivel et al., 2010). Alternatively, a second eight-week yoga study did find significant improvements ($p < 0.050$) in both balance (OLST) and mindfulness levels (Hewett et al., 2012). Mindfulness was measured with the Five Facet Mindfulness Questionnaire (Baer et al., 2006). Although both meditative movement studies examined the variables of balance and mindfulness, it is difficult to draw conclusions from the studies, as different mindfulness measures were used.

2. Do the demographic variables of age and sex moderate the relationship, if any, between mindfulness and balance?

As mindfulness was not significantly related to balance, neither sex nor age acted as moderators between mindfulness and balance. In other words, a relationship between mindfulness and balance was not supported by older adults of any age or sex. Furthermore, mindfulness was not directly related to either sex or age as revealed by the zero-order Pearson correlations conducted in Chapter Four. More specifically, the capacity to be mindful is not limited by age or sex. This outcome has significant implications for practice given that older adults and males have been found to be less likely to participate in mind-body practices (i.e., Tai chi, yoga, and qigong), than younger adults and females (Clarke et al., 2015; Olano et al., 2015).

Taken together, these findings suggest that older adults who regularly practice neuromotor exercise, whether meditative or non-meditative, are more mindful and have higher levels of balance than older adults that do not practice these activities. This was a curious finding considering that a direct relationship between mindfulness and balance was not revealed either in the zero-order Pearson correlations or through the regression analyses for research questions one and two reported in Chapter Four. What the results did show were some important relationships amongst the main study variables of age, sex, mindfulness, and balance. Although balance decreased as age increased and was greater in males compared to females, age or sex did not influence levels of mindfulness. An unexpected discovery was that mindfulness was found to be greater in older adults that practiced non-meditative rather than meditative neuromotor exercise. More specifically, dancers in this study were more mindful than those that regularly participated in exercises, such as Tai chi and yoga, which typically involve a meditative component. This finding indicates that formal meditation may not be essential for mindfulness behavior and it also

suggests the possibility that mindfulness may function differently in dance. The implications of these findings for theory, research, practice, and policy are presented in section 5.5.

5.4 Limitations of the Study

The study had the following limitations. First, the sample consisted mostly of white females, which was an expected finding and consistent with other Tai chi, yoga, and dance studies involving older adults in the U.S., which typically are not diverse with regards to ethnicity and sex limiting the generalizability of the findings (Keogh et al., 2009; Rogers, Larkey, & Keller, 2009). Furthermore, as less than ten percent of the participants in this study had self-identified as an ethnicity other than Caucasian, ethnicity was not examined in this study as a fall risk factor. This was an additional shortcoming as this study was unable to uncover findings that support the African American ethnic advantage, whereby African Americans were discovered to benefit from lower fall rates than Caucasians and Hispanics (Han et al., 2014; Sun et al., 2016). One strategy to achieve a sample reflecting a balanced representation of African American participants would be to recruit participants from geographical areas described as minority-majority. For instance, Du, Roberts, & Xu (2017) were successful in recruiting equal numbers of African American's (n=9) and Caucasians (n=9) from the minority-majority city of New Orleans for their pilot study of the effects of music on Tai chi practice.

Second, selection bias may have been a threat to the internal validity of the study. Polit & Beck (2012) describe selection bias as a threat that occurs when distinguishing characteristics exist among groups that are not associated with the independent variable by design, yet influence the dependent variable. The study population consisted of robust, healthy older adults, which may have been a result of the strict exclusion criteria employed. An alternate option to consider

is that the participants of this study may have had better levels of balance than the community-dwelling normative population, not for the reason of neuromotor exercise practice, but because they had better health.

Third, the cross-sectional design of this study may have posed a limitation. As the variables were measured on only one occasion, the researcher is unable to examine the process (Gay, Mills, & Airasian, 2014) and the factors that may have led to the differences observed (Polit & Beck, 2012). For instance, the finding that the participants in this study were more mindful than older adults from a community-dwelling normative population does not inform regarding the source of mindfulness. There may be alternative reasons to account for this study finding. A short debrief that asked participants about any purposeful mindfulness experiences (e.g., prayer, devotional reading, nature walks) might have revealed activities that increased their levels outside of physical activity. Also, the study participants may have had a predisposition for mindfulness which led to an affinity for neuromotor exercises, such as dance, Tai chi, and yoga as opposed to mindfulness being a consequence of neuromotor exercise practice. Polit & Beck (2012) recommend longitudinal study designs as a more effective strategy to examine processes and make conclusions about data compared to cross-sectional designs and should be a consideration for future research.

Fourth, the study relied on self-report data for both the demographic information as well as the mindfulness measure (i.e., MAAS). As mentioned in Chapter Three, self-report data can lead to problems with recall bias particularly in populations of older adults. A link between self-report data and under-reported falls has been well-documented in fall prevention literature (Day et al., 2002; Mitchell & Newton, 2006; Verghese et al., 2002). In this study, the investigator observed that some participants relied upon memory cues (e.g., medication lists, appointment calendars) to

assist them in completing the demographic questionnaire. The researcher can also provide memory aids; for instance, a timeline scrapbook can be created that highlights significant news events from the past year, which may help the participant to place their life events into perspective (Sobell et al., 1990).

5.5 Recommendations

The following recommendations for theory, research, policy, and practice are proposed with respect to the findings, strengths, and limitations discussed.

5.5.1 *Theoretical Implications*

One of the most noteworthy findings of this study was the presence of higher levels of mindfulness in older adults that practice non-meditative compared to meditative neuromotor exercise. Significant implications of this finding suggest that a formal meditative component may not be an essential element of neuromotor exercise. As mentioned earlier, dance as a non-meditative movement exercise may function differently from Tai chi and yoga, which are typically associated with meditation.

The unexpected nature of this finding is an indication of the need to revise the Mindfulness Cultivation Model to accommodate for the unique difference. Recall from Chapter Two that the cultivation of mindfulness was dependent on seven attitudes (i.e., Table 1) based on the principles of Kabat-Zinn (1990) and the motivational components of autonomy, interrelatedness, and competence, from Deci and Ryan's (1985) SDT. Both attitude and motivation are described as antecedent to the cultivation mindfulness through meditation (Kabat-Zinn, 1990). Langer claims that meditation is unnecessary for the induction of mindfulness (Langer & Moldoveanu,

2000), which is in line with this study's findings that the dancers were mindful. On the one hand, meditation is not practiced with dance; thus, the MCM could be modified with a separate pathway for dance that excludes both the antecedents of attitude and motivation. On the other hand, the attributes of attention, self-regulation, and awareness are essential in the approaches of both Kabat-Zinn (1990) and Langer (Delizonna, Williams, & Langer, 2009; Langer & Moldoveanu, 2000); thus, the remainder of the MCM will remain unchanged. Accordingly, dancers would begin the process of mindfulness induction at the attribute stage of the model; the process would entail the integration of attention, self-regulation, and awareness, which lead to mindfulness.

To illustrate, Langer's model involves the induction of mindfulness with the use of attentional focus to contemplate unique distinctions (Langer & Moldoveanu, 2000). Thus, the individual self-regulates their attention to the novel variations occurring during a process or task; ultimately, the process will bring about an enhanced degree of awareness. Examples from the literature cited in Chapter Two included Delizonna, Williams, & Langer's (2009) study of the emotional regulation of heart rate fluctuations and Kee's et al. (2012) examination of study participants' regulation of balance while attending to the sensation of water. Of relevance for this study, Kee et al. (2012) found the regulation of postural balance to be more successful when subjects focused on external rather than internal cues during mindfulness induction. This finding was consistent with Langer's beliefs that mindfulness induction concentrates predominantly on external stimuli (Bishop et al., 2004) and the environment (Langer & Moldoveanu, 2000). The emphasis on an increased awareness of the environment is compatible with the dancer's need to continually attend to external cues (e.g., partner, music, dance floor), in contrast to the Tai chi

practitioner's attention to maintaining a balance between breathing and energy, which are internal cues (Wayne & Fuerst, 2013).

To advance our theoretical understanding of how mindfulness is acquired, it is necessary first to consider the mode of exercise practiced and then explain the role of attentional focus associated with that specific mode of neuromotor exercise. Thus, this study has taken a major step forward by comparing two modes of exercise that differ by an internal versus an external attentional focus. The Constrained Action Hypothesis (Wulf, 2001), presented in Chapter Two, proposed that an external attentional focus was necessary for successful motor skill performance; the findings of this study, however, revealed that although the exercise modes studied differed by attentional focus, they resulted in similar motor skill performance outcomes, with respect to balance. Moreover, each mode of exercise was defined by a difference in attentional focus and was associated with differences in mindfulness levels. More specifically, the exercise with an external focus (i.e., dance) was found to be associated with greater mindfulness compared to exercises with an internal focus of attention (i.e., Tai chi, yoga, & qigong). Consequently, mindfulness levels may be dependent on the attentional focus associated with the specific mode of neuromotor exercise.

The findings from this study challenge the work of previous researchers in the areas of attentional focus and mindfulness. First, the CAH may not apply to mind-body activities that have a meditative component and apply an internal attentional focus. Next, conventions of mindfulness that stress meditation as an essential component for mindfulness cultivation may not be compatible with all modes of mind-body exercises associated with mindfulness. Consequently, the findings of this study shed new light on mindfulness in both modes of neuromotor exercise, which earlier studies had not addressed.

5.5.2 *Research*

The implications for further research were identified in the presentation of the findings and the discussion of limitations. The design of future studies that examine both mindfulness and balance in older adults could take into consideration the recommendations proposed in this chapter. Some notable suggestions included the development of a longitudinal design study to examine the processes of mindfulness and balance over time, the use of force platform technology to increase the precision and accuracy of balance measures, and the recruitment of participants from minority-majority populations for the investigation of the ethnic advantage that African Americans may have with balance.

Although a direct association between mindfulness and balance was not found in this study, research mentioned earlier by Kee et al. (2012), revealed that balance levels, as measured by the OLST, could be significantly increased through the practice of mindfulness induction. The approach Kee et al. (2012) used to enhance balance was consistent with Langer's beliefs, where mindfulness can be acquired by way of performing a behavior which required attention (Langer & Moldoveanu, 2000). In addressing the potential of a relationship between mindfulness and balance, it is possible that the measures used in this study (i.e., MAAS & OLST) were not broad enough to capture a relationship. Accordingly, it is recommended that this study be replicated with regard to the principles of both Kabat-Zinn and Langer, which may inform on mindfulness cultivation and induction. Consequently, the Langer Mindfulness Scale (Pirson et al., 2012) should be considered as a measure of mindfulness to supplement the MAAS. Another option would be to add a second measure of balance to complement the OLST. The Timed Up and Go (TUG) is a dynamic balance test used commonly in meditative and non-meditative neuromotor exercise research (Fernández-Argüelles et al., 2015; Manor et al., 2014; McKay, Ting, &

Hackney, 2016; Ory et al., 2015; Yildirim et al., 2016); the TUG has been found to be positively correlated ($r = 0.40$; $p < 0.01$) with OLST static balance measures in older adult females (Vaillant et al., 2006). The addition of the LMS and the TUG may contribute further insight into the process of mindfulness with respect to balance, in both modes of neuromotor exercise.

5.5.3 *Practice*

The findings of this study have practice implications for both balance and mindfulness. Healthcare providers should take into consideration differences in sex and age when assessing and prescribing fall prevention strategies for their clients. Although males were found, in this study, to have better balance than females, males were also reported to participate in mind-body exercise less often than females (Clarke, 2015; Olano, 2015) and may be more of a challenge to motivate. Older adults may be motivated to maintain activities if they participate in a program that they have selected (Merom et al., 2012). The results from this study suggest the option to choose from a range of available exercises is feasible, given that both modes of neuromotor exercise were similar with respect to levels of balance. All older adults, however, should be encouraged to participate in neuromotor exercise, especially as the participants of this study had better levels of mindfulness and balance than community-dwelling normative populations of older adults in the published literature.

Other considerations for practice include the evaluation of a client's level of mindfulness. A review of the literature suggested attentional focus may be facilitated by mindfulness (Chiesa, Calati, & Serretti, 2011; O'Halloran et al., 2011; Teper & Inzlicht, 2013), which has implications for all older adults given the attentional regulation of balance increases with aging (Huxhold et al., 2006). While this study found the capacity for mindfulness was not associated with

differences in age or sex, clients with low levels of mindfulness or those with a known genetic predisposition to neurodegenerative disorders, which are found to be associated with increased falls (Paillard et al., 2015), should be encouraged to consider ballroom dance. A frequently cited study by Verghese et al. (2003), found that older adults who regularly participate in dance were reported to have a 76% less risk of developing dementia. The past literature and the findings of this study will have important applications in practice for older adults in general, as well as in special populations of older adults diagnosed with cognitive impairment (e.g., Parkinson's disease, Alzheimer's disease).

5.5.4 *Policy*

While, mind-body exercises are promoted by the National Center for Complementary and Integrative Health (NCCIH, 2013) for better health, neuromotor exercise programs offered in the community are currently not eligible for reimbursement by major private health insurance providers (Aetna, 2017; Frankel, Bean, & Frontera, 2006; HealthPartners, 2017; United Health Care Services, 2017). One exception is the Silver Sneakers program, a fitness program consisting of exercise classes developed for older adults. Silver Sneakers is free to older adults that participate in the Medicare Advantage Program, although some plans may not cover this benefit (Tivity Health, 2017). Not all Silver Sneakers programs include Tai chi and yoga, and the availability of specific types of exercise is highly variable between fitness centers across the country.

It is worth noting that Silver Sneakers programs are mostly offered in gyms and fitness centers. Sites intended for traditional exercise are not optimal for the practice of dance, yoga and Tai chi; instead, classes should be conducted in environments that are designed specifically for

each neuromotor exercise. With respect to dance, studios are equipped with specialized floors to protect against injury. For instance, dance floors are often sprung, which is described as a low degree of stiffness (Hackney et al., 2011), and floors are also slip resistant (Wanke et al., 2012). Likewise, peaceful environments are best suited for yoga and Tai chi practice (Chua et al., 2003). Policymakers and private health insurance providers should consider the benefits of extending current reimbursement privileges to established facilities in the community that are designated for the practice of each specific neuromotor exercise (e.g., dance and yoga studios); classes should also be taught by experienced, certified instructors.

The goal of providing older adults with neuromotor exercise programs that are safe, effective, and affordable, seems plausible in the near future. Beattie & Schneider (2012) developed a *State Policy Toolkit for Advancing Fall Prevention* through the National Council on Aging, which outlines strategies that can be used to facilitate health policy changes. The first step of initiating a policy change would be to call attention to current peer-reviewed research that provides sufficient evidence of significant improvements in fall prevention with strategies that target neuromotor exercise. Results from this study have revealed the importance of dance for both balance and mindfulness; like Tai chi, dance should also be recognized as a fall prevention strategy. The dissemination of research efforts on neuromotor exercise, inclusive of dance, balance, and mindfulness to policymakers, healthcare providers, and older adults is a priority. One method of promoting research could be through social media campaigns. Fall prevention coalitions can also be developed at the state level with the goal of achieving funding for research and reimbursement for programs (Beattie & Schneider, 2012).

5.6 Conclusions

This study examined differences in mindfulness and balance in meditative and non-meditative forms of neuromotor exercise in older adults. Insights obtained from this study revealed the presence of mindfulness in neuromotor activities that do not contain a formal meditative component. In turn, this suggests that mindfulness can be cultivated through the practice of any neuromotor exercise. Moreover, mindfulness was found to be greater in non-meditative than meditative exercises. Taken together, the findings indicate that the process of mindfulness may function differently in dance. While an external focus of attention is important for dance, an internal focus is preferred in the practice of Tai chi and yoga. The noteworthy distinction is in the cultivation of mindfulness through meditation for Tai chi and yoga, compared to the induction of mindfulness through the actual practice of dance itself, an approach to mindfulness more aligned with Langer than Kabat-Zinn. Further research is recommended to examine the differences in mindfulness processes between modes of exercise, and modification of the MCM is necessary to reflect a combination of both mindfulness approaches. The implications for policy included recommendations to raise the awareness of health policy decision makers of research that supports the relevance of neuromotor exercise, inclusive of dance, as an important fall prevention strategy.

APPENDIX A: BALLROOM DANCE FLYER

If you are an experienced ballroom dancer,
then you are invited to take part in ...



A Mind-Body Exercise Study

Adults, 60-years of age and older, are invited to participate in a study that examines the benefits of Mind-Body exercise. Each participant will be given a Publix gift card. If you would be interested in learning more and participating in this important study, please contact Maxine Hicks at the email address provided below.

Contact Information

Maxine Hicks

xinehicks@knights.ucf.edu

(386)235-6470

APPENDIX B: TAI CHI & YOGA FLYER

If you have experience with Tai chi or yoga,
then you are invited to take part in ...



A Mind-Body Exercise Study

Adults, 60-years of age and older, are invited to participate in a study that examines the benefits of Mind-Body exercise. Each participant will be given a Publix gift card. If you would be interested in learning more and participating in this important study, please contact Maxine Hicks at the email address provided below.

Contact Information

Maxine Hicks

xinehicks@knights.ucf.edu

(386)235-6470

APPENDIX C: CONSENT FORM



THE MIND BODY EXERCISE STUDY

Informed Consent

Principal Investigator: Maxine Hicks, MSN, ARNP

Co- Principal Investigator/
Faculty Advisor: Susan K. Chase, EdD, FNP-BC, FNAP

Investigational Sites:

- Quanita's Ballroom
- Tai Chi by the Sea
- Beach Side Tai Chi
- Yoga Circle and Dance
- Yoga Bala
- Sacred Strength Healing Arts
- USA Dance (Greater Daytona)

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this, we need the help of people who agree to take part in a research study. You are being invited to take part in a research study which will include about 86 people in Central Florida. You have been asked to take part in this research study because you are experienced in the practice of either Tai chi, yoga, or ballroom dance. You must be 60 years of age or older to be included in the research study. The person doing this research is Maxine Hicks of the UCF College of Nursing. Because the researcher is a graduate student, she is being guided by Susan K. Chase, EdD, FNP-BC, FNAP, a UCF faculty advisor in Nursing.

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this study will be to focus on the link between mindfulness and balance. Adults over the age of 60 that practice Tai chi, yoga, and ballroom dancing, will be studied.

What you will be asked to do in the study: You will be asked to complete (2) paper-pencil questionnaires. One has 11 questions, and the second has 15 questions. Also, measurements will be taken of your height, weight and waist circumference. Finally, you will be asked to stand on one leg with your eyes open, and arms crossed over your chest. This stance will be held for as long as possible and the time in seconds will be measured. The trial will be repeated three times. Next, you will be asked to stand on one leg with your eyes closed, and arms crossed over your chest. This stance will be held for as long as possible and the time in seconds will be measured. The trial will be repeated three times. If you feel unstable, you may open your eyes and stop the test immediately. The primary investigator (PI) will be at your side, and you will wear a gait belt, during the exercise to ensure your safety. You do not have to answer every question or complete every task.

Location: Data will be gathered at Tai chi, yoga, and dance studios.

Time required: We expect that you will be in this research study for 20-minutes.

Risks: There are **MINIMAL** anticipated risks with this study. You will receive a copy of this consent form to read and keep for your records. The PI will answer any questions you may have regarding the study. The risks involved in this study are no greater than participation in the community activity programs through which you are currently involved (e.g. Tai chi, yoga, ballroom dance). More specifically, minimal risks include the possibility of falling and loss of time. The PI will be at your side, and you will wear a gait belt during the exercise, for safety and to prevent any falls. The PI is a registered nurse with fall safety training. If you become tired during the session, you may stop the study or return at another time to finish. Also, some people may find the questions to be personal. Your responses will be kept private and confidential. Your name will not be linked to data collected as part of the study.

Compensation or payment:

Compensation for taking part in the study will be a Publix gift card valued at \$10. If you finish any part of the study, you will get compensation for your effort.

Confidentiality: We will limit personal data collected in this study to people who have a need to review this information. We cannot promise complete secrecy.

Organizations that may inspect and copy your information include the IRB and

other representatives of UCF. Your information will be assigned a code number.

All questionnaires and associated paperwork will be kept in a locked cabinet at the University of Central Florida, where only the Co-PI will have the key.

Withdrawal: Your participation in this study is voluntary. There is no penalty for not participating. You have the right to withdraw from the study at any time without penalty. If you have any physical problems during participation, such as the inability to stand on one leg, you may withdraw and will still receive the \$10.00 Publix gift card as compensation for your time.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt you, talk to Maxine Hicks, Doctoral Student, College of Nursing (386) 235-6470; Dr. Susan Chase EdD, FNP-BC, FNAP, Associate Dean for Graduate Affairs (407) 823-3079

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of

Central Florida, Office of Research & Commercialization, 12201 Research Parkway,
Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may
also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

If you wish to have a copy of the results, information regarding the results, please provide your contact information:

Name: _____

Email: _____

APPENDIX D: DEMOGRAPHIC INFORMATION FORM

Subject Code # _____ Date _____ Time _____ Setting _____

Demographic Questionnaire

1. Date of Birth: _____ / _____ / _____
(month/day/year)

2. Sex (circle): Male Female

3. Employment (circle): Employed Retired

4. Ethnicity (check):

African American _____

Asian _____

Caucasian/White _____

Hispanic/Latino _____

Other _____

5. Number of falls within the last year: _____

6. Do you have any known balance disorders? (circle): Vision problems?

Dizziness or Vertigo? Inner ear problems? Parkinson's Disease?

Meniere's Disease? Multiple Sclerosis? Other? _____

7. How many medications do you take daily? _____

8. Which activities do you practice regularly, each week (circle all that apply)?

a) Tai chi

b) Yoga

c) Partnered Dance (e.g., Ballroom, Salsa, Tango, etc...)

9. How many minutes of activity in each session? _____

10. How many times each week? _____

11. How many years have you been doing this activity? _____

Physiological Measures

Weight: _____ Height: _____ BMI _____ Waist Circumference _____

OLST: Trial 1 _____ Trial 2 _____ Trial 3 _____

MAAS Score _____

**APPENDIX E: PERMISSION TO USE THE
MINDFUL ATTENTION AWARENESS SCALE**



Monroe Campus

V i r g i n i a C o m m o n w e a l t h U n i v e r s i t y

Department of Psychology

White House
806 West Franklin Street
P.O. Box 842018
Richmond, Virginia 23284-2018

804 828-6754
Fax: 804 828-2237
TDD: 1-800-828-1120

Dear Colleague,

The trait Mindful Attention Awareness Scale (MAAS) is in the public domain and special permission is not required to use it for research or clinical purposes. The trait MAAS has been validated for use with college student and community adults (Brown & Ryan, 2003), and for individuals with cancer (Carlson & Brown, 2005). A detailed description of the trait MAAS, along with normative score information, is found below, as is the scale and its scoring. A validated state version of the MAAS is also available in Brown and Ryan (2003) or upon request.

Feel free to e-mail me with any questions about the use or interpretation of the MAAS. I would appreciate hearing about any clinical or research results you obtain using the scale.

Yours,

Kirk Warren Brown, PhD
Department of Psychology
Virginia Commonwealth University
806 West Franklin St.
Richmond, VA 23284-2018
e-mail kwbrown@vcu.edu

APPENDIX F: MINDFUL ATTENTION AWARENESS SCALE

Day-to-Day Experiences

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I drive places on 'automatic pilot' and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

APPENDIX G: CITI TRAINING CERTIFICATE



Completion Date 29-Jul-2017
Expiration Date 28-Jul-2020
Record ID 23201003

This is to certify that:

Maxine Hicks

Has completed the following CITI Program course:

Human Research (Curriculum Group)
Group 2.Social / Behavioral Research Investigators and Key Personnel (Course Learner Group)
3 - Refresher Course (Stage)

Under requirements set by:

University of Central Florida



Verify at www.citiprogram.org/verify/?wf3677d97-a32e-4079-8784-4bf105f12f68-23201003

APPENDIX H: IRB APPROVAL LETTER



University of Central Florida Institutional Review Board
 Office of Research & Commercialization
 12201 Research Parkway, Suite 501
 Orlando, Florida 32826-3246
 Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

**From: UCF Institutional Review Board #1
 FWA00000351, IRB00001138**
To: Maxine Hicks and Co-PI: Susan Chase
Date: June 23, 2017

Dear Researcher:

On 06/23/2017 the IRB approved the following human participant research until 06/22/2018 inclusive:

Type of Review: Submission Response for UCF Initial Review Submission Form
 Expedited Review
 Project Title: The Mind Body Exercise Study
 Investigator: 2356470 Maxine Hicks 2356470
 IRB Number: SBE-17-13162
 Funding Agency:
 Grant Title:
 Research ID: N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30 days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 06/22/2018, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPA A applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the [Investigator Manual](#).

On behalf of Sophia Dziegielewska, PhD., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patria Davis on 06/23/2017 11:10:12 AM EDT

IRB Manager



University of Central Florida Institutional Review Board
 Office of Research & Commercialization
 12201 Research Parkway, Suite 501
 Orlando, Florida 32826-3246
 Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: UCF Institutional Review Board #1
 FWA00000351, IRB00001138

To: Maxine Hicks 2356470 and Co-PI: Susan Chase

Date: August 11, 2017

Dear Researcher:

On 08/11/2017 the IRB approved the following modifications human participant research until 06/22/2018 inclusive:

Type of Review: IRB Addendum and Modification Request Form
 Expedited Review

Modification Type: Increase the number of participants from 64 to 86. Two additional locations, USA Dance (Greater Daytona) and Sacred Strength Healing Arts, were added. Revised Protocol was uploaded and revised Informed consent was approved for use.

Project Title: The Mind Body Exercise Study
 Investigator: Maxine Hicks 2356470
 IRB Number: SBE-17-13162

Funding Agency:
 Grant Title:
 Research ID: N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30 days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 06/22/2018, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the [Investigator Manual](#).

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by

Karille Chaparro

Signature applied by Karille Chaparro on 08/11/2017 01:42:54 PM EDT

IRB Coordinator

APPENDIX I: SUPPLEMENTARY TABLES

Table 11
Demographic characteristics

Variable	Total	Meditative Movement			Non-Meditative Movement	p Value
		<u>Yoga</u>	<u>Tai chi</u>	<u>Combined</u>		
	N=86	n=25	n=18	n=43	n=43	
Age, M (SD)	69.33 (7.24)	65.44 (4.93)	71.83 (6.85)	68.12 (6.56)	70.53 (7.74)	0.12 ^a
Age, in years, n (%)						
60-69	52(60.5)	22 (88)	9 (50)	31 (72)	21 (48.9)	
70-79	24 (27.9)	3 (12)	6 (33.2)	9 (21)	15 (34.9)	
80-89	9 (10.5)	0	3 (16.8)	3 (7)	6 (13.9)	
90-99	1 (1.1)	0	0	0	1 (2.3)	
Sex, n (%)						
Female	66 (77)	21 (84)	14(77.8)	35 (81.4)	31 (72.1)	0.31 ^b
Male	20 (23)	4 (16)	4 (22.8)	8 (18.6)	12 (27.9)	
Ethnicity, n (%)						
African American/ Black	1 (1.2)	0	0	0	1 (2.3)	0.71 ^b
Asian	3 (3.5)	1 (4)	0	1 (2.3)	2 (4.7)	
Caucasian	78 (90.7)	22 (88)	18(100)	40 (93)	38 (88.4)	
Hispanic/ Latino	4 (4.6)	2 (8)	0	2 (4.7)	2 (4.7)	
Employment, n (%)						
Employed	21 (24.4)	10 (40)	1 (5.6)	11 (25.6)	10 (23.3)	0.80 ^b
Retired	65 (75.6)	15 60)	17(94.4)	32 (74.4)	33 (76.7)	
Falls, M (SD)	69.33 (7.24)	0.28 (0.61)	0.61 (1.50)	0.42 (1.07)	0.37 (1.05)	0.84 ^a

Variable	Total	Meditative Movement			Non-Meditative Movement	p Value
Falls in past year, n (%)						
None	69 (80.2)	20 (80)	14(77.8)	34 (79.1)	35 (81.4)	
1	8 (9.3)	3 (12)	1 (5.6)	4 (9.3)	4 (9.3)	
2	7 (8.1)	2 (8)	2 (11.1)	4 (9.3)	3 (7)	
3	0 (0)	0	0	0	0	
4 or more	2 (2.3)	0	1 (5.6)	1 (2.3)	1 (2.3)	
Number of daily medications, M (SD)	1.85 (1.91)	1.72 (1.49)	2.22 (2.39)	1.93 (1.91)	1.77 (1.94)	0.70 ^b
Number of daily medications per participant, n (%)						
None	28 (32.6)	5 (20)	7 (38.9)	12 (27.9)	16 (37.2)	
1-3	42 (48.8)	16 (64)	6 (33.3)	8 (18.6)	20(46.5)	
4 or more	16 (18.6)	4 (16)	5 (27.8)	1 (2.3)	7 (16.3)	
Body Mass Index (kg/m ²) M (SD)	25.32 (4.65)	23.68 (3.76)	26.64 (5.17)	24.92 (4.59)	25.73 (4.72)	0.42 ^b
Waist Circumference (cm)						
Male M (SD)	101.35 (11.45)	98.74 (9.69)	102.24 (17.64)	100.45 (13.31)	101.92 (10.63)	0.79 ^b
Female M (SD)	86.59 (13.52)	83.82 (9.83)	89.35 (19.63)	86.03 (14.55)	87.22 (12.45)	0.73 ^b
Number of years of practice, M (SD)	11.79 (11.37)	11.68 (9.17)	8.25 (9.81)	10.24 (9.48)	13.34 (12.92)	0.21 ^b
Number of sessions per week of practice, M (SD)	3.41 (1.72)	3.64 (1.66)	3.11 (2.14)	3.42 (1.87)	3.40 (1.58)	0.95 ^b

Notes. ^at-test comparing the meditative movement (combined) with non-meditative movement group.

^bChi-square between groups comparison.

Table I2

Outcome Measures of the One-Legged Stance Test and MAAS for Each Exercise

Variable	Meditative Movement n = 43			Non-Meditative Movement n =43	p Value
	Tai chi	Yoga	Combined	Partnered Dance	
	M (SD)	M (SD)	M (SD)	M (SD)	
OLST ^a (seconds)	7.52 (9.22)	7.71 (8.46)	7.63 (8.68)	6.03 (6.58)	0.34
MAAS Score ^a	4.66 (0.62)	4.35 (0.75)	4.48 (0.71)	4.87 (0.61)	0.01**

Notes. ^a t-test comparing the meditative movement (combined) with non-meditative movement group.
**p < .01

Table I3

Mindful Attention Awareness Scale item-total statistics, Cronbach's $\alpha = 0.85$

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I could be experiencing some emotion and not be conscious of it until sometime later.	65.09	96.603	.308	.233	.844
I break or spill things because of carelessness, not paying attention, or thinking of something else.	65.13	93.525	.492	.442	.835
I find it difficult to stay focused on what's happening in the present.	65.19	93.047	.524	.443	.834
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	65.79	90.991	.430	.421	.839

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	66.02	89.247	.510	.460	.834
I forget a person's name almost as soon as I've been told it for the first time.	66.91	90.438	.373	.358	.845
It seems I am "running on automatic," without much awareness of what I'm doing.	65.48	88.299	.645	.485	.826
I rush through activities without being really attentive to them.	65.42	91.611	.622	.589	.830
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	65.66	89.450	.547	.361	.831
I do jobs or tasks automatically, without being aware of what I'm doing.	65.67	90.857	.488	.408	.835
I find myself listening to someone with one ear, doing something else at the same time.	66.30	91.508	.415	.245	.840
I drive places on 'automatic pilot' and then wonder why I went there.	65.16	89.667	.604	.478	.829
I find myself preoccupied with the future or the past.	65.83	93.063	.343	.236	.844
I find myself doing things without paying attention.	65.58	89.470	.654	.535	.827
I snack without being aware of what I am eating.	65.00	96.212	.306	.324	.844

Table I4
SPSS Variable Codebook

SPSS Name	Variable	Coding Instructions	Measurement Scale
ID	Identification number	Number assigned to each survey	Scale
Age	Age	Age in years	Scale
Sex	Sex	0=Female 1=male	Nominal
Emp	Employment	0=Employed 1=Retired	Nominal
Ethn	Ethnicity	1=African American 2=Asian 0=Caucasian 3=Hispanic 4=Other	Nominal
Fall History	Fall History	0 = No Falls 1 = At least one fall in the past year	Nominal
Multiple Medications	Medications \geq 4	0 = No Medications 1= Greater or equal to four medications	Nominal
Act	Activity	0=Partnered Dance 1=Tai chi 2=Yoga	Nominal
Meditative	Does the activity have a known meditative component?	0= meditative 1= non-meditative	Nominal
Practice History	Number of years of practice	Number of years of practice	Scale
Time	Time per session	Number of minutes per session	Scale
Frequency	Number of hours per week of practice	Number of times per week of practice	Scale
MAAS	MAAS Score	MAAS Score	Scale

SPSS Name	Variable	Coding Instructions	Measurement Scale
BMI	Body Mass Index	$BMI = \text{weight}(\text{kg}) / \text{height}^2(\text{m}^2)$	Scale
WC	Waist Circumference	Waist Circumference in cm's	Scale
OLST	OLST Eyes Open	Number of seconds standing on one leg with eyes closed-best time	Scale

APPENDIX J: SUPPLEMENTARY FIGURES

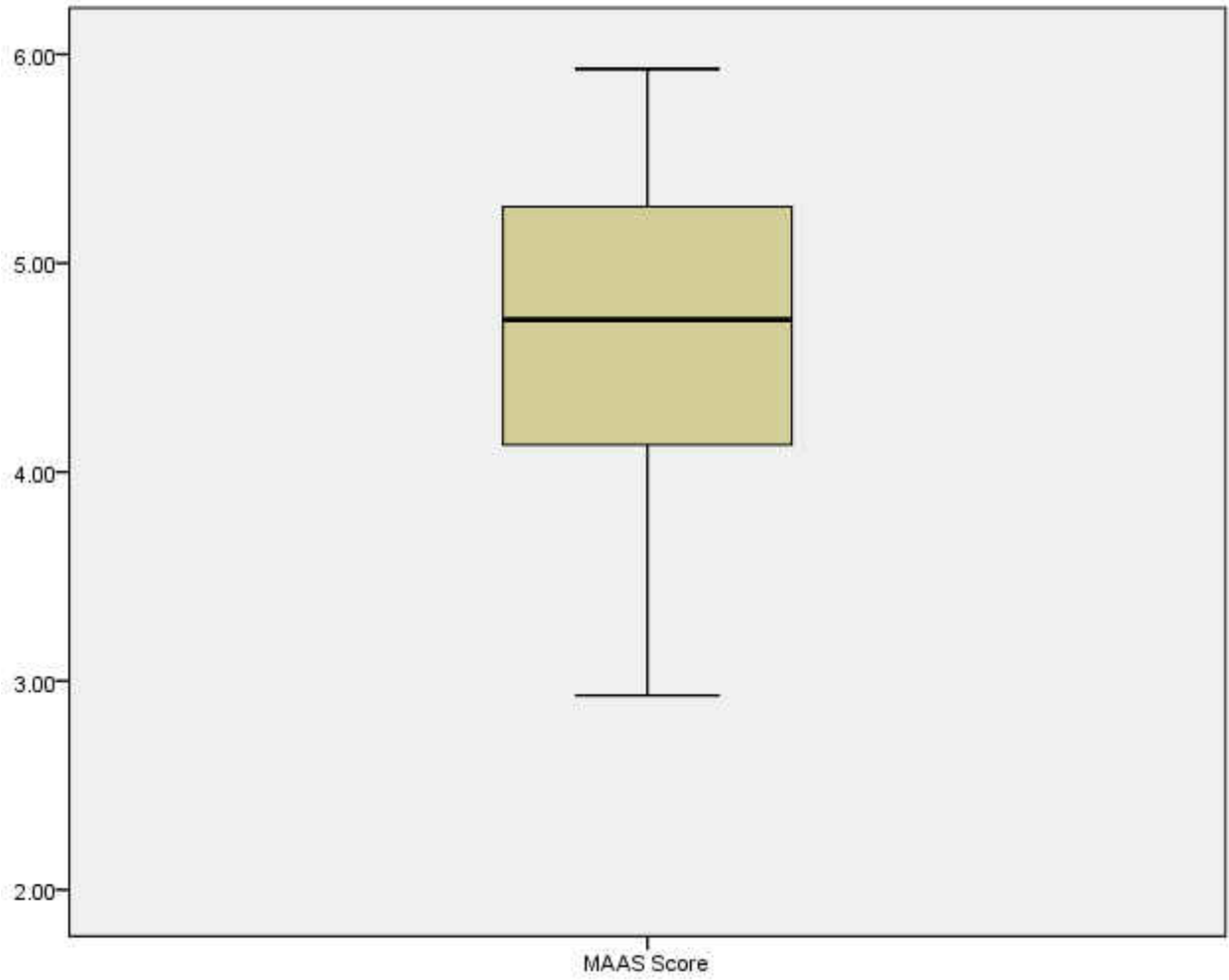


Figure J1. Boxplot graph of the variable MAAS. This figure illustrates no extreme outliers for MAAS.

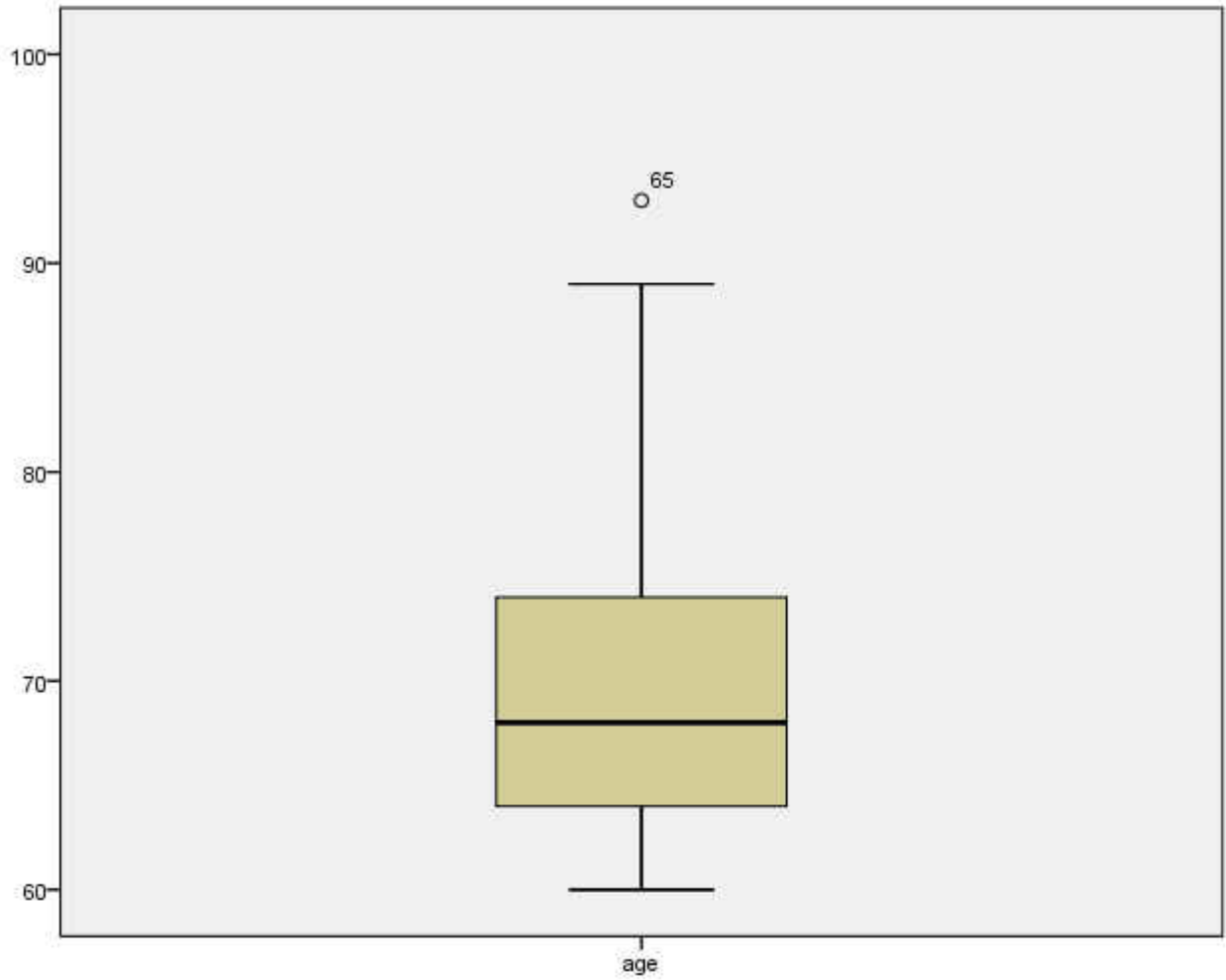


Figure J2. Boxplot graph of the variable age. This figure illustrates one extreme outlier for age, case 65.

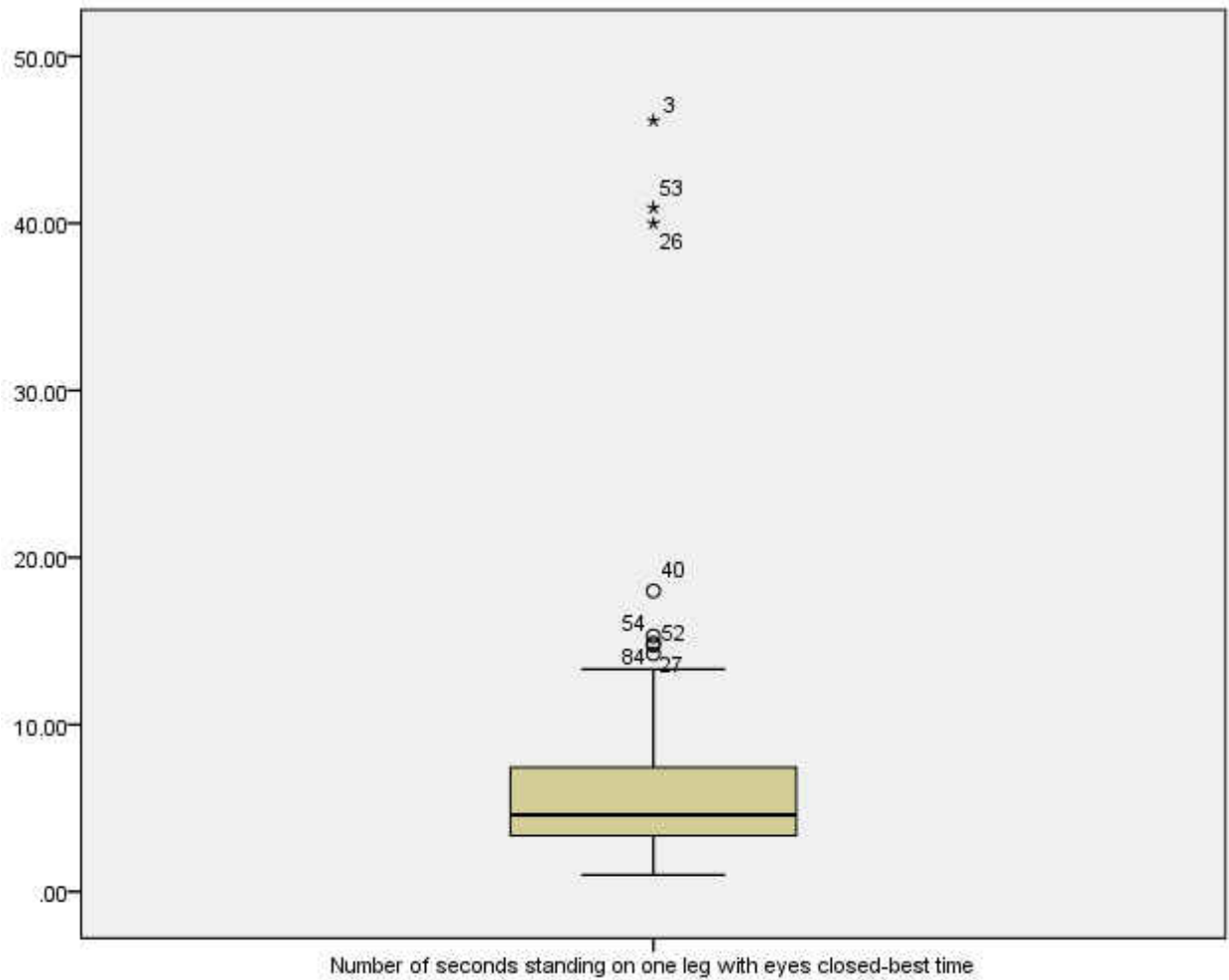


Figure J3. Boxplot graph of the variable One Leg Stance Test (OLST). This figure illustrates eight extreme outliers at cases 3, 26, 27, 40, 52, 53, 54 & 84.

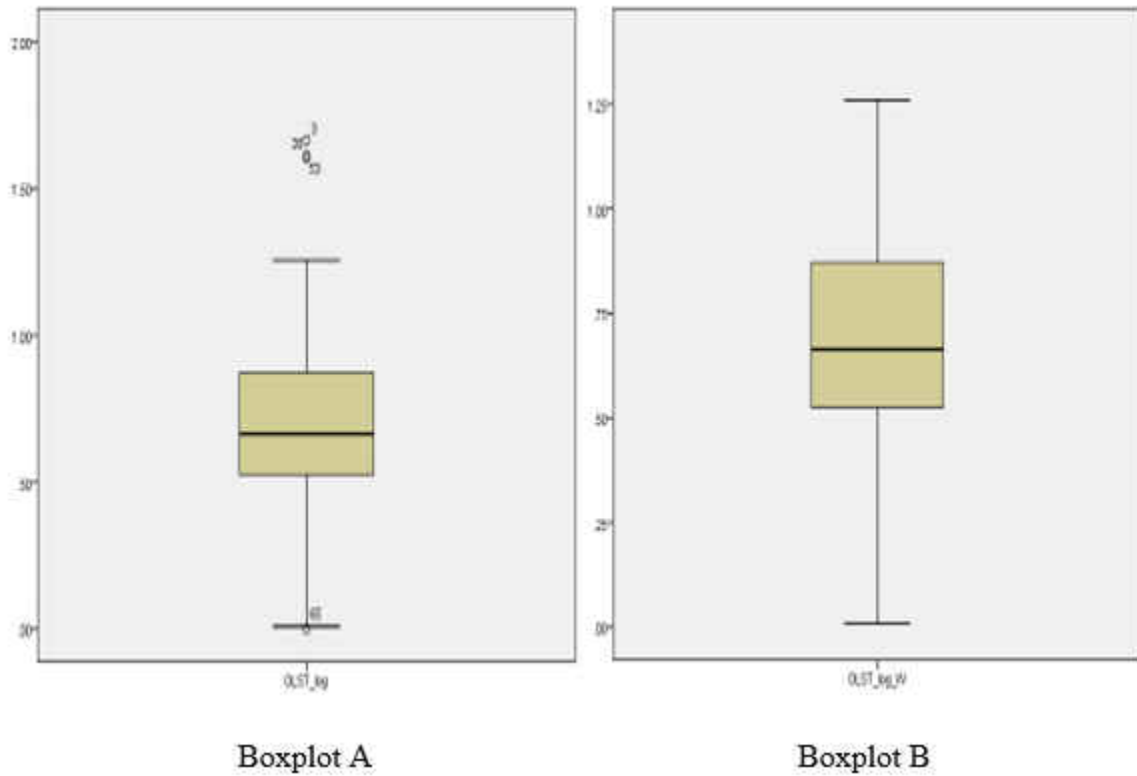


Figure J4. Boxplot graphs of the variable OLST. This figure compares boxplot A of OLST after logarithmic transformation revealing four extreme outliers (3, 26, 53, & 65) with boxplot B of OLST after transformation and Winsorization with no remaining outliers.

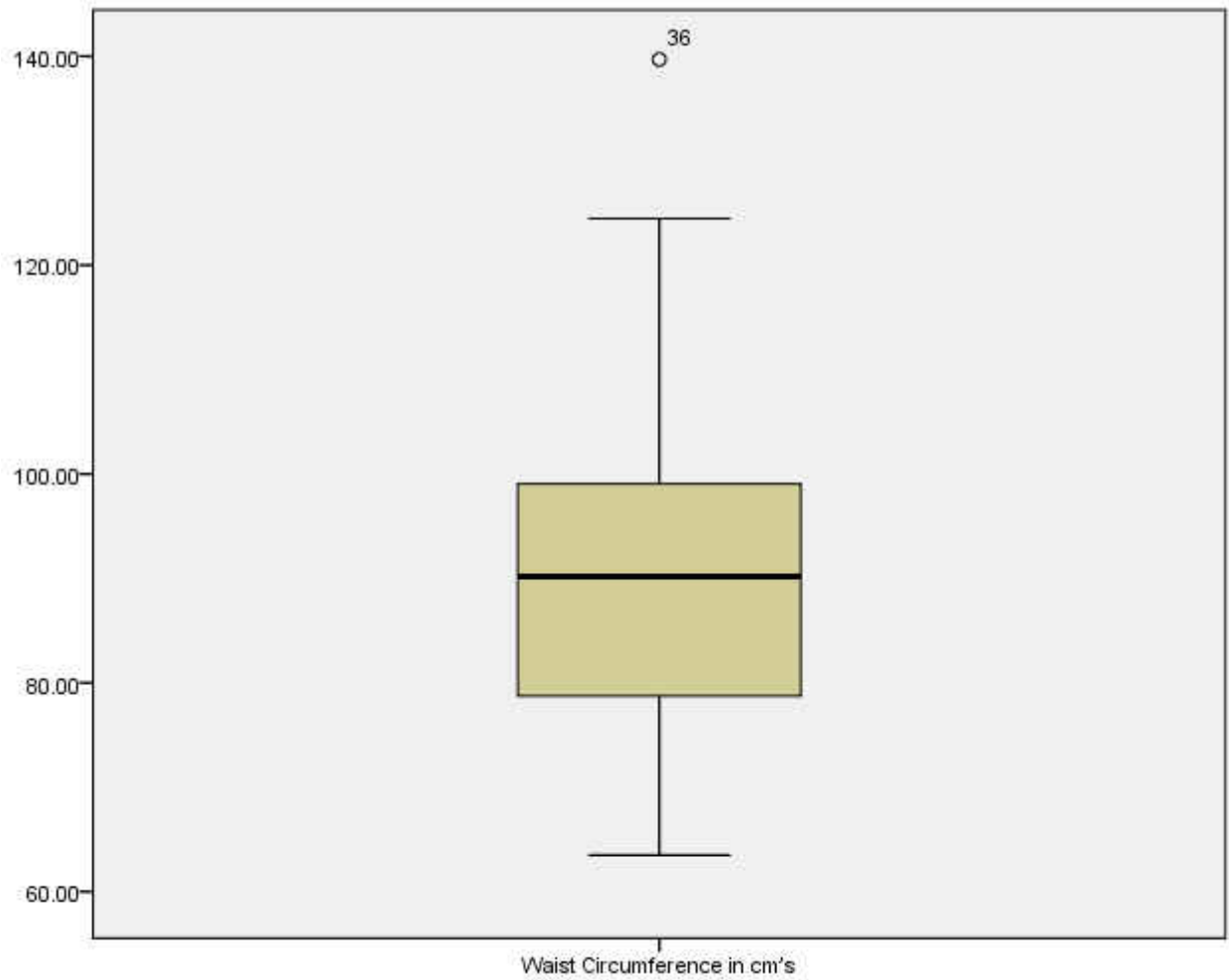


Figure J5. Boxplot graph of the variable waist circumference. This figure illustrates one extreme outlier for case 36.

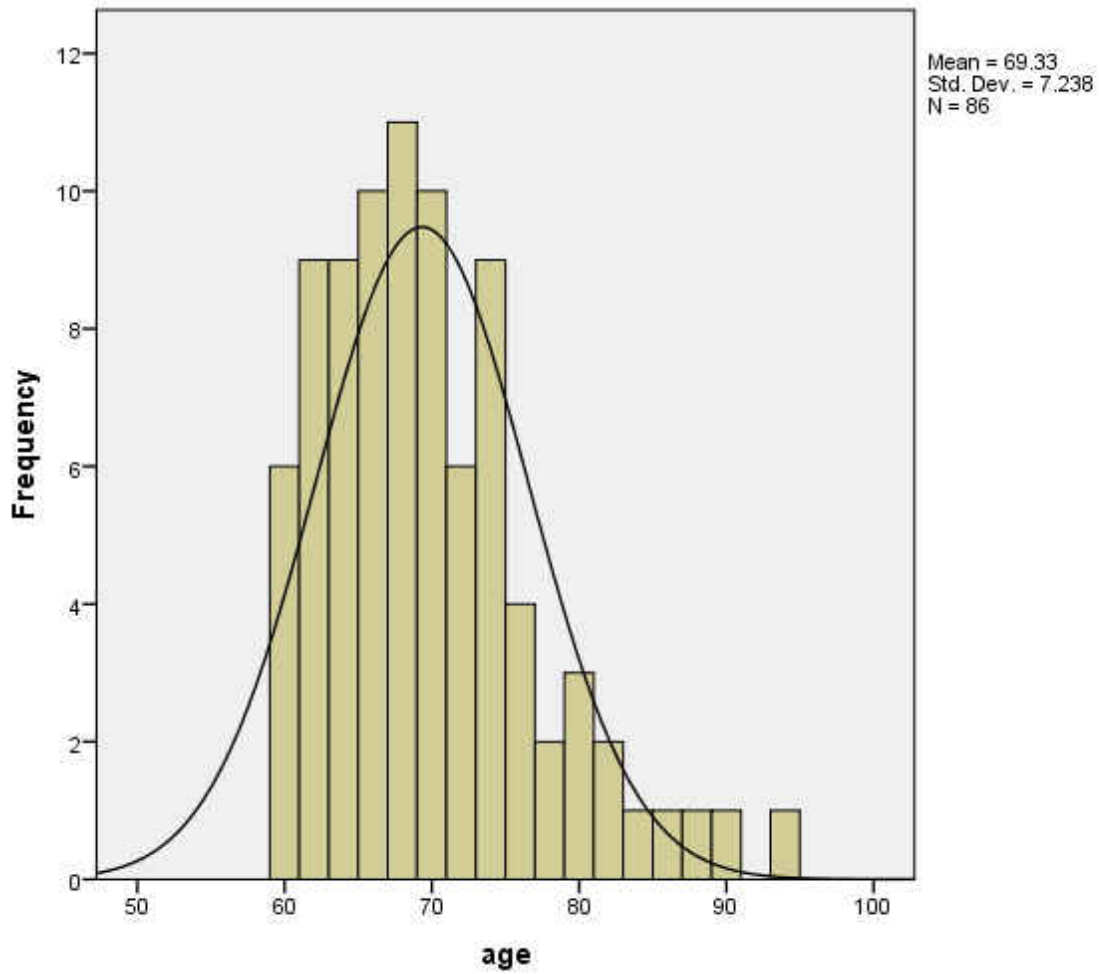


Figure J6. Histogram of the variable age in years by frequency. This figure illustrates an approximately normal distribution.

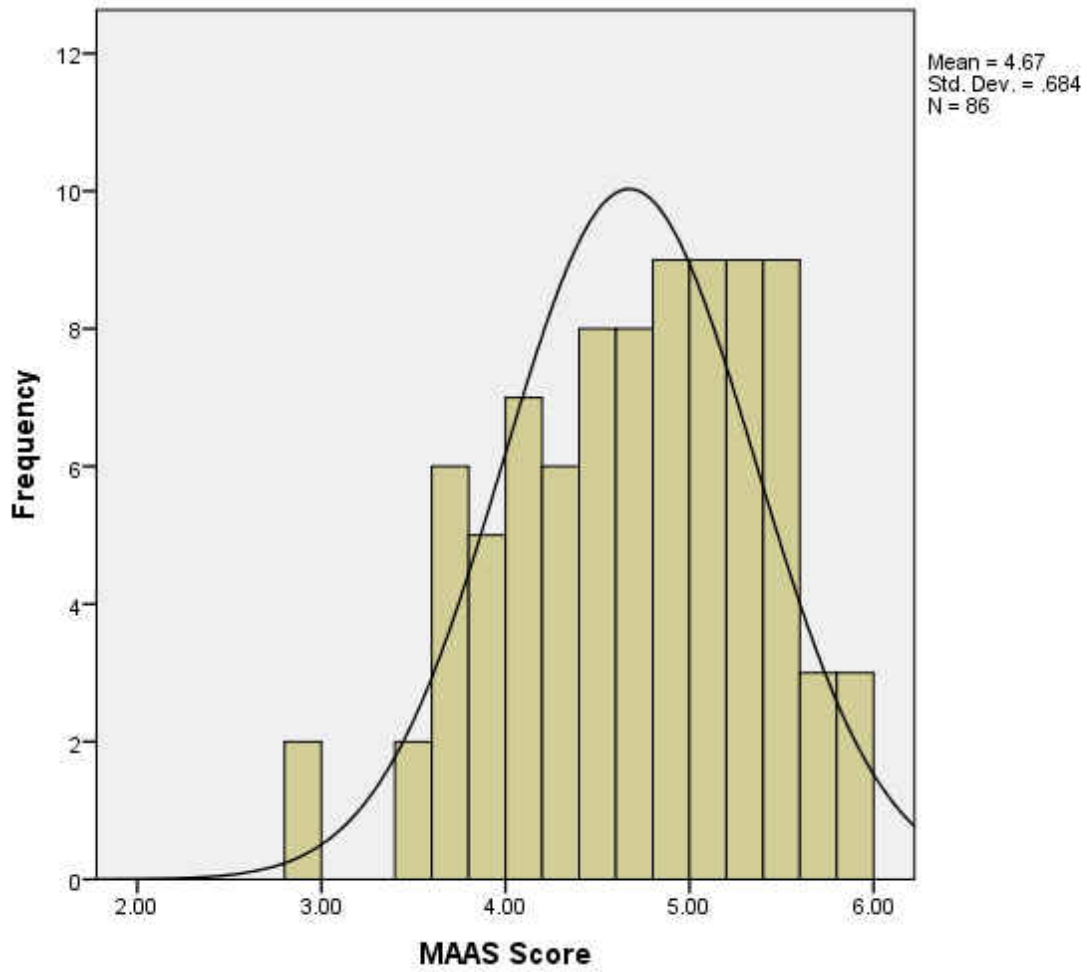


Figure J7. Histogram of the variable MAAS by frequency. This figure illustrates an approximately normal distribution.

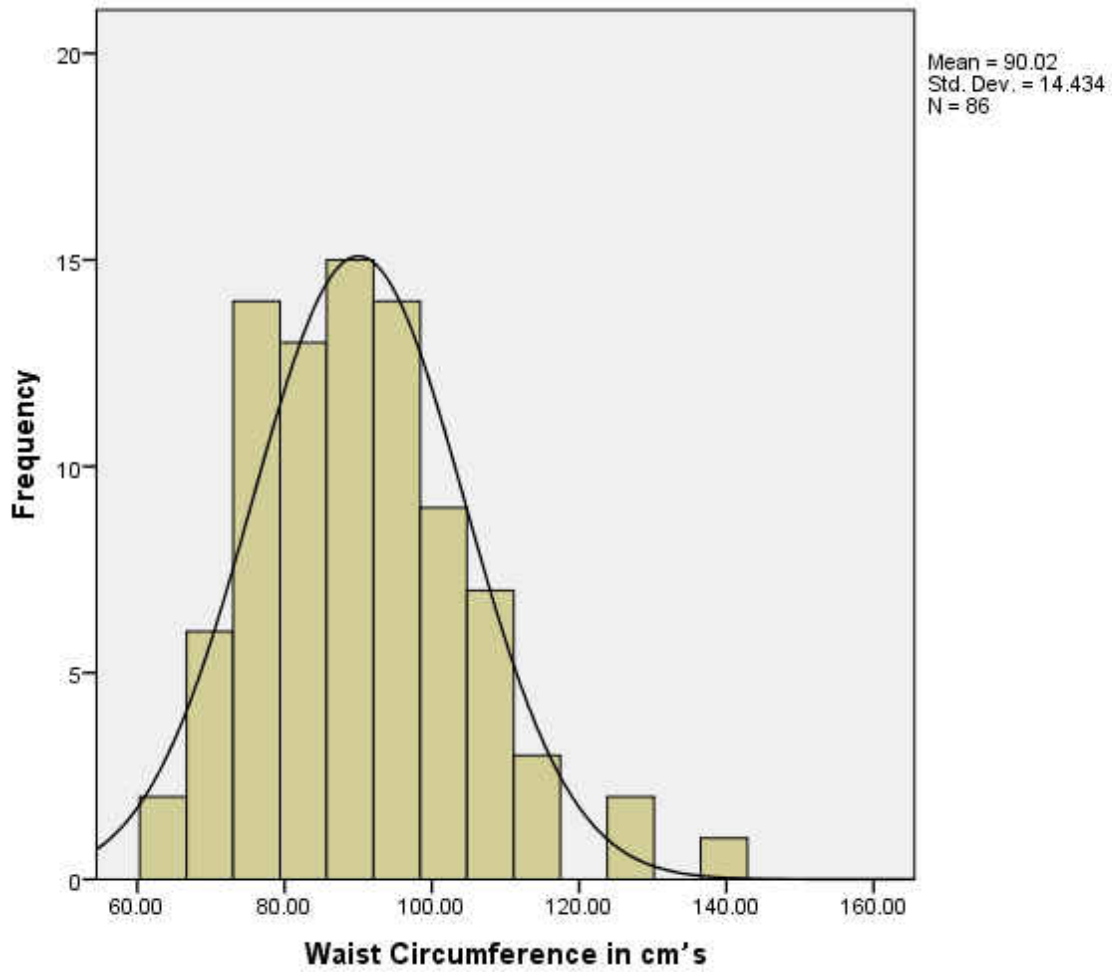


Figure J8. Histogram of the variable waist circumference in centimeters by frequency. This figure illustrates a normal distribution.

REFERENCES

- Aetna. (2017). Complementary and alternative medicine. *Aetna*. Retrieved from http://www.aetna.com/cpb/medical/data/300_399/0388.html
- Akin, U., Akin, A., & Uğur, E. (2016). Mediating role of mindfulness on the associations of friendship quality and subjective vitality. *Psychological Reports, 119*(2), 516-526. doi:10.1177/00332941166661273
- Alamgir, H., Muazzam, S., & Nasrullah, M. (2012). Unintentional falls mortality among elderly in the United States: Time for action. *Injury, 43*(12), 2065-2071. doi:10.1016/j.injury.2011.12.001
- Agrawal, Y., Carey, J. P., Della Santina, C. C., Schubert, M. C., & Minor, L. B. (2009). Disorders of balance and vestibular function in US adults. *Archives of Internal Medicine, 169*(10), 938–944.
- Al-Yahya, E., Dawes, H., Smith, L., Dennis, A., Howells, K., & Cockburn, J. (2011). Cognitive motor interference while walking: A systematic review and meta-analysis. *Neuroscience and Biobehavioral Reviews, 35*(3), 715-728. doi:10.1016/j.neubiorev.2010.08.008
- Alexander, N. B. (1994). Postural control in older adults. *Journal of the American Geriatrics Society, 42*(1), 93–108.
- Afshartous, D., & Preston, R. A. (2011). Key results of interaction models with centering. *Journal of Statistics Education, 19*(3), 1-24. Retrieved from http://www.amstat.org/publications/jse/contents_2011.htm
- Arslan, G. (2017). Psychological maltreatment, forgiveness, mindfulness, and internet addiction among young adults: A study of mediation effect. *Computers In Human Behavior, 72*57-66. doi:10.1016/j.chb.2017.02.037
- Althomali, M. M., & Leat, S. J. (2017). Binocular vision disorders and visual attention: Associations with balance and mobility in older adults. *Journal of Aging and Physical Activity, 1*-43. doi:10.1123/japa.2016-0349
- Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice, 10*(2), 125-143.
- Baer, R., Smith, G.T., & Allen, K. B. (2004). Assessment of mindfulness by self-report: The Kentucky inventory of mindfulness skills. *Assessment, 11*(3), 191-206.
- Baloh, R. W., Enrietto, J., Jacobson, K. M., & Lin, a. (2001). Age-related changes in vestibular function: a longitudinal study. *Annals of the New York Academy of Sciences, 942*(310), 210–219. <http://doi.org/10.1111/j.1749-6632.2001.tb03747.x>

- Barin, K., & Dodson, E. E. (2011). Dizziness in the elderly. *Otolaryngologic Clinics of North America*, *44*(2), 437–454. <http://doi.org/10.1016/j.otc.2011.01.013>
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173-1182.
- Batson, G. (2008). Proprioception. *International Association for Dance Medicine & Science*. Retrieved from <https://www.iadms.org/>
- Batson, G. (2009). Update on proprioception. *Journal of Dance Medicine & Science*, *13*(2), 35–41.
- Batson, G. (2010). Improving postural control in the battement tendu. *Journal of Dance Education*, *10*(1), 6-13.
- Beattie, B.L. & Schneider, E.S. (2012). *State Policy Toolkit for Advancing Falls Prevention*. Washington, DC: National Council on Aging.
- Berg, K. (1989). Balance and its measure in the elderly: A review. *Physiotherapy Canada*, *41*, 240–46.
- Bernard, A. (1997). An Introduction to ideokinesis, *Contact Quarterly*, 24-25.
- Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*(3), 230-241.
- Bläsing, B., Calvo-Merino, B., Cross, E. S., Jola, C., Honisch, J., & Stevens, C. J. (2012). Neurocognitive control in dance perception and performance. *Acta Psychologica*, *139*(2), 300–308. <http://doi.org/10.1016/j.actpsy.2011.12.005>
- Bressel, E., Yonker, J. C., Kras, J., & Heath, E. M. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. *Journal of Athletic Training*, *42*(1), 42–46.
- Briggs, R. C., Gossman, M. R., Birch, R., Drews, J. E., & Shaddeau, S. A. (1989). Balance performance among noninstitutionalized elderly women. *Physical Therapy*, *69*(9), 748–756.
- Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822–848. <http://doi.org/10.1037/0022-3514.84.4.822>
- Burns, E. B., Stevens, J. A., & Lee, R. L. (2016). The direct costs of fatal and non-fatal falls among adults-United States. *Journal of Safety Research*, *58*, 99-103

- Centers for Disease Control and Prevention. (2016). *Home and Recreational Safety*. Retrieved from <http://www.cdc.gov/NCHS/NHIS.htm>.
- Chang, V. C., & Do, M. T. (2015). Risk factors for falls among seniors: Implications of sex. *American Journal of Epidemiology*, *181*(7), 521–531. <http://doi.org/10.1093/aje/kwu268>
- Chiesa, A., Calati, R., & Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review*, *31*(3), 449–464. <http://doi.org/10.1016/j.cpr.2010.11.003>
- Choi, J., Noh, G., & Park, D. (2014). Smoking cessation apps for smartphones: Content analysis with the self-determination theory. *Journal of Medical Internet Research*, *16*(2), 143-156. doi:10.2196/jmir.3061
- Chong, Y. W., Kee, Y. H., & Chaturvedi, I. (2015). Effects of brief mindfulness induction on weakening habits: Evidence from a computer mouse control task. *Mindfulness*, *6*(3), 582-588. doi:10.1007/s12671-014-0293-3
- Chua, P.T., Crivella, R., Daly, B., Hu, N., Schaaf, R., Ventura, D., Camill, T., Hodgins, J., Pausch, R. (2003). Training for physical tasks in virtual environments: Tai Chi. In: *IEEE International Conference on Virtual Reality*, Los Angeles, CA, March 22–26.
- Chun, M. M., Golomb, J. D. & Turk-Browne, N. B. (2011). A taxonomy of external and internal attention. *Annual Review of Psychology*, *62*, 73-101.
- Chung, P., Lin, G., Liu, C., Chuang, L., & Shiang, T. (2013). The effects of Tai chi chuan combined with vibration training on balance control and lower extremity muscle power. *Journal of Sports Science & Medicine*, *12*(1), 19-26.
- Clark, N. C., Röijezon, U., & Treleaven, J. (2015). Proprioception in musculoskeletal rehabilitation. Part 2: Clinical assessment and intervention. *Manual Therapy*, *20*, 378–387. <http://doi.org/10.1016/j.math.2015.01.009>
- Clarke, T. C., Black, L. I., Stussman, B. J., Barnes, P. M., & Nahin, R. L. (2015). Trends in the use of complementary health approaches among adults: United States, 2002-2012. *National Health Statistics Reports*, *10*(79), 1–16.
- Clemson, L., Fiatarone Singh, M.,A., Bundy, A., Cumming, R. G., Manollaras, K., O'Loughlin, P., & Black, D. (2012). Integration of balance and strength training into daily life activity to reduce rate of falls in older people (the LiFE study): Randomised parallel trial. *British Medical Journal*, *345*, e4547-e4547. doi:10.1136/bmj.e4547
- Coelho, T., Fernandes, Â., Santos, R., Paúl, C., & Fernandes, L. (2016). Quality of standing balance in community-dwelling elderly: Age-related differences in single and dual task conditions. *Archives Of Gerontology And Geriatrics*, 6734-39. doi:10.1016/j.archger.2016.06.010

- Concannon, L. G., Grierson, M. J., & Harrast, M. a. (2012). Exercise in the older adult: From the sedentary elderly to the masters athlete. *Physical Medicine and Rehabilitation*, 4(11), 833–839. <http://doi.org/10.1016/j.pmrj.2012.08.007>
- Conger, A. J. (1974). A revised definition for suppressor variables: A guide to their identification and interpretation. *Educational and Psychological Measurement*, 34, 35-46.
- Crane-Okada, R., Kiger, H., Sugerman, F., Uman, G. C., Shapiro, S. L., Wyman-McGinty, W., & Anderson, N. L. R. (2012). Mindful movement program for older breast cancer survivors: A pilot study. *Cancer Nursing*, 35(4), E1-E13.
- Da Silva Borges, E. G., de Souza Vale, R. G., Cader, S. A., Leal, S., Miguel, F., Pernambuco, C. S., & Dantas, E. H. M. (2014). Postural balance and falls in elderly nursing home residents enrolled in a ballroom dancing program. *Archives of Gerontology and Geriatrics*, 59, 312–316. <http://doi.org/10.1016/j.archger.2014.03.013>
- Dania, A., Hatziharistos, D., Koutsouba, M., & Tyrovola, V. (2014). Validity and reliability of scores from a dance assessment instrument: Its application on Greek folk dance. In Overby, L. Y. & B. Lepczyk (Eds.), *Dance Current Selected Research*, Volume 8. Brooklyn, NY: AMS Press Inc.
- Day, L., Fildes, B., Gordon, I., Fitzharris, M., Flamer, H., & Lord, S. (2002). Randomised factorial trial of falls prevention among older people living in their own homes. *BMJ: British Medical Journal*, 325(7356), 128-134.
- Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*., 18(1), 105.
- Deci, E. L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology*, 22(1), 113-120. doi:10.1037/h0032355
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
- Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological wellbeing across life's domains. *Canadian Psychology*, 49(1), 14-23.
- Deci, E. L., & Ryan, R. M., Schultz, P. P. & Niemiec, C. P. (2015). Being aware and functioning fully: Mindfulness and interest taking within self-determination theory. In K. W. Brown, J. D. Creswell & R. M. Ryan (Eds.), *Handbook of Mindfulness* (pp. 112-129). New York, NY: The Guilford Press.
- de Frias, C. M., & Whyne, E. (2015). Stress on health-related quality of life in older adults: the protective nature of mindfulness. *Aging & Mental Health*, 19(3), 201–206. <http://doi.org/10.1080/13607863.2014.924090>
- de Hollander EL, Van Zutphen M, Bogers R, Bemelmans W, & De Groot, L. (2012). The impact

- of body mass index in old age on cause-specific mortality. *Journal of Nutrition Health & Aging*, *16*, 100–106.
- Delizonna, L. L., Williams, R. P., & Langer, E. J. (2009). The effect of mindfulness on heart rate control. *Journal of Adult Development*, *16*(2), 61–65. <http://doi.org/10.1007/s10804-009-9050-6>
- DiBenedetto, M., Innes, K. E., Taylor, A. G., Rodeheaver, P. F., Boxer, J. a., Wright, H. J., & Kerrigan, D. C. (2005). Effect of a gentle Iyengar yoga program on gait in the elderly: An exploratory study. *Archives of Physical Medicine and Rehabilitation*, *86*(9), 1830–1837. <http://doi.org/10.1016/j.apmr.2005.03.011>
- Du, Y., Roberts, P., & Xu, Q. (2016). The effects of Tai chi practice with asynchronous music on compliance and fall-related risk factors in middle-aged and older women. *Journal of Holistic Nursing*, 1–9. <http://doi.org/10.1177/0898010116636972>
- Elder, C., Ritenbaugh, C., Mist, S., Aickin, M., Schneider, J., Zwickey, H., & Elmer, P. (2007). Randomized trial of two mind-body interventions for weight-loss maintenance. *Journal of Alternative & Complementary Medicine*, *13*(1), 67-78.
- Faraldo-García, A., Santos-Pérez, S., Crujeiras-Casais, R., Labella-Caballero, T., & Soto-Varela, A. (2012). Influence of age and gender in the sensory analysis of balance control. *European Archives of Oto-Rhino-Laryngology*, *269*(2), 673–677. <http://doi.org/10.1007/s00405-011-1707-7>
- Faulkner, J. a., Larkin, L. M., Claflin, D. R., & Brooks, S. V. (2007). Age-related changes in the structure and function of skeletal muscles. *Clinical and Experimental Pharmacology and Physiology*, *34*(11), 1091–1096. <http://doi.org/10.1111/j.1440-1681.2007.04752.x>
- Felton, L., & Jowett, S. (2015). On understanding the role of need thwarting in the association between athlete attachment and well/ill-being. *Scandinavian Journal of Medicine & Science in Sports*, *25*(2), 289-298. doi:10.1111/sms.12196
- Fernández-Argüelles, E. L., Rodríguez-Mansilla, J., Antunez, L. E., Garrido-Ardila, E. M., & Muñoz, R. P. (2015). Effects of dancing on the risk of falling related factors of healthy older adults: A systematic review. *Archives of Gerontology and Geriatrics*, *60*(1), 1–8. <http://doi.org/10.1016/j.archger.2014.10.003>
- Ferrand, C., Martinet, G., & Durmaz, N. (2014). Psychological need satisfaction and well-being in adults aged 80 years and older living in residential homes: Using a self-determination theory perspective. *Journal of Aging Studies*, *30*, 104-111. doi:10.1016/j.jaging.2014.04.004
- Fong, S. M., & Ng, G. Y. (2006). The effects on sensorimotor performance and balance with Tai Chi training. *Archives of Physical Medicine and Rehabilitation*, *87*(1), 82–87. <http://doi.org/10.1016/j.apmr.2005.09.017>

- Frankel, J. E., Bean, J. F., & Frontera, W. R. (2006). Exercise in the elderly: Research and clinical practice. *Clinics in Geriatric Medicine*, 22(2), 239–256. <http://doi.org/10.1016/j.cger.2005.12.002>
- Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., ... Swain, D. P. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine and Science in Sports and Exercise*, 43(7), 1334–1359. <http://doi.org/10.1249/MSS.0b013e318213fefb>
- Gay, L., Mills, G. & Airasian, P. (2014). *Educational research: Competencies for analysis and application* (10th ed.). New York: Prentice Hall.
- George, D., & Mallery, P. (2016). *IBM SPSS Statistics 23 Step by Step: A Simple Guide and Reference*. New York, NY: Taylor and Francis.
- Gethin, R. (2015). Buddhist conceptualizations of mindfulness. In K. W. Brown, J. D. Creswell & R. M. Ryan (Eds.), *Handbook of Mindfulness* (pp. 9-41). New York, NY: The Guilford Press.
- Girgis, C. M. (2015). Integrated Therapies for osteoporosis and sarcopenia: From signaling pathways to clinical trials. *Calcified Tissue International*, 243–255. <http://doi.org/10.1007/s00223-015-9956-x>
- Gnambs, T., & Hanfstingl, B. (2014). A differential item functioning analysis of the German academic self-regulation questionnaire for adolescents. *European Journal of Psychological Assessment*, 30(4), 251-260. doi:10.1027/1015-5759/a000185
- Gobbo, S., Bergamin, M., Sieverdes, J. C., Ermolao, A., & Zaccaria, M. (2014). Effects of exercise on dual-task ability and balance in older adults: A systematic review. *Archives of Gerontology and Geriatrics*, 58(2), 177–187. <http://doi.org/10.1016/j.archger.2013.10.001>
- Granacher, U. (2012). Effects of salsa dance training on balance and strength performance in older adults. *Gerontology*, 58(4), 305–312.
- Greeson, J. M., Smoski, M. J., Suarez, E. C., Brantley, J. G., Ekblad, A. G., Lynch, T. R., & Wolever, R. Q. (2015). Decreased symptoms of depression after mindfulness-based stress reduction: Potential moderating effects of religiosity, spirituality, trait mindfulness, sex, and age. *The Journal of Alternative and Complementary Medicine*, 21(3), 166–174. <http://doi.org/10.1089/acm.2014.0285>
- Gunnell, K. E., Crocker, P. R. E., Mack, D. E., Wilson, P. M., & Zumbo, B. D. (2014). Goal contents, motivation, psychological need satisfaction, well-being and physical activity: A test of self-determination theory over 6 months. *Psychology of Sport and Exercise*, 15(1), 19-29. doi:10.1016/j.psychsport.2013.08.005

- Guzmán, A., Robinson, L., Rochester, L., James, I. A., & Hughes, J. C. (2017). A process evaluation of a psychomotor dance therapy intervention (DANCIN) for behavior change in dementia: Attitudes and beliefs of participating residents and staff. *International Psychogeriatrics*, 29(2), 313–322. <http://doi.org/10.1017/S104161021600171X>
- Hackney, J., Brummel, S., Jungblut, K., & Edge, C. (2011). The effect of sprung (suspended) floors on leg stiffness during grand jet landings in ballet. *Journal of Dance Medicine & Science*, 15(3), 128–133. Retrieved from <http://www.library.gatech.edu:2048/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ibh&AN=66362799&site=ehost-live>
- Hackney, M. E., & Earhart, G. M. (2010). Comparison of Argentine tango and American ballroom. *Clinical Rehabilitation*, 41(6), 475–481. <http://doi.org/10.2340/16501977-0362.Effects>
- Han, J., Waddington, G., Adams, R., Anson, J., & Liu, Y. (2015). Assessing proprioception: A critical review of methods. *Journal of Sport and Health Science*, 5(1), 80-90. <http://doi.org/10.1016/j.jshs.2014.10.004>
- Harris, R. J. (1985). *A primer of multivariate statistics* (2nd ed.). New York: Academic Press.
- HealthPartners. (2017). Complementary and alternative medicine. *HealthPartners*. <https://www.healthpartners.com/public/coverage-criteria/holistic-medicine.htm>
- Hewett, Z. L., Ransdell, L. B., Gao, Y., Petlichkoff, L. M., & Lucas, S. (2011). An examination of the effectiveness of an 8-week Bikram yoga program on mindfulness, perceived stress, and physical fitness. *Journal of Exercise Science and Fitness*, 9(2), 87–92. [http://doi.org/10.1016/S1728-869X\(12\)60003-3](http://doi.org/10.1016/S1728-869X(12)60003-3)
- Hopper, C. Kolt, G. S. & McConville, J. C. (1999). The effects of Feldenkrais awareness through movement on hamstring length, flexibility, and perceived exertion. *Journal of Bodywork and Movement Therapies*, 3(4), 238-247.
- Horak, F. B., Shupert, C. L., & Mirka, a. (1989). Components of postural dyscontrol in the elderly: a review. *Neurobiology of Aging*, 10(6), 727–738. [http://doi.org/10.1016/0197-4580\(89\)90010-9](http://doi.org/10.1016/0197-4580(89)90010-9)
- Howie-Esquivel, J., Lee, J., Collier, G., Mehling, W., & Fleischmann, K. (2010). Yoga in heart failure patients: A pilot study. *Journal of Cardiac Failure*, 16(9), 742–749. <http://doi.org/10.1016/j.cardfail.2010.04.011>
- Hui, E. K. P., Sun, R. C. F., Chow, S. S., & Chu, M. H. (2011). Explaining chinese students' academic motivation: Filial piety and self-determination. *Educational Psychology*, 31(3), 377-392. doi:10.1080/01443410.2011.559309

- Hurvitz E, Richardson J, Werner R. (2001). Unipedal stance testing in the assessment of peripheral neuropathy. *Archives of Physical Medicine and Rehabilitation*, 82, 198-204.
- Hutcheson, G. D. & Sofroniou, N. (1999). *The multivariate social scientist: Introductory statistics using generalized linear models*. Thousand Oaks, CA: SAGE Publications, Ltd.
- Huxhold, O., Li, S. C., Schmiedek, F., & Lindenberger, U. (2006). Dual-tasking postural control: Aging and the effects of cognitive demand in conjunction with focus of attention. *Brain Research Bulletin*, 69(3), 294–305. <http://doi.org/10.1016/j.brainresbull.2006.01.002>
- Jankowski, T., & Holas, P. (2014). Metacognitive model of mindfulness. *Consciousness and Cognition*, 28(1), 64–80. <http://doi.org/10.1016/j.concog.2014.06.005>
- Jola, C. (2010). Research and choreography: Merging dance and cognitive science. In B. Blasing, M. Puttke, & T. Schack (Eds.), *The Neurocognition of Dance* (pp. 203-234). New York, NY: Psychology Press.
- Jones, A. Y., Dean, E., & Scudds, R. J. (2005). Effectiveness of a community-based Tai Chi program and implications for public health initiatives. *Archives of Physical Medicine and Rehabilitation*, 86(4), 619–625. <http://doi.org/10.1016/j.apmr.2004.10.020>
- Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness*. New York: Dell Publishing.
- Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, 10(2), 144-156.
- Karastergiou, K., Smith, S. R., Greenberg, A. S., & Fried, S. K. (2012). Sex differences in human adipose tissues – the biology of pear shape. *Biology of Sex Differences*, 3, 13-25. <http://doi.org/10.1186/2042-6410-3-13>
- Kattenstroth, J. C., Kalisch, T., Holt, S., Tegenthoff, M., & Dinse, H. R. (2013). Six months of dance intervention enhances postural, sensorimotor, and cognitive performance in elderly without affecting cardio-respiratory functions. *Frontiers in Aging Neuroscience*, 5, 1–16. <http://doi.org/10.3389/fnagi.2013.00005>
- Kee, Y. H., Chatzisarantis, N. N. L. D., Kong, P. W., Chow, J. Y., & Chen, L. H. (2012). Mindfulness, movement control, and attentional focus strategies: Effects of mindfulness on a postural balance task. *Journal of Sport & Exercise Psychology*, 34(5), 561-579.
- Keith, T. Z. (2006). *Multiple regression and beyond*. Boston, MA: Pearson Education, Inc.
- Keogh, J. W. L., Kilding, A., Pidgeon, P., Ashley, L., & Gillis, D. (2009). Physical benefits of dancing for healthy older adults: a review. *Journal of Aging and Physical Activity*, 17(4), 479-500.

- Kiefer, A. W., Riley, M. A., Shockley, K., Sitton, C. A., Hewett, T. E., Cummins-Sebree, S., & Haas, J. G. (2013). Lower-limb proprioceptive awareness in professional ballet dancers. *Journal of Dance Medicine & Science : Official Publication of the International Association for Dance Medicine & Science*, 17(3), 126–32. <http://doi.org/10.12678/1089-313X.17.3.126>
- Ko, S., Simonsick, E., Deshpande, N., & Ferrucci, L. (2015). Sex-specific age associations of ankle proprioception test performance in older adults: Results from the Baltimore longitudinal study of aging. *Age and Ageing*, 44(3), 485-490. doi:10.1093/ageing/afv005
- Krampe, J. (2011). Exploring the effects of dance-based therapy on balance and mobility in older adults. *Western Journal of Nursing Research*, 35(1), 39-56. <http://doi.org/10.1177/0193945911423266>
- Laidlaw, R. W.V. & Hamilton, M. A. (1937). A study in thresholds of apperception of passive movement among normal control subjects. *Bulletin of the Neurological Institute of New York*, 6, 268-273.
- Langer, E. J. (1992). Matters of mind : FOCUS in perspective mindfulness/mindlessness. *Consciousness and Cognition*, 1, 289–305. [http://doi.org/10.1016/1053-8100\(92\)90066-J](http://doi.org/10.1016/1053-8100(92)90066-J)
- Langer, E. J., & Moldoveanu, M. (2000). The construct of mindfulness. *Journal of Social Issues*, 56(1), 1–9. <http://doi.org/10.1111/0022-4537.00148>
- Larkey, L., Jahnke, R., Etnier, J., & Gonzalez, J. (2009). Meditative movement as a category of exercise: Implications for research. *Journal of Physical Activity & Health*, 6(2), 230-238.
- Lawrence, G. P., Gottwald, V. M., Hardy, J., & Khan, M. a. (2011). Internal and external focus of attention in a novice form sport. *Research Quarterly for Exercise and Sport*, 82(3), 431–441. <http://doi.org/10.1080/02701367.2011.10599775>
- Lebreton, J. M., Ployhart, R. E., & Ladd, R. T. (2004). A Monte Carlo comparison of relative importance methodologies. *Organizational Research Methods*, 7(3), 258–282. <http://doi.org/10.1177/1094428104266017>
- Lee, S. J., Ren, Y., Kang, S. H., Geiger, F., & Zhang, L. (2015). Pivoting neuromuscular control and proprioception in females and males. *European Journal of Applied Physiology*, 115(4), 775-784. doi:10.1007/s00421-014-3062-z
- Lee, H., Hale, C. A., Hemingway, B., & Woolridge, M. W. (2012). Tai chi exercise and auricular acupuncture for people with rheumatoid arthritis: An evaluation study. *Journal of Clinical Nursing*, 21(19-20), 2812-2822. doi:10.1111/j.1365-2702.2011.04058.x
- Lewis-Beck, M. S., Bryman, A. & Futing Liao, T. (2004). *The SAGE encyclopedia of social science research methods* Thousand Oaks, CA: SAGE Publications Ltd doi: 10.4135/9781412950589

- Li, F., Harmer, P., Fisher, K. J., McAuley, E., Chaumeton, N., Eckstrom, E., & Wilson, N. L. (2005). Tai chi and fall reductions in older adults: A Randomized controlled trial. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *60*(2), 187–194. <http://doi.org/10.1093/gerona/60.2.187>
- Lord, S. R., Clark, R. D. & Webster, I. W. (1991). Postural stability and associated physiological factors in a population of aged persons. *Journal of Gerontology*, *46*(3), M69-76.
- Lord, S. R. (2006). Visual risk factors for falls in older people. *Age and Ageing*, *35*, 42-45.
- Lu, X., Siu, K. C., Fu, S. N., Hui-Chan, C. W. Y., & Tsang, W. W. N. (2013). Tai Chi practitioners have better postural control and selective attention in stepping down with and without a concurrent auditory response task. *European Journal of Applied Physiology*, *113*(8), 1939–1945. <http://doi.org/10.1007/s00421-013-2624-9>
- Maitre, J., Jully, J.-L., Gasnier, Y., & Paillard, T. (2013). Chronic physical activity preserves efficiency of proprioception in postural control in older women. *Journal of Rehabilitation Research and Development*, *50*(6), 811–20. <http://doi.org/10.1682/JRRD.2012.08.0141>
- Malinowski, P. (2013). Neural mechanisms of attentional control in mindfulness meditation. *Frontiers in Neuroscience*, *7*(7), 1–11. <http://doi.org/10.3389/fnins.2013.00008>
- Manor, B., Lough, M., Gagnon, M. M., Cupples, A., Wayne, P. M., & Lipsitz, L. a. (2014). Functional benefits of Tai chi training in senior housing facilities. *Journal of the American Geriatrics Society*, *62*(8), 1484–1489. <http://doi.org/10.1111/jgs.12946>
- Marich, J., & Howell, T. (2015). Dancing mindfulness: A phenomenological investigation of the emerging practice. *Explore: The Journal of Science & Healing*, *11*(5), 346-356. [doi:10.1016/j.explore.2015.07.001](https://doi.org/10.1016/j.explore.2015.07.001)
- Marmeleira, J.F., Pereira, C., Cruz-Ferreira, A., Fretes, V., Pisco, R., Fernandes, O. M. (2009). Creative dance can enhance proprioception in older adults. *Journal of Physical Activity and Health*, *4*(2), 203-214.
- Marques, E. A., Mota, J., Machado, L., Sousa, F., Coelho, M., Moreira, P., & Carvalho, J. (2011). Multicomponent training program with weight-bearing exercises elicits favorable bone density, muscle strength, and balance adaptations in older women. *Calcified Tissue International*, *88*(2), 117–129. <http://doi.org/10.1007/s00223-010-9437-1>
- Martín, M. A. C., De, M. S., Miján De, L. T., Barrera Ortega, S., Domínguez Rodríguez, L., & Redondo, D. R. (2016). Body mass index and waist circumference are not good surrogate indicators of adiposity in psychogeriatric patients. *American Journal of Human Biology: The Official Journal of the Human Biology Council*, *28*(2), 233-235. [doi:10.1002/ajhb.22765](https://doi.org/10.1002/ajhb.22765)
- Matosic, D., Cox, A. E., & Amorose, A. J. (2014). Scholarship status, controlling coaching

- behavior, and intrinsic motivation in collegiate swimmers: A test of cognitive evaluation theory. *Sport, Exercise, and Performance Psychology*, 3(1), 1-12. doi:10.1037/a0031954
- McDonald, J. H. (2014). *Handbook of Biological Statistics* (3rd ed.). Sparky House Publishing, Baltimore, Maryland. Retrieved from <http://www.biostathandbook.com/confounding.html>
- McKay, J. L., Ting, L. H., & Hackney, M. E. (2016). Balance, body motion, and muscle activity after high-volume short-term dance-based rehabilitation in persons with Parkinson disease. *Journal of Neurologic Physical Therapy*, 40(4), 257–268. <http://doi.org/10.1097/NPT.0000000000000150>
- McLean, R. R., & Kiel, D. P. (2015). Developing consensus criteria for sarcopenia: An update. *Journal of Bone and Mineral Research*, 30(4), n/a–n/a. <http://doi.org/10.1002/jbmr.2492>
- Merom, D., Cumming, R., Mathieu, E., Anstey, K. J., Rissel, C., Simpson, J. M., ... Lord, S. R. (2013). Can social dancing prevent falls in older adults? a protocol of the Dance, Aging, Cognition, Economics (DAnCE) fall prevention randomised controlled trial. *BMC Public Health*, 13, 477. <http://doi.org/10.1186/1471-2458-13-477>
- Merom, D., Pye, V., Macniven, R., van der Ploeg, H., Milat, A., Sherrington, C., ... Bauman, A. (2012). Prevalence and correlates of participation in fall prevention exercise/physical activity by older adults. *Preventive Medicine*, 55(6), 613–617. <http://doi.org/10.1016/j.ypmed.2012.10.001>
- Mitchell, K. D., & Newton, R. A. (2006). Performance-oriented mobility assessment (POMA) balance score indicates need for assistive device. *Disability and Rehabilitation: Assistive Technology*, 1(3), 183–189. <http://doi.org/10.1080/17483100500519325>
- Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Consciousness and Cognition*, 18(1), 176–186. <http://doi.org/10.1016/j.concog.2008.12.008>
- Morse, J. M., Mitcham, C., Hupcey, J. E., & Tásón, M. C. (1996). Criteria for concept evaluation. *Journal of Advanced Nursing*, 24(2), 385–390. <http://doi.org/10.1108/eb008101>
- Mortimer, J. A., Ding, D., Borenstein, A. R., DeCarli, C., Guo, Q., Wu, Y., . . . Chu, S. (2012). Changes in brain volume and cognition in a randomized trial of exercise and social interaction in a community-based sample of non-demented Chinese elders. *Journal of Alzheimer's Disease: JAD*, 30(4), 757-766. doi:10.3233/JAD-2012-120079
- Nakagawa, H. B., Ferraresi, J. R., Prata, M. G., & Scheicher, M. E. (2017). Postural balance and functional independence of elderly people according to gender and age: cross-sectional study. *Sao Paulo Medical Journal = Revista Paulista De Medicina*, 135(3), 260-265.

doi:10.1590/1516-3180.2016.0325280217

- Nathans, L. L., Oswald, F. L., & Nimon, K. (2012). Interpreting multiple linear regression: A guidebook of variable importance. *Practical Assessment, Research & Evaluation, 17*(9), 1–19. <http://doi.org/10.3102/00346543074004525>
- National Institute of Health (1998). *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: Evidence Report*. Retrieved from http://www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.pdf
- National Institute of Health (2016). *Making your printed health materials senior friendly*. Retrieved from <https://www.nia.nih.gov/health/publication/making-your-printed-health-materials-senior-friendly>
- Neys, J. L. D., Jansz, J., & Tan, E. S. H. (2014). Exploring persistence in gaming: The role of self-determination and social identity. *Computers in Human Behavior, 37*, 196-209. doi:10.1016/j.chb.2014.04.047
- Nguyen, M. H., & Kruse, A. (2012). A randomized controlled trial of Tai chi for balance, sleep quality and cognitive performance in elderly Vietnamese. *Clinical Interventions in Aging, 7*, 185-190.
- Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill. O'Halloran
- O'Halloran, A. M., Pénard, N., Galli, A., Fan, C., Robertson, I. H., & Kenny, R. (2011). Falls and falls efficacy: the role of sustained attention in older adults. *BMC Geriatrics, 11*(1), 85. <http://doi.org/10.1186/1471-2318-11-85>
- O'Hoski, S., Winship, B., Herridge, L., Agha, T., Brooks, D., Beauchamp, M. K., & Sibley, K. M. (2013). Increasing the clinical utility of the BESTest, mini-BESTest, and brief-BESTest: normative values in Canadian adults who are healthy and aged 50 years and Older. *Physical Therapy, 94*(3), 334–42. <http://doi.org/10.2522/ptj.20130104>
- Oken, B. S., Zajdel, D., Kishiyama, S., Flegal, K., Dehen, C., Haas, M., . . . Leyva, J. (2006). Randomized, controlled, six-month trial of yoga in healthy seniors: Effects on cognition and quality of life. *Alternative Therapies in Health and Medicine, 12*(1), 40-47.
- Olano, H. A., Kachan, D., Tannenbaum, S. L., Mehta, A., Annane, D., & Lee, D. J. (2015). Engagement in mindfulness practices by U.S. adults: sociodemographic barriers. *Journal of Alternative and Complementary Medicine, 21*(2), 100–2. <http://doi.org/10.1089/acm.2014.0269>
- Ory, M. G., Smith, M. L., Parker, E. M., Jiang, L., Chen, S., Wilson, A. D., . . . Lee, R. (2015). Fall prevention in community settings: Results from implementing Tai chi: Moving for better balance in three states. *Frontiers in Public Health, 2*, 258. <http://doi.org/10.3389/fpubh.2014.00258>

- Paillard, T., Rolland, Y., de Souto Barreto, P. (2015). Protective effects of physical exercise in alzheimer's disease and parkinson's disease: A Narrative review. *Journal of Clinical Neurology*, *11*(3), 212-219. <https://doi.org/10.3988/jcn.2015.11.3.212>
- Painter, A. L., Dhingra, P., Daughtery, J., Cogdill, K., & Trujillo, L. G. (2012). Fear of falling and its relationship with anxiety, depression, and activity engagement among community-dwelling older adults. *American Journal of Occupational Therapy*, *66*(2), 169–176.
- Palmer, P. B., & Connell, D. G. O. (2009). Regression analysis for prediction : Understanding the process. *Cardiopulmonary Physical Therapy Journal*, *20*(3), 23–26.
- Pannekoek, L., Piek, J. P., & Hagger, M. S. (2014). The children's perceived locus of causality scale for physical education. *Journal of Teaching in Physical Education*, *33*(2), 162-185. doi:10.1123/jtpe.2013-0095
- Parastatidou, I. S., Doganis, G., Theodorakis, Y., & Vlachopoulos, S. P. (2014). The mediating role of passion in the relationship of exercise motivational regulations with exercise dependence symptoms. *International Journal of Mental Health and Addiction*, *12*(4), 406-419. doi:10.1007/s11469-013-9466-x
- Pasma, J. H., Engelhart, D., Schouten, a. C., van der Kooij, H., Maier, a. B., & Meskers, C. G. M. (2014). Impaired standing balance: The clinical need for closing the loop. *Neuroscience*, *267*, 157–165. <http://doi.org/10.1016/j.neuroscience.2014.02.030>
- Pedhazur, E.J. (1997). *Multiple regression in behavioral research* (3rd ed.). Belmont, CA: Wadsworth.
- Peh, S. Y. C., Chow, J. Y., & Davids, K. (2011). Focus of attention and its impact on movement behaviour. *Journal of Science and Medicine in Sport*, *14*(1), 70–78. <http://doi.org/10.1016/j.jsams.2010.07.002>
- Perrin, P., Deviterne, D., Hugel, F., & Perrot, C. (2002). Judo, better than dance, develops sensorimotor adaptabilities involved in balance control. *Gait and Posture*, *15*(2), 187–194. [http://doi.org/10.1016/S0966-6362\(01\)00149-7](http://doi.org/10.1016/S0966-6362(01)00149-7)
- Perona-Garcelán, S., Rodríguez-Testal, J. F., Senín-Calderón, C., Ruiz-Veguilla, M., & Hayward, M. (2017). Mindfulness as a mediator between the relational style with voices and negative affect. *Mindfulness*, *8*(2), 454-459. doi:10.1007/s12671-016-0617-6
- Peterson, M. D., Al Snih, S., Stoddard, J., Shekar, A., & Hurvitz, E. A. (2014). Obesity misclassification and the metabolic syndrome in adults with functional mobility impairments: Nutrition examination survey 2003-2006. *Preventive Medicine*, *60*, 71-76. doi:10.1016/j.ypmed.2013.12.014
- Pichierri, G., Coppe, A., Lorenzetti, S., Murer, K., & de Bruin, E. D. (2012). The effect of a

- cognitive-motor intervention on voluntary step execution under single and dual task conditions in older adults: A randomized controlled pilot study. *Clinical Interventions in Aging*, 7, 175–184. <http://doi.org/10.2147/CIA.S32558>
- Pinniger, R., Thorsteinsson, E. B., Brown, R. F., & McKinley, P. (2013). Tango dance can reduce distress and insomnia in people with self-referred affective symptoms. *American Journal of Dance Therapy*, 35(1), 60–77. <http://doi.org/10.1007/s10465-012-9141-y>
- Pirson, M., Langer, E. J., Bodner, T., and Zilcha-Mano, S. (2012). The development and validation of the langer mindfulness scale—enabling a socio-cognitive perspective in mindfulness in organizational contexts. *Fordham University Schools of Business Paper*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2158921
- Podsiadlo, D., & Richardson, S. (1991). The timed "up & go": A test of basic functional mobility for frail elderly persons. *Journal of the American Geriatrics Society*, 39(2), 142-148.
- Polit, D. F., & Beck, C. T. (2012). *Nursing research: Generating and assessing evidence for nursing practice*. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.
- Pollock, A. S., Durward, B. R., & Rowe, P. J. (2000). What is balance? *Clinical Rehabilitation*, 14, 402-406.
- Raufelder, D., Hoferichter, F., Schneeweiss, D., & Wood, M. A. (2015). The power of social and motivational relationships for test-anxious adolescents' academic self-regulation. *Psychology in the Schools*, 52(5), 447-462. doi:10.1002/pits.21836
- Rahal, M., Alonso, A., Andrusaitis, F., Rodrigues, T., Speciali, D., Greve, J., & Leme, L. (2015). Analysis of static and dynamic balance in healthy elderly practitioners of Tai Chi Chuan versus ballroom dancing. *Clinics*, 70(3), 157–161. [http://doi.org/10.6061/clinics/2015\(03\)01](http://doi.org/10.6061/clinics/2015(03)01)
- Razali, N. M., & Wah, Y. B. (2011). Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics*, 2(1), 21-23.
- Rejeski, W. J., & Gauvin, L. (2013). The embodied and relational nature of the mind: Implications for clinical interventions in aging individuals and populations. *Clinical Interventions in Aging*, 8, 657–665. <http://doi.org/10.2147/CIA.S44797>
- Riva, D., Mamo, C., Fanì, M., Saccavino, P., Rocca, F., Momenté, M., & Fratta, M. (2013). Single stance stability and proprioceptive control in older adults living at home: Gender and age differences. *Journal of Aging Research*, 2013. <http://doi.org/10.1155/2013/561695>
- Rogers, C. E., Larkey, L. K., & Keller, C. (2009). A review of clinical trials of Tai chi and qigong in older adults. *Western journal of nursing research*, 31(2), 245-279. <http://doi.org/10.1177/0193945908327529>

- Rummel, R. J. (1970). *Applied factor analysis*. Evanston, IL: Northwestern University Press.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68-78.
- Schmalzl, L., Crane-Godreau, M. a, & Payne, P. (2014). Movement-based embodied contemplative practices: definitions and paradigms. *Frontiers in Human Neuroscience*, *8*, 205. <http://doi.org/10.3389/fnhum.2014.00205>
- Schmid, A. a., van Puymbroeck, M., & Kocejka, D. M. (2010). Effect of a 12-week yoga intervention on fear of falling and balance in older adults: A pilot study. *Archives of Physical Medicine and Rehabilitation*, *91*(4), 576–583. <http://doi.org/10.1016/j.apmr.2009.12.018>
- Shapiro, J., Douglas, K., De La Rocha, O., Radecki, S., Vu, C., & Dinh, T. (1999). Generational differences in psychosocial adaptation and predictors of psychological distress in a population of recent Vietnamese immigrants. *Journal of Community Health*, *24*(2), 95–113. <http://doi.org/10.1023/A:1018702323648>
- Shapiro, S. L., & Schwartz, G. E. R. (2000). Intentional systemic mindfulness: An integrative model for self-regulation and health. *Advances in Mind-Body Medicine*, *16*(2), 128–134.
- Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, *53*(3/4), 591-611.
- Shumway-Cook, a, & Horak, F. B. (1986). Assessing the influence of sensory interaction of balance. Suggestion from the field. *Physical Therapy*, *66*(10), 1548–1550. <http://doi.org/10.2522/ptj.20080227>
- Silva, M. N., Vieira, P. N., Coutinho, S. R., Minderico, C. S., Matos, M. G., Sardinha, L. B., & Teixeira, P. J. (2010). Using self-determination theory to promote physical activity and weight control: A randomized controlled trial in women. *Journal of Behavioral Medicine*, *33*(2), 110-122. doi:10.1007/s10865-009-9239-y
- Simmons, R. W. (2005). Sensory organization determinants of postural stability in trained ballet dancers. *The International Journal of Neuroscience*, *115*(1), 87–97. <http://doi.org/10.1080/00207450490512678>
- Smith, M. J., & Liehr, P. R. (2008). *Middle range theory for nursing* (2nd ed.). New York: Springer.
- Sobell, L. C., Toneatto, T., Sobell, M. B., Schuller, R., & Maxwell, M. (1990). A procedure for reducing error in reports of life events. *Journal of Psychosomatic Research*, *34*(2), 163-170.

- Solberg, P. A., Halvari, H., & Ommundsen, Y. (2013). Linking exercise and causality orientations to change in well-being among older adults: Does change in motivational variables play a role? *Journal of Applied Social Psychology*, *43*(6), 1259-1272. doi:10.1111/jasp.12088
- Soriano, C. T., & Batson, G. (2011). Dance-making for adults with Parkinson disease: one teacher's process of constructing a modern dance class. *Research in Dance Education*, *12*(3), 323–337. <http://doi.org/10.1080/14647893.2011.614334>
- Springer, B. A, Marin, R., Cyhan, T., Roberts, H., & Gill, N. W. (2007). Normative values for the unipedal stance test with eyes open and closed. *Journal of Geriatric Physical Therapy* (2001), *30*(1), 8–15. <http://doi.org/10.1519/00139143-200704000-00003>
- Sturnieks, D. L., St. George, R., Fitzpatrick, R. C., & Lord, S. R. (2008). Effects of spatial and nonspatial memory tasks on choice stepping reaction time in older people. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences*, *63A*(10), 1063-1068.
- Sutton, S. (2001). Health behavior: Psychosocial theories. In N. J. Smelser & P. B. Baltes (Ed.), *International Encyclopedia of the social and behavioral sciences* (pp. 6499-6506). Oxford, UK: Elsevier Science Ltd.
- Sun, D. Q., Huang, J., Varadhan, R., & Agrawal, Y. (2016). Race and fall risk: data from the National Health and Aging Trends Study (NHATS). *Age and Ageing*, *45*(1), 120–127. 32 <http://doi.org/10.1093/ageing/afv173>
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson.
- Takata, Y., Ansai, T., & Soh, I. (2007). Association between body mass index and mortality in an 80-year-old population. *Journal of American Geriatric Society*, *55*, 913–917.
- Taylor-Piliae, R., Newell, K. A., Cherin, R., Lee, M. J., King, A. C., & Haskell, W. L. (2010). Effects of tai chi and western exercise on physical and cognitive functioning in healthy community-dwelling older adults. *Journal of Aging and Physical Activity*, *18*(3), 261-279.
- Tian, L., Tian, Q., & Huebner, E. S. (2015). School-related social support and adolescents' school-related subjective well-being: The mediating role of basic psychological needs satisfaction at school. *Social Indicators Research*, doi:10.1007/s11205-015-1021-7
- Tiedemann, A., O'Rourke, S., Sesto, R., & Sherrington, C. (2013). A 12-week Iyengar yoga program improved balance and mobility in older community-dwelling people: A pilot randomized controlled trial. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *68*(9), 1068-1075.

- Tivity Health. (2017). *Silver Sneakers*. Retrieved from <https://www.silversneakers.com/>
- Teper, R., & Inzlicht, M. (2013). Meditation, mindfulness and executive control: The importance of emotional acceptance and brain-based performance monitoring. *Social Cognitive and Affective Neuroscience*, 8(1), 85–92. <http://doi.org/10.1093/scan/nss045>
- Tsang, W. W. N., & Hui-Chan, C. W. Y. (2003). Effects of Tai Chi on joint proprioception and stability limits in elderly subjects. *Medicine and Science in Sports and Exercise*, 35(12), 1962–1971. <http://doi.org/10.1249/01.MSS.0000099110.17311.A2>
- Tsang, W. W. N., Kwok, J. C. Y., & Hui-Chan, C. (2013). Effects of aging and tai chi on a finger-pointing task with a choice paradigm. *Evidence-Based Complementary and Alternative Medicine*, 653437-653437. doi:10.1155/2013/653437
- Tukey, J. W. (1977). *Exploratory Data Analysis*. Reading, MA: Addison-Wesley.
- Turner, S., Kisser, R., & Rogmans, W. (2015). Falls among older adults in the EU-28: Key facts from the available statistics. *European Public Health Association*. Retrieved from https://eupha.org/repository/sections/ipsp/Factsheet_falls_in_older_adults_in_EU.pdf
- Tyson, S., & Connell, L. (2009). How to measure balance activity in clinical practice. A systematic review of the psychometric properties and clinical utility of measurement tools in neurological conditions. *Clinical Rehabilitation*, 23(9), 824–840. <http://doi.org/10.1177/0269215509335018>
- United States Census Bureau. (2016). *Facts for features: Older Americans Month: May 2016*. Retrieved from <https://www.census.gov/newsroom/facts-for-features/2016/cb16-ff08.html>
- United Healthcare. (2017). Coverage summary: Complementary and alternative medicine. *United Healthcare*. Retrieved from <https://www.uhcprovider.com/content/dam/provider/docs/public/policies/medadv-coverage-sum/complementary-alternative-medicine.pdf>
- Vaillant, J., Vuillerme, N., Martigne, P. (2006). Balance, aging, and osteoporosis: Effects of cognitive exercises combined with physiotherapy. *Joint Bone Spine*, 73(4):414–418. SLS time identifies fallers.
- van Vugt, M. K. (2014). Ballet as a movement-based contemplative practice? Implications for neuroscientific studies. *Frontiers in Human Neuroscience*, 8, 513. <http://doi.org/10.3389/fnhum.2014.00513>
- Vanvoorhis, C. R. W., & Morgan, B. L. (2007). Understanding power and rules of thumb for determining sample sizes. *Tutorials in Quantitative Methods*, 3(2), 43–50.

- Vellas, B., Wayne, S., Romero, L., Baumgartner, R., Rubenstein, L., Garry, P. (1997). One-leg balance is an important predictor of injurious falls in older persons. *Journal of the American Geriatric Society*, 45, 735-738.
- Verdecchia, D. H., Mendoza, M., Sanguineti, F., & Binetti, A. C. (2014). Outcomes after vestibular rehabilitation and Wii® therapy in patients with chronic unilateral vestibular hypofunction. *Acta Otorrinolaringologica (English Edition)*, 65(6), 339–345. <http://doi.org/10.1016/j.otoeng.2014.11.002>
- Vergheze, J. (2006). Cognitive and mobility profile of older social dancers. *Journal of the American Geriatrics Society*, 54(8), 1241–1244. <http://doi.org/10.1111/j.1532-5415.2006.00808.x>
- Vergheze, J., Buschke, H., Viola, L., Katz, M., Hall, C., Kuslansky, G., & Lipton, R. (2002). Validity of divided attention tasks in predicting falls in older individuals: A preliminary study. *Journal of the American Geriatrics Society*, 50(9), 1572–1576. <http://doi.org/10.1046/j.1532-5415.2002.50415.x>
- Vergheze, J., Lipton, R. B., Katz, M. J., et al. (2003). Leisure activities and the risk of dementia in the elderly. *New England Journal of Medicine*, 348(25), 2508–2516.
- Wanke, E. M., Mill, H., Wanke, A., Davenport, J., Koch, F., & Groneberg, D. A. (2012). Dance floors as injury risk: analysis and evaluation of acute injuries caused by dance floors in professional dance with regard to preventative aspects. *Medical Problems Of Performing Artists*, 27(3), 137-142.
- Wayne, P. M. & Fuerst, M. L. (2013). *The Harvard Medical School guide to Tai Chi*. Boston, MA: Shambala.
- Wayne, P. M., Gow, B. J., Costa, M. D., Peng, C. K., Lipsitz L. A. et al. (2014) Complexity-based measures inform effects of tai chi training on standing postural control: Cross-sectional and randomized trial studies. *PLoS ONE*, 9(12). e114731. doi: 10.1371/journal.pone.0114731
- Wiener, N. (1948). *Cybernetics or, Control and Communication in the Animal Machine*. Cambridge, MA: Massachusetts Institute of Technology.
- Weeks, D. L., Forget, R., Mouchnino, L., Gravel, D., & Bourbonnais, D. (2003). Interaction between attention demanding motor and cognitive tasks and static postural stability. *Gerontology*, 49(4), 225-232.
- Wiesmeier, I. K., Dalin, D., & Maurer, C. (2015). Elderly use proprioception rather than visual and vestibular cues for postural motor control. *Frontiers in Aging Neuroscience*, 7, 97-97. doi:10.3389/fnagi.2015.00097
- Woodman, J. P., & Moore, N. R. (2012). Evidence for the effectiveness of Alexander Technique lessons in medical and health-related conditions: A systematic review. *International*

Journal of Clinical Practice, 66(1), 98–112. <http://doi.org/10.1111/j.1742-1241.2011.02817.x>

- Woollacott, M. J., & Shumway-Cooke, a. (2002). Attention and the control of posture and gain: A review of an emerging area of research. *Gait and Posture*, 16, 1–14.
- World Health Organization (2017). Falls fact sheet. *World Health Organization Media Center*. Retrieved from <http://www.who.int/mediacentre/factsheets/fs344/en/>
- World Health Organization (2017). Proposed working definition of an older person in Africa for the MDS Project. *Health Statistics and Information Systems*. Retrieved from <http://www.who.int/healthinfo/survey/ageingdefnolder/en/>
- Wu, E., Barnes, D. E., Ackerman, S. L., Lee, J., Chesney, M., & Mehling, W. E. (2014). Preventing Loss of Independence through Exercise (PLIÉ): qualitative analysis of a clinical trial in older adults with dementia. *Aging & Mental Health*, 19(4), 1–10. <http://doi.org/10.1080/13607863.2014.935290>
- Wulf, G., McNevin, N. & Shea, C. H. (2001). The automaticity of complex motor skill learning as a function of attentional focus. *The Quarterly Journal of Experimental Psychology*, 54(4), 1143-1154.
- Yildirim, P., Ofluoglu, D., Aydogan, S., & Akyuz, G. (2016). Tai Chi vs. combined exercise prescription: A comparison of their effects on factors related to falls. *Journal of Back and Musculoskeletal Rehabilitation*, 29(3), 493–501. <http://doi.org/10.3233/BMR-150645>
- Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulness meditation improves cognition: Evidence of brief mental training. *Consciousness and Cognition*, 19(2), 597–605. <http://doi.org/10.1016/j.concog.2010.03.014>