MEMORY, COGNITION, AND THE EFFECT OF A MUSIC INTERVENTION ON HEALTHY OLDER ADULTS

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MEMORY, COGNITION, AND THE EFFECT OF A MUSIC INTERVENTION ON HEALTHY OLDER ADULTS

DISSERTATION

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Gerontology at the University of Kentucky

By

Shannon Leanne Bowles

Lexington, KY

Co-Directors: John F. Watkins, Ph.D., Graduate Center for Gerontology and Joy M. Jacobs-Lawson, Ph.D., Graduate Center for Gerontology

2013

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ABSTRACT OF DISSERTATION

MEMORY, COGNITION, AND THE EFFECT OF A MUSIC INTERVENTION ON HEALTHY OLDER ADULTS

Music is a powerful modality that can bring about changes in individuals of all ages. This research employed both an experimental and quasi-experimental design to identify the effects of music as it influenced psychological well-being, memory, and cognition among older adults. Specifically, it addressed three aims: (a) To determine to what extent learning to play a music instrument later in life influenced psychological well-being and cognitive function of non-institutionalized healthy seniors, (b) To determine the effects of the amount of music involvement on psychological well-being and cognitive function (c) To determine the benefit of music for those with limited/no music experience. For the first aim, it was hypothesized that individuals in the experimental music group would maintain and/or improve psychological well-being, memory, and cognitive function more than those assigned to the wait-list control group. For the second aim, it was hypothesized that participants with extensive music involvement would have higher scores on cognitive ability measures and experience greater psychological well-being than those who had not been actively involved in music throughout their life. For the third aim, it was hypothesized that the participants with limited/no music involvement throughout their life would have a larger change on the psychological well-being measures and cognitive assessments than those who had more music involvement. For the experimental portion (Aim 1), the study employed a 6-week music intervention with non-institutionalized older adults. The quasi-experimental portion (Aims 2 & 3) divided participants according to their amount of time involved in music and then looked at psychological well-being and cognitive function. This dissertation did not show a strong connection between music, memory, and cognition so it did not achieve the desired overall results. However, the findings did suggest that music may modify some areas of cognitive function (verbal learning, memory, and retention) and psychological well-being but did not influence other areas (playing a music instrument for any length of time). Therefore, the findings of this dissertation can be a basis upon which future research relating to music, cognitive functioning, psychological well-being and involvement in music can build.
Keywords: Music, Aging, Psychological Well-Being, Cognitive Function

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January 28, 2013
MEMORY, COGNITION, AND THE EFFECT OF A MUSIC INTERVENTION ON HEALTHY OLDER ADULTS

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TABLE OF CONTENTS

Acknowledgements ................................................................. iii
List of Tables ................................................................. ix
List of Figures ................................................................. x
Chapter One: Introduction .................................................. 1
  Purpose Statement and Hypotheses ........................................ 2
    Aim 1 ................................................................. 2
    Aim 2 ................................................................. 4
    Aim 3 ................................................................. 5
  Overview of Dissertation .................................................. 5
Chapter Two: Literature Review ............................................ 7
  Theoretical Perspectives .................................................. 7
    Cognitive Reserve and Aging ........................................... 8
    The Life Course Perspective and Aging ............................... 11
  Aging and Brain Activity ................................................ 13
  Music and the Brain ..................................................... 18
    The Effect of Musical Training and Performance on Brain Activity ... 19
    Musicians Compared to Non-Musicians .................................. 20
  Psychological Well-Being, Music, and Older Adults .................. 21
    Music and Psychological Well-Being .................................. 23
    Therapeutic Uses of Music ............................................. 26
  Summary ................................................................. 29
Chapter Three: Methodology ............................................... 30
  Participants .............................................................. 30
  Measurements ............................................................ 32
    Choir Chime Study Questionnaire ..................................... 32
    Ryff’s Scales of Psychological Well-Being ............................ 34
    Controlled Oral Word Association Test ................................ 37
    Digit Vigilance Test .................................................. 38
    Grooved Pegboard ...................................................... 39
    Judgment of Line Orientation ......................................... 40
Multilingual Aphasia Examination Token Test .......................... 41
Rey Auditory Verbal Learning Test ................................. 42
Rey Complex Figure Test ........................................... 43
Seashore Rhythm Test ............................................... 44
Stroop Neuropsychological Screening Test ....................... 44
Trails A & B ......................................................... 45
Specific Aim 1 Design and Methodology .......................... 46
  Procedure ....................................................... 46
  Group Designations ............................................ 48
  Modifications .................................................. 51
  Data Analysis .................................................. 52
Specific Aim 2 Design and Methodology .......................... 53
  Group Designations ............................................ 53
  Data Analysis .................................................. 54
Specific Aim 3 Design and Methodology .......................... 54
  Data Analysis .................................................. 54
Chapter Four: Analyses for Aim 1 .................................. 56
Participants .......................................................... 56
The Effect of Music on Psychological Well-Being, Memory and Cognitive Functioning (Aim 1) ........................................... 58
  Ryff’s Scales of Psychological Well-Being ..................... 60
  Controlled Oral Word Association Test ........................ 60
  Digit Vigilance Test ........................................... 61
  Grooved Pegboard ............................................. 61
  Judgment of Line Orientation ................................ 61
  MAE Token Test ................................................ 61
  Rey Auditory Verbal Learning Test ............................ 62
  Rey Complex Figure Test ...................................... 62
  Seashore Rhythm Test ......................................... 63
  Stroop Neuropsychological Screening Test .................... 63
  Trails A & B ..................................................... 64
Chapter Five: Analyses for Aims 2 and 3 ............................................................... 65
Participants ............................................................................................................. 65
The Impact of Duration of Music Involvement on Psychological Well-Being,
Memory, and Cognitive Functioning (Aim 2) .................................................. 65
Ryff’s Scales of Psychological Well-Being ......................................................... 67
Controlled Oral Word Association Test .............................................................. 67
Digit Vigilance Test ............................................................................................. 67
Grooved Pegboard .............................................................................................. 68
Judgment of Line Orientation ............................................................................. 68
MAE Token Test .................................................................................................. 69
Rey Auditory Verbal Learning Test ................................................................... 69
Rey Complex Figure Test ................................................................................... 69
Seashore Rhythm Test ........................................................................................ 69
Stroop Neuropsychological Screening Test ...................................................... 70
Trails A & B .......................................................................................................... 70
The Benefit of Music for Participants with Limited/No Music Involvement
(Aim 3) .................................................................................................................. 71
Ryff’s Scales of Psychological Well-Being ......................................................... 71
Controlled Oral Word Association Test .............................................................. 72
Digit Vigilance Test ............................................................................................. 72
Grooved Pegboard .............................................................................................. 73
Judgment of Line Orientation ............................................................................. 73
MAE Token Test .................................................................................................. 73
Rey Auditory Verbal Learning Test ................................................................... 73
Rey Complex Figure Test ................................................................................... 73
Seashore Rhythm Test ........................................................................................ 73
Stroop Neuropsychological Screening Test ...................................................... 74
Trails A & B .......................................................................................................... 74
Chapter Six: Discussion and Conclusions ......................................................... 76
The Effect of Music on Psychological Well-Being, Memory, and Cognitive
Functioning (Aim 1) ............................................................................................ 76
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Impact of Duration of Music Involvement on Psychological Well-Being, Memory, and Cognitive Functioning (Aim 2)</td>
<td>78</td>
</tr>
<tr>
<td>The Benefit of Music for Participants with Limited/No Music Involvement (Aim 3)</td>
<td>79</td>
</tr>
<tr>
<td>Overall Discussion of Findings</td>
<td>81</td>
</tr>
<tr>
<td>Limitations of the Study</td>
<td>82</td>
</tr>
<tr>
<td>Recommendations and Future Directions</td>
<td>84</td>
</tr>
<tr>
<td>Practical Applications and Implications</td>
<td>86</td>
</tr>
<tr>
<td>Appendices</td>
<td>88</td>
</tr>
<tr>
<td>Appendix A: Recruitment Flier</td>
<td>88</td>
</tr>
<tr>
<td>Appendix B: Choir Chime Study Questionnaire</td>
<td>90</td>
</tr>
<tr>
<td>Appendix C: Research Consent Form</td>
<td>97</td>
</tr>
<tr>
<td>Appendix D: Songs Played During Study</td>
<td>104</td>
</tr>
<tr>
<td>References</td>
<td>106</td>
</tr>
<tr>
<td>Vita</td>
<td>125</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 3.1 Areas Measured by the 10 Assessments of Cognitive Functioning . . . . . . . . 33
Table 4.1 Demographic Description for the Wait-List Control and Experimental
       Groups ................................................................. 57
Table 4.2 Musical Background and Training for the Wait-List Control and
       Experimental Groups ............................................. 59
Table 4.3 Group Differences on Ryff’s Scales of Psychological Well-Being . . . . . . . . 60
Table 4.4 Rey Auditory Verbal Learning Test Difference Scores ......................... 63
Table 5.1 Demographic Description for the Limited/No Music and Extensive Music
       Groups .................................................................... 66
Table 5.2 T-Test Comparison for Pre-Test Ryff’s Scales of Psychological
       Well-Being .............................................................. 68
Table 5.3 T-Test Comparison for Pre-Test RAVLT ........................................... 70
Table 5.4 The Effect of Music Involvement on Pre-Post Changes on Ryff’s Scales
       of Psychological Well-Being ...................................... 72
Table 5.5 The Effect of Music Involvement on Pre-Post Changes on Rey Auditory
       Verbal Learning Test ................................................ 74
LIST OF FIGURES

Figure 2.1 Cognitive Reserve and the Life Course .............................. 11
Figure 2.2 Lobes of the Brain ......................................................... 14
Figure 3.1 Effects of Music on Psychological Well-Being, Memory, and Cognitive
    Functioning ............................................................. 47
Figure 3.2 Malmark Choirchime® .................................................... 51
Figure 3.3 Effects of Extensive Music Involvement on Psychological Well-Being,
    Memory, and Cognitive Functioning ..................................... 53
Figure 3.4 Benefits of Music for Participants with Limited/No Music
    Involvement .............................................................. 55
Chapter 1

Introduction

It has been said that music is with us from the cradle to the grave – from the first lullaby to the last funeral dirge (Gfeller, 2002). Although individuals may not realize it, music is a part of everyday life as it is present in department and grocery stores, restaurants, elevators, as you wait on the phone, and in television shows and commercials; even while driving down the road, one is likely to hear music coming from another car (Clair & Memmott, 2008; Gfeller, 2008). However, the manner in which we respond to or involve ourselves with music varies across the life span (Cross, 2001). Additionally, music and making music with others can help fill a basic human need - the need to belong and be part of a group of individuals who come together for a common purpose (Clair & Memmott, 2008; Gaston, 1968; Gfeller, 2002; Roskam, 1993).

There are extant resources on the benefits of music for healthy older adults for enhancing psychological well-being and self-esteem, decreasing the symptoms of depression and pain, providing relief from stress, and improving life satisfaction (Boxberger & Cotter, 1968; Coffman, 2002b; Olson, 1984; Rohwer, 2002). In addition, a few quantitative research studies on the benefits of music have suggested that older adults with more instrumental music playing experiences (e.g., playing the piano or guitar) throughout their life time have reduced age effects on various tasks (e.g., memory and perceptual speed tasks), a more positive attitude about participation in music in later life, and may favor music programs over other types of activities, such as trivia or comedy (Bowles, 1991; Durham & Whittemore, 1993; Meinz, 2000). Also for older adults, music may become a new hobby or a chance to re-learn a skill long forgotten and as such will
perhaps enhance psychological well-being and overall life satisfaction (Clair & Memmott, 2008).

The literature has demonstrated the connection between cognition/memory abilities and on-going psychological well-being in old age (Hao, 2008; Kramarow, Lubitz, Lentzner, & Gorina, 2007; Menec, 2003; Nyberg & Backman, 2011). But few studies have quantitatively focused on the benefits of music among older individuals, and little to no research has rigorously addressed how music, either as an intervention or derived from lifelong engagement, influences cognitive and memory decline that may occur with advanced age. This research intended to fill this important gap in understanding by identifying the effects of music as it influenced cognition and memory among older adults.

**Purpose Statement and Hypotheses**

The purpose of this study was two-fold. First, it examined how a music intervention (specifically, a hand chime choir) modified psychological well-being and cognitive function in non-institutionalized older adults and how music may provide quantitative benefits. Secondly, it investigated how playing music may help slow cognitive decline and further aid in psychological well-being for healthy older adults. Three central aims were addressed.

**Aim 1.** The first aim was to determine to what extent learning to play a music instrument later in life influenced psychological well-being and cognitive function of non-institutionalized healthy seniors.

It was hypothesized that individuals in the experimental group would maintain and/or improve psychological well-being, memory, and cognitive function more than
those who were in the wait-list control group (those in this group waited for 6-weeks and then received the music intervention).

Cognitive abilities assessed in this dissertation were: attention, working memory, retention, executive function, manipulative dexterity, oral language comprehension, learning, verbal fluency, speed of processing, visual-motor tracking, and visuospatial/constructional abilities. Attention refers to selectively focusing on one aspect and ignoring others. Working memory is temporary storage. Retention is retaining facts and figures. Executive function is cognitive processing that regulates, controls and manages other cognitive processes and abilities. Manipulative dexterity is being able to move and pick up objects. Oral language comprehension is being able to understand spoken word. Learning is the acquisition of knowledge or skills. Verbal fluency is the ability to produce words. Speed of processing is cognitive efficiency. Visual-motor tracking is the ability to control hand movement guided by vision. Visuospatial/constructional abilities include the capability to visually perceive the spatial relationship. These abilities were evaluated by ten cognitive functioning assessments that will be discussed in Chapter Three (see Table 3.1 on pg. 32).

Areas of psychological well-being that were assessed included: Autonomy, Environmental Mastery, Personal Growth, Positive Relations with Others, Purpose in Life, and Self-Acceptance. Autonomy is independence, self-governance, resisting social pressure to conform to the norm, and evaluation of self by one's own standards. Environmental Mastery is being able to choose/create a suitable place to exist, control external activities, and make use of surrounding opportunities (Ryff, 1999). Personal Growth refers to the desire to continue personal development, being open to new
experiences and realizing his or her potential (Ryff, 1999). Positive Relations with Others embraces interpersonal connections between people and a concern about the welfare of others. Purpose in Life is having goals and a sense of directedness and finding meaning in life (Ryff, 1999). Self-Acceptance includes a positive attitude towards oneself and maturity. They were measured by one assessment that tapped into those six areas of psychological well-being. For this dissertation, psychological well-being for older adults was operationally defined as including the following variables: maintaining social networks, being actively involved in enriching, stimulating, and enjoyable activities, and maintaining optimal health and cognitive functioning for each individual. Psychological well-being also included the areas of autonomy, environment mastery, personal growth, positive relations with others, having a purpose in life, and self acceptance.

For Aim 1, an experimental design was used to evaluate a 6-week music intervention using hand chimes with non-institutionalized older adults. Measures included the Choir Chime Study Questionnaire, demographic information, pre- and post-scores on Ryff’s Scales of Psychological Well-Being, and pre- and post- scores on 10 assessments that measured specific areas of cognitive functioning. Participants were divided into two groups (wait-list control and experimental) and difference scores, and independent samples t-tests were applied to quantitative measures to evaluate the efficacy of the music intervention.

Aim 2. The second aim was to determine the effects of the amount of music involvement on psychological well-being and cognitive function.
It was hypothesized that participants with more music involvement would have higher scores on cognitive ability measures and experience higher psychological well-being than those who had not been actively involved in music throughout their life. Music involvement was defined as playing (or learning to play) a music instrument for any amount of time.

**Aim 3.** The third aim was to determine the benefit of music for those with limited/no music experience.

This aim dealt with predicting change based on the amount of time involved in music. It was hypothesized that participants with limited to no music involvement throughout their life would have a larger change on the psychological well-being measures and cognitive assessments than those who had more music involvement. Cognitive ability and psychological well-being were measured using the same variables as Aim 1.

In Aims 2 and 3, participants were divided into two groups (limited/no music and extensive music) and independent samples t-tests, difference scores, and regressions were applied to the cognitive measures to evaluate the effect of music involvement.

**Overview of Dissertation**

Chapter Two provides a literature review of the pertinent study-related topics. Design and methodology, participant description, information on all assessments and measures utilized, study procedure, and data analyses are outlined in Chapter Three. Chapter Four includes analyses and syntheses of quantitative data for Aim 1 and Chapter Five includes analyses and syntheses of data for Aim 2 and Aim 3, with Chapter Six discussing results, implications, and recommendations for future study. The recruitment
flyer, Choir Chime Study Questionnaire, research consent form, and list of 21 songs played during the study are included in the appendices.
Chapter 2

Literature Review

The beneficial aspects of music were the central driving forces and integral components of this dissertation. They provided the overarching connectors and links for this literature review. The literature review encompassed four main areas - theoretical foundations for the dissertation (cognitive reserve model and the life course perspective); aging and brain activity; music and the brain; and psychological well-being, music and older adults.

The brain can be changed by music. Thus, since this dissertation’s focal point was to use music to hopefully change psychological well-being and cognitive functioning in older adults, it was crucial to know what research had been done in this area, what it indicated, and the impact on people. Also, it was essential to examine how the brain was changed by aging – before adding in the music variable.

Theoretical Perspectives

As will be discussed later in this chapter, there are multiple cognitive abilities that decline as individuals age (Small, Hughes, Hultsch, & Dixon, 2007). However, there is a growing body of literature that suggests that older adults who are involved in a variety of intellectually stimulating and engaging activities (such as music) may be more protected from cognitive decline and dementia than their counterparts who are not engaged in such stimulating activities (Anstey & Christensen, 2000; Kramer, Bherer, Colcombe, Dong, & Greenough, 2004; Small et al., 2007). Consequently, involvement in these activities may provide a buffer in old age. While some interject that the activities that we engage in during our youth and younger years are more important (Fritsch, McClendon, Smyth,
Lerner, Friedland, & Larsen, 2007), there is evidence that even engaging in stimulating activities in later years has a positive effect on the brain and can help our cognitive reserve (Wilson, Barnes, & Bennett, 2007).

Cognitive reserve and aging. As individuals age, abilities and neural hardware to perform cognitive tasks decrease, thus processing of information becomes less efficient. This depletion of the cognitive reserve can be due to various factors including age, lifestyle factors (e.g., physical activity, drug and alcohol abuse), biological (e.g., disease, stroke), and environmental (e.g., pollution, socioeconomic status) (Vance, 2006). Thankfully, even though the reserve may be diminished, the brain can still react to and process new information; thus creating observable changes in the brain which help improve cognition (Vance, 2006).

Cognitive reserve (CR) suggests that intelligence and experiences in life such as educational or occupational attainments and involvement in enriching activities, such as leisure activities, over a lifetime may supply a buffer in the form of a set of skills that allows some people to cope with cognitive declines better than others (Kesler, Adams, Blasey, & Bigler, 2003; Kolanowski, Fick, Clare, Therrien, & Gill, 2010; Murphy & O’Leary, 2010; Spitznagel & Tremont, 2005; Stern, 2002; Sumowski, Chiaravalloti, & DeLuca, 2009; Wilson et al., 2007). There is evidence that a lifestyle characterized by engagement in leisure activities of an intellectual, social and physical nature is associated with slower cognitive decline in healthy older adults and may reduce the risk of dementia. Studies indicate that those with greater education have higher intelligence, greater brain weight and larger neurons when compared to those with less education (Grabner, Neubauer, & Stern, 2006; Katzman, Terry, DeTeresa, Brown, Davies, Fuld,
participation in leisure activities may result in more efficient cognitive networks and therefore provide a CR that delays the onset of clinical manifestations of cognitive decline (Scarmeas, 2007; Stern, 2007). What individuals experience during development, adulthood and old age can contribute to structural and functional changes in the nervous system (Wilson et al., 2007). Additionally, when neurologic disease places requirements on cognitive processing abilities, persons with higher cognitive reserve are able to cope better with the increased cognitive demands associated with disease, thus avoiding or delaying cognitive impairment (Sumowski et al., 2009). Finally, the protective effect of cognitive reserve has been demonstrated across various neurological conditions such as Alzheimer’s disease, stroke, traumatic brain injury (TBI), and cardiovascular disease (Sumowski et al., 2009).

It should be noted that the cognitive reserve model does not assume that cognitive decline will have the same effect on every individual. Rather, it states that those with greater cognitive reserve have the ability to maximize performance through different recruitment of brain networks and thus process tasks in a more efficient and effective manner (Spitznagel & Tremont, 2005; Stern, 2002). Additionally, individuals are born with and can develop other resources to help assist normal and disease-related cognitive changes that may occur during aging (Fritsch et al., 2007). Thus, there are two components to the cognitive reserve model, a passive and active portion.

The passive model includes a brain reserve or threshold. It is defined as the amount of damage a person can take before exhibiting clinical signs or symptoms of cognitive impairment (Kesler et al., 2003; Kolanowski et al., 2010; Satz, 1993;
Spitznagel & Tremont, 2005; Stern, 2002; Stern, 2007). The active model suggests that the brain actively attempts to compensate for brain damage by utilizing and recruiting pre-existing cognitive processing approaches or by other compensatory approaches such as other neural pathways (Kesler et al., 2003; Kolanowski et al., 2010; Spitznagel & Tremont, 2005; Stern, 2002; Stern, 2007). Thus, the active model uses neural networks in more efficient ways. According to Stern (2007), this is a normal process used by healthy individuals when coping with task demands as well as by individuals with brain damage.

While earlier life experiences seem to be vital in increasing cognitive reserve, Fritsch et al. (2007) stressed that it was important to look at various points throughout the life course. Small and colleagues (2007) reviewed several studies that investigated whether or not participation in leisure activities would circumvent age-related changes in cognition. Results indicated partial support for participation in leisure activities. They suggested that finding out what types of activities that elicited the greatest gains in cognitive functioning may be a better route so that effective interventions could be designed to help older adults optimize their cognitive functioning in later life (Small et al., 2007). Music could possibly be one modality that would help make a greater change in cognitive functioning for adults. This dissertation may help to fill this research gap. Richards and Deary (2005) proposed applying the cognitive reserve model across the life course as cognitive ability is modifiable at all stages in life. Linking music involvement and the life course may also be an integral component to cognitive reserve. Is there a critical time frame for learning music that helps with cognitive reserve? Or could it be that someone who has been actively involved in music throughout their life has a greater
cognitive reserve. Figure 2.1 represents Richards and Deary's (2005) cognitive reserve model across the life course.

Figure 2.1

*Cognitive Reserve and the Life Course*¹

![Diagram of cognitive reserve and the life course](image)

a. Cognitive reserve is represented by peak pre-mortem cognitive ability.

b. Cognitive reserve modifies the clinical expression of CNS lesions.

c. Cognitive reserve is influenced by many factors across the life course.

d. These same factors influence the accumulation of CNS lesions.

e. CNS lesions in turn damage brain size and function.

f. There are also factors other than CNS lesions that affect disease (especially dementia) expression.

¹From Richards & Deary, 2005, p. 619

**The life course perspective and aging.** The life course perspective assesses the biological, psychological, and social factors that link early life experiences, adult risk factors and health outcomes in later life, which can influence individuals but may not involve everyone in the same way (Kuh & Ben-Shlomo, 2004; Kuh & Hardy, 2002; Rockwell & Elder, 1982; Shanahan & Elder, 2002).
There are five general principles, derived from research in the social and behavioral sciences that drive life course theory: (a) life span development -- human development and aging are lifelong processes; (b) agency -- individuals construct their own life course and actions they take within the opportunities and constraints of history and social circumstance; (c) time and place -- the life course of individuals is embedded and shaped by the historical times and places they experience over their lifetime; (d) timing -- the developmental antecedents and consequences of life transitions, events, and behavioral patterns vary according to their timing in a person’s life; and (e) linked lives -- lives are lived interdependently and socio-historical influences are expressed through this network of shared relationships (Elder, Johnson, & Crosnoe, 2006). The life course perspective’s central theme is that no period of life, from people's prior experiences, can be understood by itself (Mortimer & Shanahan, 2006).

The first half of life establishes the groundwork for the later life path (Elder & Johnson, 2003). Thus, by studying events earlier in the life course, one may explain or even predict some aspects associated with growing old (e.g., involvement in society, participation in senior centers, and health issues) (Elder & Johnson, 2003). It should be noted that the life course approach does not deny the importance of adult risk factors (e.g., heart disease, stroke, diabetes, certain types of cancer, Parkinson’s disease), but instead supports taking a long-term, multilevel, contextual and dynamic view of aging to identify risk and protective pathways across the life course (Fuller-Iglesias, Smith, & Antonucci, 2010; Kuh & Hardy, 2002). This perspective takes into account, at the group level, the roles of age stratification, cohort and historical period effects, and the accumulation of (in)equalities over time (Fuller-Iglesias et al., 2010). It also recognizes
that all age periods (including old age) are dynamic and cumulative and because aging is a lifelong process, old age is the result of a lifetime of experiences (Fuller-Iglesias et al., 2010).

Factors throughout the life course can influence health outcomes, from psychological well-being to physical functioning. Risk factors, protective factors, and early life experiences shape people’s long-term health and disease outcomes and create a unique life health trajectory for each person (Clipp, Pavalko, & Elder, 1992; Halfon & Hochstein, 2002; Hareven, 2001; Hertzman & Power, 2003; Kirkwood, 2010; Settersten, 2003). According to Kirkwood (2010), the longevity and health trajectory of an individual is directly influenced by a combination of the following factors: 1) genetic factors, 2) environmental factors, including lifestyle and nutrition, and 3) how damage changes molecules and cells in the brain and other organs of the body. This trio of health across the life course is consistent with growing evidence for the flexibility of aging. It offers the possibility for interventions (such as music) to improve the trajectory of brain health (Kirkwood, 2010).

**Aging and Brain Activity**

All organs in the body, including the brain, change with age. Structural changes in the brain are manifested in cognitive functioning (Flood & Morley, 2000; Reuter-Lorenz, 2000; Salthouse 1996a; Salthouse, 1996b; Small et al., 2007). Although it is known that changes occur in the brain as individuals age, researchers do not completely understand the longitudinal changes that occur with age (Beason-Held, Kraut, & Resnick, 2008). However, they do know that not all brain regions are equally changed by the normal aging process (Beason-Held et al., 2008; Breathnach, 1998; Dennis & Cabeza,
2008; Dickstein, Kabaso, Rocher, Luebke, Wearne, & Hof, 2007; Gunning-Dixon, Brickman, Cheng, & Alexopoulos, 2009; Hestad, Ellertsen, & Klove, 1998; Kolb, Gibb, & Robinson, 2003). Neuroimaging studies indicated that some regions (i.e., frontal and temporal lobes) were more predisposed to age-related changes than others (Baena, Allen, Kaut, & Hall, 2010; Beason-Held, Golski, Kraut, Esposito, & Resnick, 2005; Beason-Held et al., 2008; Goh & Park, 2009; Gunning-Dixon et al.; Park & Reuter-Lorenz, 2009; Reuter-Lorenz, 2000) (see Figure 2.2).

Figure 2.2

*Lobes of the brain*

![Lobes of the brain image]


Attention difficulties, slowed planning, and decreased initiation of complex activities were associated with reduced frontal lobe functioning as well (Miner, 1994). Memory deficits for context (i.e., time and place) may also be related to frontal lobe
dysfunction; furthermore, a functional decrease in this lobe may impair the ability to integrate events into stored memories and thus, cause problems remembering events, dates, and facts (Schugens, Daum, Spindler, & Birbaumer, 1997). The frontal cortex (external layer of the frontal lobe) of the brain was most susceptible to age-related shrinkage in volume which can result in decreases in memory, decision making, autonomy, emotional regulation, and general executive function (Baena et al., 2010; Fernandez, 2009; Park & Bischof, 2011; Verhaeghen & Cerella, 2008). Impairments of executive function have been linked to a wide range of linguistic and cognitive abilities (Kemper & McDowd, 2008).

Just as with the frontal lobe, and as individuals age, the temporal lobe exhibits structural changes. This lobe is predominant in auditory function, learning, emotional experience, memory, and a sense of self and time (Fernandez, 2009; Kolb & Whishaw, 2003). Additionally, problems remembering new information can be caused by a decrease in hippocampal function (Schugens et al., 1997).

Due to changes in the lobes of the brain, functions and abilities that are controlled in various parts of the brain also decline and/or change with aging. Memory, executive function, and attention deteriorate linearly after about 50 years of age (Liddell et al., 2007). However, the most widely recognized influenced process is memory. As individuals age, they begin to exhibit declines in tasks that are markers of fluid intelligence such as speed of processing, working memory function, long term memory, and reasoning (Park & Bischof, 2011).

Age-related changes in memory (both long-term and short-term memory) are well documented (Finkel, Reynolds, McArdle, Gatz, & Pedersen, 2003; Nyberg & Backman,
However, memory remains one of the most elusive phenomena of the human brain, as it is hard to identify exactly how and where in the brain memory is stored. Liddell and colleagues (2007) found that a decline in memory and associated brain activity measures was characteristic of normal aging. However, not all aspects of memory are equally changed (Craik, 2000; Flood & Morley, 2000; Kolb & Whishaw, 2003).

Longitudinal and cross-sectional studies have indicated that the decline of cognitive abilities is not abrupt and varies due to several factors, including effects linked specifically to life experiences (Beason-Held et al., 2008; Benton & Sivan, 1984; Hestad et al., 1998; Murphy & O'Leary, 2010). Demographic and lifestyle choices, such as education, work, environmental stimulation, socioeconomic status, and health status have all been shown to correlate with levels of cognitive functioning. Health status appears to play a very important role in cognitive abilities as people age. Those who are in excellent health have better cognitive functioning than those with chronic conditions. Leisure time activities and level of engagement in the environment appear to be associated with cognitive abilities.

Beason-Held and colleagues (2008) found that individuals who maintained good physical and cognitive health had more stable longitudinal memory performance (verbal and figural recognition). Also, there were differences among individuals that would influence the rate of decline. Even though there was typically a decline in abilities with age, some individuals displayed little decline or none at all (Beason-Held et al., 2008; Goh & Park, 2009; Hestad et al., 1998; Murphy & O'Leary, 2010).
Despite decreases in brain activity with age, the older brain is as capable as a younger brain to form new neural connections with use. Even as individuals age, new neural connections and networks are created (Kolb et al., 2003). In fact, the frontal and temporal regions also revealed areas of increased activity, suggesting that the healthy aging brain continues to undergo functional reorganization with advancing age (Beason-Held et al., 2008). In normal aging, there is a preservation or even improvement in social/emotional cognition and evidence that crystallized intelligence abilities, such as vocabulary and general knowledge, increase across age (Finkel et al., 2003; Liddell et al., 2007; Park & Bischof, 2011).

Research indicated that older adults who remained stimulated by traveling, learning a music instrument, taking up a new hobby, joining a club, and meeting new people were able to keep their brains mentally challenged, exercised, and flexible (Anstey & Christensen, 2000; Kramer et al., 2004; Small et al., 2007). If fact, even though patterns of brain activity changed over time for older adults, for those who maintained good cognitive and physical health, longitudinal memory performance remained stable (Beason-Held et al., 2008).

When changes occur in the nervous system, a corresponding change in psychological function or behavior (specifically learning and memory) is frequently observed. Consequently when individuals learn new skills, such as playing a musical instrument, physical changes in the brain and cell structures have been found (Kolb et al., 2003). Perhaps individuals who are continuously involved with music (i.e., composing music, playing a music instrument or singing) have a better psychological well-being,
which helps them to improve/maintain cognitive function and plasticity and maintain
higher self-esteem as they grow older.

Music and the Brain

Music is one of the oldest characteristics of the human species; nearly every
human culture has played and enjoyed music (Koelsch & Siebel, 2005; Peretz, 2006).
Music offers an alternative perspective for studying and better understanding the
organization of the human brain, speech, neuroplasticity, the motor system, and other
areas of human cognition (Margulis, 2008; Peretz & Zatorre, 2005; Zatorre & McGill,
2005). Music activities can involve listening as well as playing and creating. Research
has indicated that the brain may be equipped with neural networks that specifically
process music (Peretz, 2003). According to Zatorre and McGill (2005), nearly everyone
seems to have neural systems that allow for perception of music and the reproduction of
sung musical patterns, but not everyone is able to play a music instrument like an
accomplished player.

Research tells us that the different components of music (e.g., pitch, timbre,
rhythm) are processed in different areas of the brain. Nevertheless, music shares certain
cognitive organizational features with other cognitive abilities, which are in various areas
and systems in the brain (Omar, Hailstone, Warren, Crutch, & Warren, 2010; Zatorre &
McGill, 2005). There is evidence that both hemispheres of the brain process music.
Furthermore, music centers are distributed throughout the brain just like language centers
(Ratey, 2001; Sousa, 2001). In fact, processing of the various elements of music rely on
areas of the brain that are also involved in language comprehension (Vuust, Roepstorff,
Wallentin, Mouridsen, & Ostergaard, 2006). Studies have shown that the left hemisphere
usually contains most of the specialized language areas and most of the specialized music areas are in the right hemisphere (Ratey, 2001; Sousa, 2001).

**The effect of musical training and performance on brain activity.** Brain activity and neural connections are changed by music because playing a music instrument is a multisensory and motor experience that requires learning and maintaining a range of skills over the course of a musician’s lifetime. Making music enables stronger neural connections between sensory, motor and multimodal integrative regions throughout the brain (Schlaug, 2009). Specifically, musicians learn and repeatedly practice the association of motor actions with specific sound and visual patterns (musical notation) while receiving continuous multisensory feedback. According to Wan and Schlaug (2010), this association learning can strengthen connections between auditory and motor regions while activating other regions. Plasticity in these regions may explain some of the sensorimotor and cognitive enhancements that have been associated with music training. These enhancements suggest the potential for music making as an interactive treatment or intervention for neurological and developmental disorders, as well as those associated with normal aging (Wan & Schlaug, 2010). Furthermore, data suggest that there is a functional and useful role for music training in cognitive rehabilitation (Thaut, 2010).

Zatorre and McGill (2005) stated that music influences practically every cognitive function. Franklin, Moore, Yip, Jonides, Rattray, and Moher (2008) reviewed and evaluated the link between musical training and general cognitive abilities. They discovered there was disagreement as to which abilities were improved with musical training. Several studies found that musical training may lead to increased motor,
attention, and verbal abilities (Patston, Hogg, & Tippett, 2007; Schlaug, 2003; Wan & Schlaug, 2010; Zatorre & McGill, 2005) as well as changes in the auditory system (Kraus & Chandrasekaran, 2010; Musacchia, Sams, Skoe, & Kraus, 2007).

Research on aging has shown that music may be a protective factor against cognitive decline. Verghese and colleagues (2003) found participants who frequently played a musical instrument were less likely to have developed dementia compared to those who rarely played a music instrument. This protective effect of playing music was stronger than those of other cognitive activities such as reading, writing, or doing crossword puzzles (Wan & Schlaug, 2010). However, Bangert and Schlaug (2006) found that the changes in the brain actually depended on which music instrument was being played. When they compared pianists, string players and non-musicians, results indicated musicians had greater activation in the brain compared to non-musicians and pianists had greater left hemisphere advantage and string-players a right hemisphere advantage.

**Musicians compared to non-musicians.** Musicians, rather than non-musicians, appear to be less susceptible to age-related degenerations in the brain, presumably because of their daily musical activities (Wan & Schlaug, 2010). There are structural differences in the brain between musicians and non-musicians (Bermudez & Zatorre, 2005; Bugos, Perlstein, McCrae, Brophy, & Bedenbaugh, 2007; Sluming, Barrick, Howard, Cezayirli, Mayes, & Roberts, 2002). Additionally, there are differences in memory between musicians and non-musicians. In a study by Schulze, Mueller, and Koelsch (2011), musicians and non-musicians performed a working memory task and functional differences were observed for musicians (certain areas of the brain were activated more strongly), but not for non-musicians. Another study comparing musicians
and non-musicians, found that musicians not only had better motor and sensory skills, but they also had an increased ability to learn new tasks (Rosenkranz, Williamon, & Rothwell, 2007). Franklin and colleagues (2008) presented additional data comparing musicians and non-musicians on several tasks that relied on verbal memory. Their results suggested that musical training does influence long-term memory and verbal working memory.

**Psychological Well-Being, Music, and Older Adults**

In this final section of the literature review, the meaning and definition of psychological well-being for older adults will be discussed, followed by a discussion of the importance of music in the psychological well-being of elders, and then conclude with therapeutic uses of music and older adults. Psychological well-being is difficult to define and measure. It is often depicted as a multidimensional phenomenon (Borglin, Edberg, & Hallberg, 2005) meaning different things to different people.

Numerous articles measure psychological well-being based on health status (Degl’Innocenti et al., 2002; Muraki, Nagao, & Ishikawa, 2001; Trief, Wade, Pine, & Weinstock, 2003). The dimensions for this specific type of psychological well-being include: an individual’s perceived health; actual physical and mental health; physical function; prevention of functional decline, disability, sensory and memory impairments; functional independence; and improvement of health status and lifestyle factors (Degl’Innocenti et al., 2002; Muraki et al., 2001; Trief et al., 2003).

Other articles, pertaining to psychological well-being and satisfaction among older adults, indicate that participation in any of the following are variables that contribute to psychological well-being: social activities; maintaining social networks;
religious activities; autonomy; pets; marital status; educational attainment; living arrangements; socioeconomic status; participation in the labor force; self-esteem; life satisfaction; and life expectancy (Abu-Bader, Rogers, & Barusch, 2002; Ellingson & Conn, 2000; Federal Interagency Forum on Aging Related Statistics, 2004; Galambos, 1997; Ganguli, Snitz, Lee, Vanderbilt, Saxton, & Chang, 2010; Green, Capitman, & Leutz, 2002; Hao, 2008; Ingersoll-Dayton, Saengtienchai, Kespichayawattana, & Aungsuroch, 2001; Johansson, 2003; Keller, 2001; Lawton, 2001; Menec, 2003).

Activity level appears to have a wide range of benefits in later life and plays a large role in the health trajectory of an individual. Studies indicated that activity level, in addition to being a component of psychological well-being, predicted functional and cognitive status (Hao, 2008; Menec, 2003). A qualitative study by Hilleras, Pollitt, Medway and Ericsson (2000), examined subjective experiences of aging among 12 individuals. Results indicated that among the important contributors for psychological well-being were positive outlook on life, social and emotional connections, active engagement with society, and being physically able to engage in life (Hilleras et al., 2000).

Cognitive functioning is a crucial determinant of psychological well-being (Kramarow et al., 2007; Nyberg & Backman, 2011). Research is currently directed toward furthering our understanding of the brain on the basis of cognitive changes as individuals age (Nyberg & Backman, 2011). In contrast to decline associated with physical and cognitive aging, emotional aging appears to benefit from age. Shifts in cognitive processing of emotional stimuli and enhanced emotional motivation and emotional competence likely contribute to improvements (Scheibe & Carstensen, 2010).
Thus, social relationships could become more important for psychological well-being in later life when functional decline has more of an impact on daily activities. Windsor and Anstey (2010) stated that the cognitive, behavioral, and self-regulatory influences which are believed to underlie older adults’ higher relative psychological well-being, could take on varying levels of importance with advancing age.

**Music and psychological well-being.** Music can elicit cognitive, physical and emotional responses for individuals of all ages (Bright, 1997). Additionally, music can engage people in social experiences, give meaning to life experiences, help form social networks and friendships, provide a sense of accomplishment, and encourage lifelong learning (Clair & Memmott, 2008; Harju, 1998; Kenny, 1999; Palmer, 1980). Thus, music can potentially increase psychological well-being for older adults. Music provides important insights into the human condition (Hodges, 2005). It allows us to experience, share, and convey things that may be difficult to put into words such as feelings, self-awareness, group identity, and healing and wholeness. It is inherently connected with feelings and is a form of communication (Hodges, 2005). Music can also be a means of expressing ideas, as it provides a way of structuring thoughts and feelings. Individuals may gain their sense of self through experiences in and with music (Hodges, 2005). Finally, music has profound effects on human beings; it can integrate the mind, body, and spirit (Hodges, 2005).

Hays and Minichiello (2005) studied the personal meaning and importance of music in the lives of older adults. Results revealed that music provided older adults with ways of understanding and developing self-identity, connecting with other people, maintaining well being and experiencing and expressing spirituality as well as providing
strong associations with memories. Specifically, music was used as a source of entertainment as well as a forum to share and interact with others (Hays & Minichiello, 2005).

Age-related physical changes can impact the way older adults participate in activities, but these physical changes do not always generate insurmountable obstacles that hinder older persons from developing a new skill or interest (Clair & Memmott, 2008). Many older adults may have wanted to learn to play a musical instrument for a long time, to sing, develop new musical skills, or to re-learn a musical skill learned as a child, but forgotten (Clair & Memmott, 2008). Others have continued to make music throughout their entire life. Nevertheless, music has the potential to increase wellness, regardless of music skill or talent (Clair & Memmott, 2008).

Several articles tout the benefits of active music making well into the older adult years. For example, active music making throughout the life course has been proven to improve psychological well-being and socialization and as well as aid in enjoyment and musical growth (Bruhn, 2002; Coffman, 2002a; Coffman, 2002b; Coffman & Adamek, 1999; Gibbons, 1984; Iritani, 2002; Koga & Tims, 2001; Rohwer, 2002; Wise, Hartmann, & Fisher, 1992). Furthermore, research has suggested that participating in leisure activities such as musical performance may reduce the risk for developing dementia (Verghese et al., 2003).

Active participation in music has been shown to be physically, socially and cognitively beneficial. By engaging in playing a musical instrument several times a week elders may reduce their risk of dementia and exercise fingers, hands, arms, and other muscles which can aid in improving physical health. Social connections can help older
adults stay healthier and live longer; and older adults involved in creative arts programs are generally happier and healthier (Hartley, 2006). Furthermore, active music making promotes increases in cognitive performance and cognitive skills that can directly influence memory formation and retrieval (Bugos et al., 2007; Thompson, Moulin, Hayre, & Jones, 2005).

There are extant resources on the benefits of music for enhancing psychological well-being and self-esteem, and improving life satisfaction for healthy older adults and those with specific medical conditions (Bell, 1987; Boxberger & Cotter, 1968; Clair & Memmott, 2008 Coffman, 2002a; Coffman, 2002b; Cohen, Bailey, & Nilsson, 2002; Gaston, 1968; Gibbons, 1984; Glassman, 1983; Hamburg & Clair, 2008; Hanser, 2001; Kartman, 1990; Liederman, 1967; Olson, 1984; Rohwer, 2002; Ruud, 1997; Tomaino, 1994). Hays (2005 & 2006), reported that music was key in helping older adults maintain a sense of psychological well-being and health and facilitating meaning in life. Participants stated that music was vital to psychological well-being and improved health, regardless of their medical condition. Music contributes to positive aging by providing means for individuals to maintain positive self-esteem, feel competent, independent, and avoid feelings of isolation and loneliness (Hays, 2005). Specifically older adults reported that music helped to balance the emotional, intellectual, and spiritual aspects of their lives (Hays, 2006).

Laukka (2007) found that music listening was a frequent source of positive emotions for older adults. Additionally some music listening strategies were significantly associated with psychological well-being (Laukka, 2007). However, in regards to memory and cognitive ability, there is a lack of quantitative research on the effects of
music listening with the normal/healthy aging population. Meinz (2000) measured musical memory and music perceptual speed in relation to the effects on age and cognition of 107 persons from the ages of 19-88 years who played piano at least one hour per week. Results indicated that the playing experiences of the older participants reduced the age effects on most of the tasks related to the study, and perhaps thereby lessened some age-associated memory and cognitive deficits.

**Therapeutic uses of music.** Therapeutic benefits of music for older adults are well documented. Research indicates that music can relieve stress and anxiety (Aldridge 1996; Coffman, 2002b; Tang, Harms, Speck, Vezeau & Jesurum, 2009), improve sleep quality (Lai & Good, 2006), boost immune function (Aldridge 1996; Maranto, 1993), decrease the symptoms of depression (Chan, 2011; Chan, Chan, Mok, & Tse, 2009; Chan, Wong, Onishi, & Thayala, 2011; Hanser, 1992; Tomaino, 1994), and aid in various areas with persons with chronic pain (Kneafsey, 1997; Maranto, 1993; Park & Hughes, 2012; Tomaino, 1994) and Parkinson’s disease (Clair & Memmott, 2008; Kneafsey, 1997).

A review of the music and aging literature revealed a large body of empirical research supporting the efficacy of music among persons with dementia or Alzheimer’s disease (Brotons, Koger, & Pickett-Cooper, 1997; Bruer, Spitznagel, & Cloninger, 2007; Carruth, 1997; Clair, 1996; Clair & Bernstein, 1990; Gibbons, 1988; Han et al., 2011; Hanser, 2001; Knight, 2006; Koger, Chapin, & Brotons, 1999; Ledger & Baker, 2007; Lipe, 1991; Olderog-Millard & Smith, 1989; Ozdemir & Akedmir, 2009; Pollack & Namazi, 1992; Prickett & Moore, 1991; Riegler, 1980; Silber & Hes, 1995; Simmons-Stern, Budson, & Ally, 2010; Sixsmith & Gibson, 2007; Smith, 1990; Smith, 1986; Wall
Several articles examined the use of music for nursing home residents. As said by these authors, the use of music improved and increased physical and mental functioning including reality orientation and psychological well-being (Mahendra, 2001; Palmer, 1980; Vanderark, Newman, & Bell, 1983).

Sole, Mercadal-Brotons, Gallego and Riera (2010) evaluated the impact of three music programs (choir, music appreciation and music therapy) on the psychological well-being of healthy older adults. Four aspects of psychological well-being were assessed (physical health, subjective health, psychological well-being and interpersonal relations). Results indicated no significant changes between the pre- and post-test scores. However, the initial scores were high and so the margin of change was small. The authors determined that participation in music did help to maintain psychological well-being for participants. The reasons older adults became involved in music activities included opportunities to meet new people, create new friendships and the need to learn more about music (a cognitive component). Perhaps the most interesting results from this study came from participants’ subjective perceptions about music involvement. The older adults felt that being involved in the music improved some components of their psychological well-being, especially in social relations and personal development. The authors concluded that the results suggest that being involved in music activities contributes positively to a more active and satisfactory aging process.

Music therapy is defined as the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program (American Music Therapy Association, 2005). “Music therapy is a systematic process of
intervention wherein the therapist helps the client to promote health, using music experiences and the relationships that develop through them as dynamic forces of change” (Bruscia, 1998, p. 20). Music is used to change non-musical behavior and address emotional, cognitive, physical and social needs of individuals of all ages.

Psychological well-being has not been extensively addressed in the gerontological arena in music therapy. Rather, music therapists have been more concerned with examining how music experiences can improve abilities in specific functional areas. Nevertheless, it is important to address psychological well-being and to study how music and music therapy can contribute to the maintenance and improvement of psychological well-being from a preventive as well as a therapeutic sense. Music therapy improves psychological well-being for individuals who are well and meets the needs of others with disability or illness. Music therapists often work with populations where it is difficult to foresee specific improvements because of the nature of the illness they have. However, music therapy can contribute to the maintenance of psychological well-being through the end of life (Sole et al., 2010).

Koelsch (2009) argued the benefit of music therapy and provided suggestions for future research. "From the perspective of neuroscience and biology, there are numerous reasons to assume that music therapy has beneficial effects on the psychological and physiological health of individuals. However, so far only few studies have actually tested, and systematically investigated, such effects, and it is our challenge for the next decade to change this" (Koelsch, 2009, p. 382).
Summary

Literature clearly demonstrates that music is a powerful modality that can bring about positive change in persons of all ages. For older adults, music may become a new hobby or a chance to re-learn a skill long forgotten, and as such, music will perhaps enhance well-being and overall life satisfaction. Extant articles dominantly examine music therapy and its effects on residents of nursing homes and those with depression. However, there are few quantitative articles regarding music’s effects in terms of cognitive function on older adults who are healthy and non-institutionalized. Thus, at the most basic level, there is a significant gap in the literature on how music quantitatively influences older adults.

In summary, there are many components in this review of literature. The connecting factor is music – how it plays a role in psychological well-being, fits into the cognitive reserve and the life course trajectory for individuals, shapes cognition and brain activity, differs between musicians and non-musicians, and how it helps with maintaining mental acuity and brain activity in older adults.
Chapter 3

Methodology

This chapter presents the design and procedures for a controlled experimental music intervention involving healthy older adults (Aim 1). The experimental group received 6-weeks of music and the wait-list control group received it after the post assessments. In addition, the effect of the amount of music experience was examined using a quasi-experimental design (Aims 2 & 3).

Participants

Participants were community-dwelling seniors, age 60 and older, who had an interest in music. Inclusionary criteria included (a) normal physical function and strength in arms and hands, (b) ability to hold hands steady and grasp the chimes, (c) ability to extend forearms, (d) ability to converse, (e) enjoyment of music, (f) naturally right-handed, (g) ability to adequately read English (defined by being able to read the consent form), (h) consent to being videotaped, (i) ability to follow verbal and visual cues and instructions, (j) adequate hearing (defined by being able to follow verbal directions and cues given by the researcher), (k) not color blind, (l) not currently playing in a handbell or chime choir, and (m) not currently taking any type of formal music lessons (e.g., piano, voice). Participants were selected to participate based upon their verbal self-reports of these criteria and being able to hold and ring a hand chime when presented one by the researcher. Additionally, in order to be included, participants had to score above 23 on the Mini Mental State Examination (MMSE) (Folstein, Folstein, & Fanjiang, 2001; Folstein, Folstein, McHugh, & Fanjiang, 2001).
Based upon the researcher's clinical music therapy experience, it was determined that six participants were needed to comprise a single hand chime group. Thus, 12 randomly selected participants - six for the experimental group and six for the wait-list control group (which received the intervention at the end of the 6 weeks) - were recruited at one time to ensure that the groups were even, could meet at the same time, and would adhere to random assignment. Consequently, three experimental/wait-list control group pairs consisting of 12 members each (a total of 36 participants) were planned for the study.

Following Institutional Review Board (IRB) approval, ministers, service administrators and other individuals, who worked with older adults in the Central Kentucky area, were contacted in order to gain permission to recruit at their facility. Once approval was obtained, a letter from the facility stating such was sent to the IRB. Meetings, Sunday school classes, and choir practices were attended in order to recruit participants and distribute an IRB approved recruitment flyer (see Appendix A). In addition, flyers were placed in areas where seniors often congregated, such as hallways and rooms where Sunday school classes for seniors were located. If the organization, such as a church or small community, had a newsletter or other form of communication (e.g., email, church bulletin) that would reach prospective participants, the flyer was placed in the communication. Those interested in the study directly contacted the researcher, who then provided more information about the study. During the contact, the researcher asked specific questions to ensure the participant met inclusion study criteria. If the participant qualified and was interested in participating, then the researcher asked about meeting availability and set up initial meetings. These meetings occurred either in
the potential participant’s home or a designated location where the intervention would take place.

**Measurements**

Outcome measures in the study included the Choir Chime Study Questionnaire, Ryff’s Scales of Psychological Well-Being (Ryff, 1999), and 10 cognitive assessments that were selected because they provided reliable measures of memory and cognitive function (see Table 3.1). The 10 assessments were: Controlled Oral Word Association Test (COWAT) (Benton, Hamsher, & Sivan, 2000); Digit Vigilance Test (DVT) (Lewis, 1995); Grooved Pegboard (GP) (Lafayette Instrument, 2002); Judgment of Line Orientation (JLO) (Benton, Sivan, Hamsher, Varney, & Spreen, 1994); Multilingual Aphasia Examination Token Subtest (TOKEN) (Benton et al., 2000); Rey Auditory Verbal Learning Test (RAVLT) (Schmidt, 1996); Rey Complex Figure Test (RCFT) (Meyers & Meyers, 1995); Seashore Rhythm Test (SRT) (Seashore, Lewis, & Saetveit, 1960); Stroop Neuropsychological Screening Test (SNST) (Trenerry, Crosson, DeBoe, & Leber, 1989); and the Trails A & B (TRAILS) (Lezak, Howieson, & Loring, 2004; Mitrushina, Boone, Razani, & D’Elia, 2005; Strauss, Sherman, & Spreen, 2006). Based upon consultation with a neuropsychologist, the cognitive assessment measures used were selected because they provided reliable measures of memory and cognitive function, were appropriate for use with older adults, collectively took approximately 60-90 minutes to administer, and were able to be administered by the researcher after training.

**Choir Chime Study Questionnaire.** The Choir Chime Study Questionnaire was a music and health questionnaire designed specifically for this study to gather demographic data as well as music background and interests for each of the participants.
Table 3.1

Areas Measured by the 10 Assessments of Cognitive Functioning

<table>
<thead>
<tr>
<th>Area</th>
<th>Assessments</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>C  D  G  J  T  R  R  S  S  T</td>
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<tr>
<td></td>
<td>O  V  P  L  O  A  C  R  N  R</td>
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<tr>
<td></td>
<td>W  T  O  K  V  F  T  S  A</td>
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<tr>
<td></td>
<td>A  E  L  T  T  I</td>
</tr>
<tr>
<td></td>
<td>T  N  T  L</td>
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<tr>
<td>Attention/Working Memory Retention</td>
<td>X  X  X  X  X  X</td>
</tr>
<tr>
<td>Executive Function</td>
<td>X  X</td>
</tr>
<tr>
<td>Manipulative Dexterity</td>
<td>X  X</td>
</tr>
<tr>
<td>Oral Language Comprehension/Learning/Fluency</td>
<td>X  X  X</td>
</tr>
<tr>
<td>Speed of Processing</td>
<td>X  X</td>
</tr>
<tr>
<td>Visual-Motor Tracking</td>
<td>X  X</td>
</tr>
<tr>
<td>Visuospatial Constructional Abilities</td>
<td>X  X</td>
</tr>
</tbody>
</table>

Note. COWAT (Controlled Oral Word Association Test); DVT (Digit Vigilance Test); GP (Grooved Pegboard); JLO (Judgment of Line Orientation); TOKEN (Multilingual Aphasia Examination Token Subtest); RAVLT (Rey Auditory Verbal Learning Test); RCFT (Rey Complex Figure Test); SRT (Seashore Rhythm Test); SNST (Stroop Neuropsychological Screening Test); TRAILS (Trails A & B).
Part of the questionnaire was modeled after Adler's (2001) *Musical Assessment of Gerontologic Needs and Treatment: The MAGNET Survey*. The paper questionnaire consisted of three sections: general background information, music background information, and musical preferences. The general background information section asked about current medications, exercise and dietary habits, and tobacco and alcohol usage. It also included questions about age, gender, race, highest grade achieved, current marital status. This information was used to assure that the groups were comparable with each other on as many variables as possible. The music background information section included questions relevant to the participant concerning immediate family music participation, personal music habits (e.g., listening to music in free time to relax or fall asleep) and current and previous music abilities and activities. The final section, musical preferences, asked participants about their preferences for numerous different styles of music, favorite song and composer, and favorite instrument. For this dissertation, parts of the general and music background information sections were taken out for analysis and were categorized (e.g., marital status and highest grade achieved). Questions used in analysis, were yes/no, fill in the blank and open ended-type questions (See Appendix B).

**Ryff’s Scales of Psychological Well-Being.** In 1989, Ryff developed scales of 20 items to assess psychological well-being but later, the scales were revised and shortened to 14 items that were used in this dissertation. Ryff's revised scales measured Autonomy, Environmental Mastery, Personal Growth, Positive Relations with Others, Purpose in Life, and Self-Acceptance (Ryff, 1999). For each scale, items were scored on a six-point scale: 1 = strongly disagree to 6 = strongly agree. Participants were asked to mark on the assessment form how they felt about themselves and their lives. In
instances where items were negatively worded, questions were reversed coded so that high scores indicated high self-ratings on the scale being evaluated. For each of the six scales, items specific to it were summed to obtain the score for that exclusive scale; the range for each scale could be from 14 to 84. The six scales were Autonomy, Environmental Mastery, Personal Growth, Positive Relations with Others, Purpose in Life, and Self-Acceptance.

The Autonomy scale measured independence, self-determination, and regulation of behavior from within (Ryff, 1989; Ryff, 1999). A sample question was "Sometimes I change the way I act or think to be more like those around me" (Ryff, 1999, p. 3). An individual who scored high on the Autonomy scale tended to be independent, evaluated themselves by personal standards and was able to resist social pressures to behave in certain ways; whereas, lower scores suggested someone who was dependent on others, concerned about others' expectations, and conformed to social pressures to behave in certain ways. Ryff has reported that internal consistency for the Autonomy scale was .83 and correlation with the 20-item parent scale was .97 (Ryff, 1999). The reliability alpha for Autonomy in this dissertation was .75.

Environmental Mastery measured a person's "ability to choose or create environments suitable to his or her psychic conditions" (Ryff, 1989, p. 1071). An example from this area included: "In general, I feel I am in charge of the situation in which I live" (Ryff, 1989, p. 4). Higher scores on the Environmental Mastery scale were indicative of an individual who was competent, controlled complex external activities and effectively used surrounding opportunities to choose or create contexts suitable for personal needs and values. Those who scored lower might be unable to manage everyday
affairs and lacked not only confidence to change or improve surrounding contexts but also felt inadequate in being in control over external matters. Environmental Mastery (α = .86) had a correlation with the 20-item parent scale of .98 (Ryff, 1999). For this dissertation, the reliability alpha for Environmental Mastery was .89.

Personal Growth measured a person's potential to grow and expand as a person (Ryff, 1989; Ryff, 1999). A sample question was "In general, I feel that I continue to learn more about myself as time goes by" (Ryff, 1999, p. 5). A higher score on the Personal Growth scale represented an individual who had a sense of personal growth and development and was changing in ways to reflect more self-knowledge and was striving to realize personal potential; but lower scores suggested someone who felt stagnant, bored, and not interested in life or with developing new attitudes or behaviors. Personal Growth (α = .85) had a correlation with the 20-item parent scale of .97 (Ryff, 1999). The reliability alpha for Personal Growth in this dissertation was .79.

Positive Relations with Others assessed a person's interpersonal relationships with others (Ryff, 1989; Ryff, 1999). A sample question in this area was "Most people see me as loving and affectionate" (Ryff, 1999, p. 6). An individual who scored high on the Positive Relations with Others scale was interested in others, had strong satisfying give and take relationships, and was concerned about the welfare of others; the lower score suggested someone who was impersonal and had few trusting relationships with others because of an unwillingness to make compromises. Positive Relations with Others had an internal consistency of .88 and a correlation with the 20-item parent scale of .98 (Ryff, 1999). For this dissertation, Positive Relations with Others had a reliability alpha of .87.
The Purpose in Life scale measured a person's beliefs and feelings of having a purpose in and a meaning to life (Ryff, 1989). A sample question included "I feel good when I think of what I've done in the past and what I hope to do in the future" (Ryff, 1999, p. 7). Higher scores on the Purpose in Life scale represented someone who had a positive outlook on life and set goals and objectives but a lower score suggested someone who had a lack of meaning in life and no sense of direction or purpose. Purpose in Life ($\alpha = .88$) had a correlation with the 20-item parent scale of .98 (Ryff, 1999). Purpose in Life had a reliability alpha of .86 in this dissertation.

Finally, Self-Acceptance measured self-actualization and maturity (Ryff, 1989). A question included in this area was "When I look at the story of my life, I am pleased with how things have turned out" (Ryff, 1999, p. 8). An individual who scored high on the Self Acceptance scale possessed a positive attitude and accepted multiple aspects of both good and bad personal qualities; whereas, the individual who scored low on this particular scale had low self-esteem, was disappointed with personal life and wished to be different. The internal consistency of Self-Acceptance was .91 with a correlation with the 20-item parent scale of .99 (Ryff, 1999). For this dissertation, the Self-Acceptance scale had a reliability alpha of .87.

**Controlled Oral Word Association Test.** The COWAT is part of the Multilingual Aphasia Examination and was used to measure oral fluency. Participants were asked to verbalize words beginning with three different pre-determined letters. For each of these three pre-determined letters, participants had 60 seconds to verbalize as many words as they could that began with the given letter. Acceptable responses were any words beginning with the given letter except proper names and the same word again.
with a different ending (run, running). Each word was recorded by the researcher. Each of the three letters (i.e., C, F, and L) increased in associative difficulty, determined by the number of words beginning with that letter found in English dictionaries.

The COWAT was scored by summing all of the acceptable words of the three letters to make up the raw score. However, scores on the COWAT were influenced by age, sex and education (Lezak et al., 2004). Thus, the raw scores were adjusted for these variables and converted into t-scores for analysis purposes and scored following the format outlined in the COWAT administration manual (Benton et al., 2000). The test was standardized on a sample of 360 individuals ranging from age 16 to 69 years (Benton et al., 2000). Test-retest reliability reported for a 6-month retest yielded a reliability coefficient of $R = .74$ (Ruff, Light, Parker, & Levin, 1996). Previous tests have shown the test to be reliable and valid (Ivnik, Malec, Smith, Tangalos, & Petersen, 1996; Ruff et al., 1996; Spreen & Strauss, 1998).

**Digit Vigilance Test.** The DVT was a timed pencil-and-paper test designed to measure psychomotor speed, visual-motor tracking, visual attention during rapid visual tracking, and accurate selection of target stimuli. Additionally, the task isolated alertness and vigilance. Individuals scanned two pages of numbers and crossed out every number 6 they saw in each line (Lewis, 1995; Miller, 2001; Psychological Assessment Resources, Inc., 2005a). Scores were calculated for Total Time and Total Errors. The time in seconds that an individual took to complete each page was recorded and summed together for the Total Time raw score. Scoring templates were used to identify and count errors of omission and commission on both pages. Omission and commission errors
counted the same. The Total Errors raw score was derived by summing the total number of errors on both pages (Lewis, 1995).

The DVT was standardized and normed on two adult samples: ages 20 to 80 years and 19 to 79 years (Lewis, 1995). According to the Professional User's Guide, Total Time was a better measure than Total Errors and is the primary measure derived from the DVT, regardless of age (Lewis, 1995). Thus, the Total Time score tends to be the preferred measure, with higher Total Time scores indicating greater levels of impairment. The DVT was sensitive to demographic variables (i.e., age, education, sex and ethnicity) which could change score accuracy, so the Heaton, Miller, Taylor and Grant (2004) comprehensive norms were used to score this assessment for this dissertation. Test-retest reliability coefficients for one-week retest interval were high (Total Time, \( r = .91 \)) and test-retest reliability coefficients for Total Errors were moderately high (Total Errors, \( r = - .66 \)) (Dean & Hill, 2001; Lewis, 1995; Miller, 2001).

The raw scores were derived following the scoring instructions described above. The raw scores were then compared with the Heaton norms (Heaton et al., 2004) and calculated into t-scores based upon the participant's sex, educational level, age, and race. T-scores for both Total Time and Total Errors were analyzed for this dissertation.

**Grooved Pegboard.** The GP measured manipulative dexterity, eye-hand coordination, and motor speed. This assessment was a small board containing slotted holes slanting in different directions and pegs with a ridge on one side. Individuals were tested using each hand and asked to insert the pegs row by row. For the right hand, the individual was asked to place the pegs moving left to right; for the left hand, the individual was asked to reverse the movement order. Scores were calculated by adding
in seconds the amount of time taken to perform the task for each hand, the number of
times a peg was dropped, and how many pegs are correctly placed in the holes for each of
the trials (Lafayette Instrument, 2002; Psychological Assessment Resources, Inc., 2005b).
However, Heaton et al. (2004) suggest using only the time required to place the pegs for
each hand. For this dissertation, only the time to complete the task was analyzed.

Strauss, Sherman, and Spreen (2006), reported marginal to high (.67 to .86)
reliability coefficients for normal individuals over the age of 15. Visual acuity and
dominant-hand pegboard time were correlated \( r = -.62 \). Additionally, moderate to high
associations were reported with measures of attention, perception speed, and nonverbal
reasoning (Strauss et al., 2006).

Since the GP was sensitive to demographic variables (i.e., age, education, sex and
ethnicity) which could influence score accuracy, the Heaton et al. (2004) comprehensive
norms were used to score this assessment. The raw scores were derived following the
scoring instructions described above. The raw scores were then compared with the
Heaton norms (Heaton et al., 2004) and calculated into t-scores based upon the
participant's sex, educational level, age, and race. T-scores were analyzed for this test.

**Judgment of Line Orientation.** The JLO test assessed
visuospatial/constructional abilities (e.g., perception of objects in the field of vision).
Participants were asked to visually match 30 angled line pairs to a stimulus book showing
different angled lines forming a semicircle and verbalize which pair matched; they were
not to touch the stimulus book. One point was deducted for each incorrect response
(range 30-0). The following score corrections were used with older adults: for men
between the ages of 50 and 64 one point was added to the total score, for men between
the ages of 65-74 three points were added, and for women, regardless of age, two points were added to the total score (Benton et al., 1994; Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006).

The test was standardized and normed on a sample of 137 individuals divided into six age-sex groups (Benton et al., 1994). Reliability was high ($r = .84$ to $.91$) and correlations with the WAIS-R visual-spatial subtests (Block Design $r = .68$; Object Assembly $r = .69$) tended to be higher compared to verbal subtests (Information $r = .45$; Vocabulary $r = .28$) (Strauss et al., 2006). Raw scores, adjusted for age and following the scoring method above, were analyzed for this test.

**Multilingual Aphasia Examination Token Test.** The TOKEN test served as an assessment of oral language comprehension of instructions of increasing complexity and right and left hemisphere differences. It was a modification and abbreviated version of De Renzi and Vignolo’s Token Test (Strauss et al., 2006). A series of plastic tokens in five colors (red, white, yellow, black, and green), two sizes, and two shapes (circles and squares) were arranged in a fixed order in front of the participant. The participant was asked to point to or pick up tokens of specifically identified shapes and colors. The tasks became increasingly more difficult as the test progressed (e.g., the participant was asked to pick up two tokens of different shapes and sizes). The total/maximum score for this test was 66; based on two trials each containing 22 questions. Participants received two points on the first trial, and one point on the second trial for correct responses (Benton et al., 2000; Psychological Assessment Resources, Inc., 2005c; Strauss et al., 2006).

The TOKEN was standardized on a sample of 360 individuals ranging in age from 16 to 69 years (Benton et al., 2000). According to the Manual of Instructions
(Benton et al., 2000), no age or education corrections were required for this test. Internal consistency and test-retest reliability were not provided for this test. The TOKEN did show modest correlations with the WAIS-R Performance subtests (Strauss et al., 2006). For this dissertation, the raw scores were analyzed.

**Rey Auditory Verbal Learning Test.** The RAVLT was used to measure verbal learning, memory, and retention. The test was administered one on one and the participant was presented with a total of six readings of 15 words and asked to recall the words after each reading. For the first five readings, the same list of words was used. The sixth list contained a different set of words. Following recall of the 6th list, the participant was asked to once again recall the original list. A delayed recall trial of the original list was implemented approximately 20-45 minutes later. For each trial, the number of correct responses were counted and calculated based on the metanorms of the appropriate age, which were listed in the RAVLT Handbook (Lezak et al., 2004; Mitrushina et al., 2005; Psychological Assessment Resources, Inc., 2005d; Schmidt, 1996; Strauss et al., 2006).

A comprehensive set of norms does not exist for this test; rather normative data are presented from 24 different studies and clinicians have the choice on which to base their analysis (Ivnik et al., 1996; Mackler, 2001; Shaw, 2001). Internal reliability of the total score tended to be high (approximately .90) and test-retest reliability was average ($r = .60$ to $.70$). Delayed-recall scores correlated highly with total scores ($r > .75$).

According to the manual for the RAVLT (Schmidt, 1996) and for scoring purposes, the test was adjusted for age and educational level of the participants and converted into t-scores. Adjusted (for age and education) t-scores were used for analyses.
**Rey Complex Figure Test.** The RCFT assessed visuospatial/constructional ability, organizational skills, and visual memory. This test consisted of a complex two-dimensional line drawing that the participant carefully copied with a pencil on a different sheet of paper (RCFT - Copy). There was no time limit imposed but the amount of time required to complete the copy was recorded. After approximately three minutes of verbal discussion (not related to the test), the participant was given a blank paper and instructed to reproduce the same figure from memory (RCFT - Immediate Recall). Thirty minutes later from the copy trial, the subject was once again asked to draw the figure (RCFT - Delayed Recall). For scoring purposes, the figure was divided into 18 different sections. A score of 0, 0.5, 1, or 2 was given to each section based upon accuracy and placement and then summed to obtain the raw score for that drawing (Meyers & Meyers, 1995; Psychological Assessment Resources, Inc., 2005e). The maximum score for each trial was 36 points. Scores were taken for the Copy, Immediate Recall and Delayed Recall portions of the test as well as the time to copy the figure. In this study, only Immediate Recall and Delayed Recall scores were analyzed and reported.

Normative data were derived from a group of 601 participants between the ages of 18 and 89 years and aggregated from several distinct samples (Meyers & Meyers, 1995). Interrater reliability coefficients ranged from .93 to .99 for summed scores, indicating high interrater reliability. Construct validity was evaluated by comparing the RCFT to several WAIS-R subtests (Meyers & Meyers, 1995). The raw scores for the Immediate Recall and Delayed Recall were converted into t-scores, using the Professional Manual (Meyers & Meyers, 1995). T-scores were analyzed.
**Seashore Rhythm Test.** The SRT, part of an assessment entitled Seashore Measures of Musical Talents, evaluated nonverbal auditory perception, auditory attention, rhythm discrimination, concentration, and immediate auditory memory. Participants were played a recording of 30 pairs of rhythmic sequences of five to seven beats in length. The test consisted of three parts (A, B, and C), each with 10 pairs. Participants were to mark an answer sheet indicating whether the pairs were the same or different. This test was scored by summing the number of correct responses out of 30 (Mitrushina, Boone, & D’Elia, 1999; Seashore et al., 1960).

Norms for the entire test were provided for three educational levels (grades 4-5, 6-8, and 9-16) in the manual. Seashore and colleagues (1960) reported that the internal validity was well established. Reliability ranged from .64 to .67 (Mitrushina et al., 1999; Seashore et al., 1960). Since the Seashore Rhythm Test was sensitive to demographic variables (i.e., age, education, sex and ethnicity) which could influence score accuracy, the Heaton et al. (2004) comprehensive norms were used to score this assessment. The raw scores were derived following the scoring instructions described above. The raw scores were then compared with the Heaton norms (Heaton et al., 2004) and calculated into t-scores based upon the participant's sex, educational level, age, and race. T-scores were analyzed.

**Stroop Neuropsychological Screening Test.** The Stroop Neuropsychological Screening Test (SNST) measured executive functioning. Participants were presented with a stimulus sheet with the names of colors printed in different colors on it (i.e., the word blue printed in green ink) and first asked to read the names of the colors on the sheet. The second task required the naming of the color of the ink in which the words
were printed rather than the word itself. The scores were calculated individually for each task. For each one, the number of correct responses was summed and scored according to the SNST administration manual (Lezak et al., 2004; Mitrushina et al., 2005; Psychological Assessment Resources, Inc., 2005f; Strauss et al., 2006; Trenerry et al., 1989). For analysis purposes, only the second task data were analyzed for the dissertation.

Normative data were based on a sample of 156 adults aged 18-79 years, who were screened for neurological disorders, major psychiatric illnesses or disabilities. Test-retest reliability was assessed by retesting 30 of the participants in the normative sample. Correlation between the two tasks was high (.90), indicating high stability (Trenerry et al., 1989). Raw scores for the Color-Word (second task) were used.

**Trails A & B.** The TRAILS measured complex visual scanning, motor speed, attention, and executive function. For the assessment, participants completed two worksheets. For the first worksheet, the participant drew a line connecting consecutively numbered circles (Trail A). The second was more complex in that the participant connected the same number of consecutively numbered and lettered circles but alternated between the two sequences (Trail B). The participant was to connect the circles as fast as possible without lifting the pencil from the paper. While there was no time limit and errors were not counted, the score for each trail was the number of seconds a participant took to complete the trail (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006).

It was normed using a sample comprised of 1,212 individuals, ranging in age from 20-85 (Strauss et al., 2006). For older adults, one year test-retest reliabilities ranged
from .53 to .64 for part A and .67 to .72 for part B. Trail A and B correlated moderately well with each other \((r = .31)\), suggesting that they measure similar functions (Strauss et al., 2006). Since the TRAILS was sensitive to demographic variables (i.e., age, education, sex and ethnicity) which could influence score accuracy, the Heaton et al. (2004) comprehensive norms were used to score this assessment. The raw scores were derived following the scoring instructions described above. The raw scores were then compared with the Heaton norms (Heaton et al., 2004) and calculated into t-scores based upon the participant's sex, educational level, age, and race. T-scores were analyzed.

**Specific Aim 1 Design and Methodology**

The first aim was to determine to what extent learning to play a music instrument later in life influenced psychological well-being and cognitive function of non-institutionalized older adults. The research used an experimental design to evaluate the effectiveness of a 6-week hand chime music intervention on the cognitive function of community-dwelling older adults. Specifically, a 2 (treatment group) X 2 (time of measurement) design was used to evaluate changes in cognitive function and psychological well-being (Figure 3.1). Participants were randomly assigned into either an experimental or wait-list control group (received the music intervention later).

Cognitive function and psychological well-being outcomes were evaluated using the Choir Chime Study Questionnaire (see Appendix B) and cognitive and psychological well-being assessments. The following sections describe the procedure, group designations, modifications, and data analyses for specific aim 1.

**Procedure.** Once participants were recruited, informed consent (see Appendix C) was obtained from all potential participants. Each person was administered the MMSE,
and grip strength and extension of forearms were tested by holding two of the hand chimes and learning how to ring the chimes. Participants who met all of the inclusion criteria were given the Choir Chime Study Questionnaire and Ryff’s Scales of Psychological Well-Being to complete and bring to their follow-up appointment, which was typically scheduled for the following week. Individuals who did not meet the inclusion criteria were informed that they did not qualify for the study and were thanked for their time.

At the second meeting, either in the participant’s home or a designated location where the intervention would take place, participants brought back the completed measures, which were reviewed for accuracy and clarification, if needed. The participant then completed 10 measures of cognitive functioning. The order in which the assessments were administered was randomized to prevent order and practice effects. Once the assessments were completed for everyone participating in the study, those randomly assigned to the experimental group began the music intervention. The determination and selection of the intervention locations was based upon location,
availability, and accessibility for the participants. Three different locations were chosen -
a community center (located in a retirement community that had independent-living
elders), a retirement community (had independent and assisted living residents), and a
church.

Participants were assigned to either the experimental or wait-list control group.
Those in the experimental group participated in one of three chime playing groups. At
the completion of the 6-week music intervention, all participants again completed the 10
assessments of cognitive functioning and Ryff’s Scales of Psychological Well-Being. As
with the pre-test assessments, all 10 assessments were presented in random order to avoid
order and practice effects.

Participants assigned to the wait-list control condition were assessed at the same
time as those in the experimental condition. These participants were initially assessed,
asked to wait 6-weeks, and assessed again. Once the final assessments were completed,
the wait-list control participants then received 6-weeks of the music intervention.

**Group designations.** As stated above, the participants were assigned to either the
experimental or wait-list control group. Participants assigned to the wait-list control
condition were recruited and assessed at the same time as those in the experimental
condition. These participants were initially assessed, asked to wait 6-weeks, and assessed
again (at the same time as those in the experimental group). Once the final assessments
were completed, the wait-list control participants then received 6-weeks of the music
intervention. Those in the experimental group participated in one of three chime playing
groups. Those in the experimental group were recruited, tested and then began the chime
choir intervention, which consisted of two 60 minute music sessions per week over a
period of 6 weeks. Songs used in the training sessions included popular music from the participants’ young adult years as well as general folk and well-known tunes (e.g., *Amazing Grace, Home on the Range, You Are My Sunshine*). The order in which the songs were played was varied to keep the participants engaged.

In each session, the participants were arranged in a semicircle. All participants were seated in straight backed chairs, and to keep them more engaged, each participant was assigned a different seat at each of the sessions. Participants’ first names were printed on 8½ x 11 sheets of white paper and placed on one of the six chairs in the semicircle at the beginning of each of the 12 sessions. The order in which the participants sat (and what chimes were played) was randomized. Specifically, each participant played different chimes and sat in different locations during each of the 12 sessions. The chimes were arranged chromatically, going from left to right as if each chime was a key on a piano (i.e., the lowest note was on the left of the researcher and moved up chromatically to the right, with the highest note being on the right of the researcher). For three of the six randomly assigned chairs, participants were responsible for playing three chimes; whereas the other three were responsible for playing two chimes. Participants played the chimes with both hands.

There was only one song where a person assigned to a particular chair playing three chimes, had to play all three chimes. In order to know when to switch and play the third chime, the participant was given a verbal cue, by the researcher, several notes in advance. Also, there were three songs in which one person playing two assigned chimes did not play (i.e., their specific chimes were not used in those songs). In those instances, that person was asked to listen and indicate the name of the song.
All sessions were held in rooms with closed doors and few distractions. Each group stayed in the same room for all 12 sessions, except for the first experimental and wait-list control groups, which were moved to a different room during one session each due to the normal location being used for another event.

Every session consisted of the same intervention format and all sessions were videotaped. First, the participants located their assigned seat for the day and held their respective chimes. Second, participants would be informed which chimes would be used for the particular song about to be played. Participants then placed the chimes not being used on their laps, the floor, or available chair or table. Next, using a direct cuing method, the researcher started the first song and to direct cue, moved around the semicircle and pointed to the participant when it was time to play his/her note(s) in the song. The researcher would point to the person’s left or right depending on which chime was to be played. This procedure was used for all 21 songs.

For the music group interventions, a 25-note set of Malmark Choirchimes® (see Figure 3.2), JVC digital video camera and tripod, and 21 prepared songs (see Appendix D) written on note cards were used in every session. The number of songs was based on the number of chimes needed for each song and the length of the session. Nine of the songs were played in the Key of G; four in the Key of F; one in the Key of D; one in the Key of D, modulating to A; four in the Key of Bb; one in the Key of Ab; and one in C. This was done to ensure variety in what the participants were hearing and playing. Additionally, based on experience, the researcher/music therapist felt that using 21 songs in the same key would not be mentally stimulating and, therefore, would not promote as much cognitive learning.
Modifications. Initially, there were 40 potential participants; however, instead of the planned 36 participants, only 34 persons (as described below) between the ages of 61 and 92 met the inclusionary criteria, completed the entire study and were thus considered eligible for data collection. The remaining six participants (one experimental and five wait-list control participants) either withdrew from the study or were disenrolled due to missing data, macular degeneration problems, or being ambidextrous. The 34 participants who completed the entire study included 23 females and 11 males.

The first four groups (24 people – divided into two experimental and two wait-list control groups) were assigned and participated as planned. However, due to scheduling conflicts and other issues, it was difficult to amass 12 participants who could meet the same days and times for the last experimental and wait-list control group. As a result, random assignment for the last pairing was not possible. Instead of 12 people, the last pairing consisted of only 10 participants. Six participants attended all sessions for the
last experimental group but one participant was ambidextrous so data from that participant were not used in analysis; thus, the final experimental group consisted of only five people. To match this group, five participants were recruited to participate in the last wait-list control group. Consequently, the experimental and wait-list control groups each had a total of 17 participants. Each of the 34 participants, including those in the wait-list control group, met individually with the researcher and completed a battery of cognitive measures at pre-test and post-test (after 6 weeks).

Data analysis. Each participant was assigned a unique participant number, and data from the MMSE, the Choir Chime Study Questionnaire, Ryff’s Scales of Psychological Well-Being and the 10 cognitive assessments were recorded for all qualifying participants. For all participants (both experimental and wait-list control), each assessment was given prior to the 6-week music intervention and 6-weeks later and then was scored and entered into SPSS where various statistical analyses were run and examined. Quantitative analysis included calculating difference scores by converting the post-test minus pre-test scores for the wait-list control and experimental groups and then conducting independent samples t-tests for each of the assessments.

For scoring purposes, the Controlled Oral Word Association Test, Rey Auditory Verbal Learning Test, and the Rey Complex Figure Test scores were converted into t-scores. For those assessments, t-scores were analyzed. Since the Digit Vigilance Test, Grooved Pegboard, Seashore Rhythm Test and Trails A & B are sensitive to demographic variables (i.e., age, education, sex and ethnicity), which could influence score accuracy, the Heaton et al. (2004) comprehensive norms were used to score these assessments and T-scores were used for analyses.
Specific Aim 2 Design and Methodology

Aim two of the dissertation was to determine the effects of the amount of music involvement on psychological well-being and cognitive function. The research used a quasi-experimental design to evaluate the effect of music involvement on cognitive functioning and psychological well-being of community-dwelling older adults. The participants were divided into two groups based on their duration of music playing. The initial assessments (before the music intervention) from both groups were used to evaluate levels of cognitive function and psychological well-being (see Figure 3.3).

Figure 3.3
Effects of Extensive Music Involvement on Psychological Well-Being, Memory, and Cognitive Functioning

**Group designations.** Based on the music information provided by the participants in the Choir Chime Study Questionnaire, the participants were divided into either limited/no music (< 10 years music experience) or extensive music (> 10 years music experience).
Data analysis. As stated previously, participants were divided in relation to music experience (those with limited/no music experience and those who had over 10 years of music experience). Then independent samples t-tests were conducted on the pre-test scores. For scoring purposes, the Controlled Oral Word Association Test, Rey Auditory Verbal Learning Test, and the Rey Complex Figure Test scores were converted into t-scores. For those assessments, t-scores were analyzed. Since the Digit Vigilance Test, Grooved Pegboard, Seashore Rhythm Test and Trails A & B are sensitive to demographic variables (i.e., age, education, sex and ethnicity), which could influence score accuracy, the Heaton et al. (2004) comprehensive norms were used to score these assessments and T-scores were used for analyses.

Specific Aim 3 Design and Methodology

Aim three was to determine the benefit of music for those with limited/no music experience. Since this aim pertained to change for the participants with limited/no music involvement, only those who were assigned to the experimental group (Aim 1) were evaluated for this aim (see Figure 3.4). Cognitive function and psychological well-being outcomes were evaluated using cognitive and psychological well-being assessments.

Data analysis. As the final aim addressed the effect of music for those without a lengthy involvement in music, only those in the experimental group were used in the analysis. Difference scores were calculated for each assessment by subtracting pre-test scores from post-test scores and then using duration of involvement in music as the predictor, regressions were conducted using the differences scores as the outcome. For scoring purposes, the Controlled Oral Word Association Test, Rey Auditory Verbal Learning Test, and the Rey Complex Figure Test scores were converted into t-scores.
For those assessments, t-scores were analyzed. Since the Digit Vigilance Test, Grooved Pegboard, Seashore Rhythm Test and Trails A & B are sensitive to demographic variables (i.e., age, education, sex and ethnicity), which could influence score accuracy, the Heaton et al. (2004) comprehensive norms were used to score these assessments and T-scores were used for analyses.
Chapter 4

Analyses for Aim 1

This dissertation examined the benefits of a music intervention on non-institutionalized healthy older adults. Three aims were addressed. The first aim investigated the extent to which learning to play a music instrument later in life influenced psychological well-being and cognitive function of non-institutionalized healthy seniors will be presented in this chapter. The second and third aims examined the effect of duration of music experience in terms of psychological well-being and cognitive function and will be discussed in the next chapter. Prior to describing analyses, information about the sample is presented.

Participants

Participants were community-dwelling seniors, age 60 and older, who had an interest in music. One prerequisite to participate in this study was to score above a 23 on the MMSE. For the 34 participants who completed the entire study, the average MMSE score was 28.21 (SD = 1.86) out of a possible 30 points. Participants ranged in age from 61 to 92 years, with the mean being 77.41 (SD = 7.59). The sample was predominately White (91.2%) and women (n=23) outnumbered men (n=11). Nearly sixty-eight percent (n=23) of the 34 participants held a college degree (bachelor’s or higher) (see Table 4.1). Participants were assigned to either the experimental or wait-list control group. 17 individuals were in the experimental condition and participated in one of three chime playing groups. Both groups were initially assessed at the same time.

Attendance in the experimental group was relatively high, with the average being 11.12 (SD = 1.05) out of 12 sessions. Attendance for the wait-list control group was not
Table 4.1

*Demographic Description for the Wait-List Control and Experimental Groups*

<table>
<thead>
<tr>
<th></th>
<th>Wait-List Control % (frequency)</th>
<th>Experimental % (frequency)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>29.4 (5)</td>
<td>35.3 (6)</td>
</tr>
<tr>
<td>Women</td>
<td>70.6 (12)</td>
<td>64.7 (11)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
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<td></td>
</tr>
<tr>
<td>White</td>
<td>100.0 (17)</td>
<td>82.4 (14)</td>
</tr>
<tr>
<td>Black</td>
<td>0.0 (0)</td>
<td>17.6 (3)</td>
</tr>
<tr>
<td><strong>Education Level</strong></td>
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<td></td>
</tr>
<tr>
<td>High School</td>
<td>17.6 (3)</td>
<td>5.9 (1)</td>
</tr>
<tr>
<td>Some College</td>
<td>23.5 (4)</td>
<td>17.6 (3)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>29.4 (5)</td>
<td>41.2 (7)</td>
</tr>
<tr>
<td>Master’s degree or higher</td>
<td>29.4 (5)</td>
<td>35.3 (6)</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
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<tr>
<td>Never Married</td>
<td>5.9 (1)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Married</td>
<td>41.2 (7)</td>
<td>41.2 (7)</td>
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<tr>
<td>Widowed</td>
<td>47.1 (8)</td>
<td>47.1 (8)</td>
</tr>
<tr>
<td>Divorced</td>
<td>5.9 (1)</td>
<td>11.8 (2)</td>
</tr>
<tr>
<td><strong>Income</strong></td>
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<tr>
<td>$0-$12,999</td>
<td>5.9 (1)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>$13,000-$33,999</td>
<td>47.1 (8)</td>
<td>29.4 (5)</td>
</tr>
<tr>
<td>$34,000+</td>
<td>35.3 (6)</td>
<td>47.1 (8)</td>
</tr>
<tr>
<td>Declined to answer</td>
<td>11.8 (2)</td>
<td>23.5 (4)</td>
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<tr>
<td><strong>Exercise Frequency</strong></td>
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<tr>
<td>None</td>
<td>35.3 (6)</td>
<td>23.5 (4)</td>
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<tr>
<td>Once or Twice a Month</td>
<td>5.9 (1)</td>
<td>0.0 (0)</td>
</tr>
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<td>1-2 Times per Week</td>
<td>17.6 (3)</td>
<td>17.6 (3)</td>
</tr>
<tr>
<td>3-5 Times per Week</td>
<td>35.3 (6)</td>
<td>35.3 (6)</td>
</tr>
<tr>
<td>6-7 Times per Week</td>
<td>5.9 (1)</td>
<td>23.5 (4)</td>
</tr>
</tbody>
</table>
calculated due to one wait-list control group ending before the 12th session and the final wait-list control group choosing not to play the chimes. The mean age for the wait-list control group was 79.7 (SD = 7.3) years of age compared to 75.1 (SD = 7.4) years for the experimental group. There were nearly twice as many women in each group (71% for the wait-list control group and 65% for the experimental group) as there were men. In terms of education, 58.8% of the wait-list control group had some type of college degree compared to 76.5% of the experimental group holding a college degree. The experimental group exercised more often than the wait-list control group. On the Choir Chime Study Questionnaire, 58.8% of the respondents in the experimental group stated they exercised three or more times a week compared to 41.2% of the wait-list control group exercising three or more days a week. Chi Square tests were run on all categorical data to compare the two groups; only race ($\chi^2 (1) = 3.29, p = 0.07$) was marginally significant, indicating a slight difference between the groups.

Table 4.2 contains musical background information from the Choir Chime Study Questionnaire for the wait-list control and experimental groups. Of the entire sample, 67.7% (n=23) had played some sort of music instrument and 73.5% (n=25) had sung in some type of vocal ensemble during their lifetime. Also, 61.8% (n=21) took some form of music lessons during their life. Coincidentally, 47.1% (n=8) from each group (wait-list control and experimental) still played a music instrument and/or sang.

The Effect of Music on Psychological Well-Being, Memory, and Cognitive Functioning (Aim 1)

The first purpose of this study was to examine how a music intervention influenced psychological well-being and cognitive functioning in non-institutionalized
Table 4.2  
*Musical Background and Training for the Wait-List Control and Experimental Groups*

<table>
<thead>
<tr>
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<th>Wait-List Control</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (frequency)</td>
<td>% (frequency)</td>
</tr>
<tr>
<td>Ever Played a Music Instrument</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>70.6 (12)</td>
<td>64.7 (11)</td>
</tr>
<tr>
<td>No</td>
<td>29.4 (5)</td>
<td>35.3 (6)</td>
</tr>
<tr>
<td>Ever Sang in a Choir/Vocal Ensemble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>76.5 (13)</td>
<td>70.6 (12)</td>
</tr>
<tr>
<td>No</td>
<td>23.5 (4)</td>
<td>29.4 (5)</td>
</tr>
<tr>
<td>Ever Taken Music Lessons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>64.7 (11)</td>
<td>58.8 (10)</td>
</tr>
<tr>
<td>No</td>
<td>35.3 (6)</td>
<td>41.2 (7)</td>
</tr>
<tr>
<td>Lifelong Music</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Still Plays or Sings</td>
<td>47.0 (8)</td>
<td>47.0 (8)</td>
</tr>
<tr>
<td>No music/used to sing/play</td>
<td>53.0 (9)</td>
<td>53.0 (9)</td>
</tr>
</tbody>
</table>

Older adults. It was hypothesized that, as evidenced by scores on a psychological well-being measure and cognitive assessments, persons age 60 and older who participated in the music intervention, would maintain and/or improve psychological well-being, memory, and cognitive function more than those who were in the wait-list control group. To test this hypothesis, wait-list control and experimental group scores from each assessment were converted into difference scores (post-test minus pre-test) and then independent samples t-tests were conducted for the psychological well-being indicators and cognitive function measures. A two-tailed significance value to .05 was used on all tests.
Ryff’s Scales of Psychological Well-Being. Ryff’s Scales of Psychological Well-Being measured six factors (Autonomy, Environmental Mastery, Personal Growth, Positive Relations with Others, Purpose in Life, and Self-Acceptance) relating to personal well-being (Ryff, 1999). One of the six of the Scales yielded significant results - Positive Relations with Others ($t(31) = -2.05, p = 0.05$) indicating a larger change for the experimental group compared to the wait-list control group (see Table 4.3). The Self-Acceptance scale was marginally significant ($t(31) = -1.88, p = 0.07$).

Table 4.3

<table>
<thead>
<tr>
<th></th>
<th>Wait-List Control</th>
<th>Experimental</th>
<th>$t(31)$</th>
<th>$p$</th>
<th>$d$</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>-1.35 (9.47)</td>
<td>1.56 (6.11)</td>
<td>-1.04</td>
<td>0.31</td>
<td>0.37</td>
<td>0.27</td>
</tr>
<tr>
<td>Environmental Mastery</td>
<td>-0.71 (6.47)</td>
<td>2.69 (6.66)</td>
<td>-1.49</td>
<td>0.15</td>
<td>0.52</td>
<td>0.43</td>
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<tr>
<td>Personal Growth</td>
<td>0.53 (5.63)</td>
<td>2.12 (5.52)</td>
<td>-0.82</td>
<td>0.42</td>
<td>0.29</td>
<td>0.20</td>
</tr>
<tr>
<td>Positive Relations With Others</td>
<td>-0.76 (6.95)</td>
<td>4.00 (6.36)</td>
<td>-2.05</td>
<td>0.05*</td>
<td>0.71</td>
<td>0.65</td>
</tr>
<tr>
<td>Purpose in Life</td>
<td>1.06 (4.84)</td>
<td>2.75 (6.11)</td>
<td>-0.89</td>
<td>0.38</td>
<td>0.31</td>
<td>0.22</td>
</tr>
<tr>
<td>Self-Acceptance</td>
<td>-0.76 (5.62)</td>
<td>2.44 (3.97)</td>
<td>-1.88</td>
<td>0.07</td>
<td>0.66</td>
<td>0.59</td>
</tr>
</tbody>
</table>

*p < .05, two tailed.

Controlled Oral Word Association Test. The COWAT served as a measure of verbal fluency (Benton et al., 2000). Results indicated no significant differences between
the two groups on this assessment (wait-list control $M = 2.88, SD = 6.30$ and experimental $M = 1.82, SD = 5.93$, $t(31.88) = .50, p = 0.62, d = 0.17, power = 0.08$).

**Digit Vigilance Test.** The DVT measured psychomotor speed and visual-motor tracking (Lewis, 1995). Results indicated no significant differences between the wait-list control group ($M = -0.41, SD = 6.96$) and experimental group ($M = -0.88, SD = 4.72$) on Total Time ($t(32) = 0.23, p = 0.82, d = 0.08, power = 0.08$). Total Errors was marginally significant, indicating that the wait-list control group ($M = -2.35, SD = 7.62$) decreased their errors pre to post more than the experimental group ($M = 2.06, SD = 5.14, t(32) = -1.98, p = 0.06, d = 0.68, power = 0.61$).

**Grooved Pegboard.** The GP assessed manipulative dexterity, eye-hand coordination, motor speed, and right and left hemisphere differences (Lafayette Instrument, 2002). There were no significant differences between the wait-list control group (right hand $M = 2.59, SD = 6.43$) and experimental group (right hand $M = 2.71, SD = 9.70$, $t(32) = -0.04, p = 0.97, d = 0.01, power = 0.05$). Similar results were found for the left hand (wait-list control $M = -1.65, SD = 5.49$, experimental group $M = -0.17, SD = 5.15$, $t(32) = 0.52, p = 0.61, d = 0.18, power = 0.13$).

** Judgment of Line Orientation.** The JLO measured visuospatial/constructional abilities (Benton et al., 1994). Results indicated that the experimental group ($M = 0.29, SD = 5.54$) and wait-list control group ($M = 0.47, SD = 3.28$) did not differ on this assessment ($t(32) = 0.11, p = 0.91, d = 0.04, power = 0.06$).

**MAE Token Test.** The TOKEN measured oral language comprehension (Benton et al., 2000). Results for this assessment indicated no significant differences between
the wait-list control group \((M = 0.35, SD = 3.35)\) and experimental group \((M = 1.88, SD = 3.89, t(32) = -1.23, p = 0.23, d = 0.42, power = 0.33)\).

**Rey Auditory Verbal Learning Test.** Analyses of the RAVLT, which measured verbal learning, memory and retention (Schmidt, 1996), revealed mixed results, meaning the wait-list control or experimental groups had more change on various trials of the RAVLT (see Table 4.4). On Trials 2, 3, 4, 6, DR, and T1-T5, the experimental group (RAVLT Trial 2 \(M = 1.41, SD = 34.02\), RAVLT Trial 3 \(M = -0.53, SD = 22.93\), RAVLT Trial 4 \(M = 3.94, SD = 30.91\), RAVLT Trial 6 \(M = 6.53, SD = 9.43\), RAVLT DR \(M = 6.35, SD = 34.58\), and RAVLT T1-T5 \(M = 1.24, SD = 32.85\)) had more change than did the wait-list control group (RAVLT Trial 2 \(M = -3.76, SD = 26.13\), RAVLT Trial 3 \(M = -4.35, SD = 33.23\), RAVLT Trial 4 \(M = 1.82, SD = 11.43\), RAVLT Trial 6 \(M = 0.00, SD = 18.33\), RAVLT DR \(M = -5.41, SD = 17.80\), and RAVLT T1-T5 \(M = -2.35, SD = 29.21\)).

**Rey Complex Figure Test.** The RCFT measured visuospatial/constructonal ability, organization skills and visual memory (Meyers & Meyers, 1995). On both the Immediate Recall and the Delayed Recall portions of the RCFT, there were no significant differences between the groups; Immediate Recall t-score (wait-list control \(M = 6.29, SD = 11.40\), experimental \(M = 9.76, SD = 8.98, t(32) = -0.99, p = 0.33, d = 0.34, power = 0.25\)) and Delayed Recall t-score (wait-list control \(M = 6.73, SD = 6.90\), experimental \(M = 9.00, SD = 9.90, t(20) = -0.63, p = 0.54, d = 0.27, power = 0.15\)). It should be noted that due to an administration error, 12 scores for the Delayed Recall portion of the test were excluded (6 scores from wait-list control group and 6 scores from the experimental group).
Table 4.4

Rey Auditory Verbal Learning Test Difference Scores

<table>
<thead>
<tr>
<th></th>
<th>Wait-List Control M (SD)</th>
<th>Experimental M (SD)</th>
<th>p</th>
<th>t(32)</th>
<th>d</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1 T-score</td>
<td>0.35 (32.68)</td>
<td>-0.12 (20.51)</td>
<td>0.96</td>
<td>0.05</td>
<td>0.02</td>
<td>0.06</td>
</tr>
<tr>
<td>Trial 2 T-score</td>
<td>-3.76 (26.13)</td>
<td>1.41 (34.02)</td>
<td>0.62</td>
<td>-0.50</td>
<td>0.17</td>
<td>0.12</td>
</tr>
<tr>
<td>Trial 3 T-score</td>
<td>-4.35 (33.23)</td>
<td>-0.53 (22.93)</td>
<td>0.70</td>
<td>-0.39</td>
<td>0.13</td>
<td>0.10</td>
</tr>
<tr>
<td>Trial 4 T-score</td>
<td>1.82 (11.43)</td>
<td>3.94 (30.91)</td>
<td>0.79</td>
<td>-0.27</td>
<td>0.09</td>
<td>0.08</td>
</tr>
<tr>
<td>Trial 5 T-score</td>
<td>-1.59 (39.08)</td>
<td>-2.59 (31.79)</td>
<td>0.94</td>
<td>0.08</td>
<td>0.03</td>
<td>0.06</td>
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<tr>
<td>Trial B T-score</td>
<td>-3.47 (17.04)</td>
<td>-7.06 (15.37)</td>
<td>0.52</td>
<td>0.65</td>
<td>0.22</td>
<td>0.16</td>
</tr>
<tr>
<td>Trial 6 T-score</td>
<td>0.00 (18.33)</td>
<td>6.53 (9.43)</td>
<td>0.20</td>
<td>-1.31</td>
<td>0.45</td>
<td>0.36</td>
</tr>
<tr>
<td>DR T-score</td>
<td>-5.41 (17.80)</td>
<td>6.35 (34.58)</td>
<td>0.22</td>
<td>1.25</td>
<td>0.43</td>
<td>0.34</td>
</tr>
<tr>
<td>T1-T5 T-score</td>
<td>-2.35 (29.21)</td>
<td>1.24 (32.85)</td>
<td>0.74</td>
<td>-0.34</td>
<td>0.12</td>
<td>0.09</td>
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</table>

* $p < .05$, two tailed.

**Seashore Rhythm Test.** The SRT measured nonverbal auditory perception, auditory attention, concentration, and immediate auditory memory (Seashore et al., 1960). There were no statistically significant differences for this test (wait-list control $M = 3.59$, $SD = 8.08$, experimental $M = -0.29$, $SD = 11.58$, $t(32) = 1.13$, $p = 0.27$, $d = 0.39$, power = 0.30).

**Stroop Neuropsychological Screening Test.** The SNST measured executive functioning (Trenerry et al., 1989) and results indicated no significant differences between the groups for the Color-Word portion of the assessment (wait-list control $M =$ -
0.53, SD = 17.85, experimental M = 4.00, SD = 14.16, t(32) = -0.82, p = 0.42, d = 0.28, power = 0.20).

**Trails A & B.** The TRAILS measured complex visual scanning, motor speed, attention, and executive function (Lezak et al., 2004). Trail A failed to reveal significant differences (wait-list control M = 1.12, SD = 8.91, experimental M = 1.76, SD = 12.58, t(32) = -0.17, p = 0.86, d = 0.06, power = 0.07); as did Trail B (wait-list control M = 0.00, SD = 8.34, experimental M = 1.59, SD = 6.75, t(32) = -0.61, p = 0.55, d = 0.21, power = 0.15).
Chapter 5

Analyses for Aims 2 and 3

The second aim in this dissertation examined the extent to which older adults with extensive music involvement differed from their counterparts having limited/no music involvement, in terms of psychological well-being and cognitive function. The third aim determined the benefit of music for those with limited/no music experience. Prior to describing analyses, information about the sample is presented.

Participants

The same participants who were involved with the first aim were divided according to amount of time playing a music instrument. Those who had played less than 10 years were placed in the limited/no music group and those with more than 10 years of playing experience were in the extensive music group. The mean age for the limited/no music group was 76.61 (SD = 6.66) compared to 78.31 (SD = 8.65) for the extensive music group. Nearly 72.2% of the limited/no music group held a college degree (bachelor's degree or higher) compared to 63% of the extensive music group (see Table 5.1). Chi Square tests were run on all categorical data to compare the two groups and no significant differences were found between the groups.

The Impact of Duration of Music Involvement on Psychological Well-Being, Memory, and Cognitive Functioning (Aim 2)

The second aim of the study was to investigate the impact of duration of playing music on psychological well-being, memory, and cognitive functioning. Specifically investigating how older adults with extensive music involvement compared with their
### Table 5.1

**Demographic Description for the Limited/No Music and Extensive Music Groups**

<table>
<thead>
<tr>
<th></th>
<th>Limited/No Music</th>
<th>Extensive Music</th>
</tr>
</thead>
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<tr>
<td></td>
<td>% (frequency)</td>
<td>% (frequency)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>27.8 (5)</td>
<td>37.5 (6)</td>
</tr>
<tr>
<td>Women</td>
<td>72.2 (13)</td>
<td>62.5 (10)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>94.4 (17)</td>
<td>87.5 (14)</td>
</tr>
<tr>
<td>Black</td>
<td>5.6 (1)</td>
<td>12.5 (2)</td>
</tr>
<tr>
<td>Education Level</td>
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<td></td>
</tr>
<tr>
<td>High School</td>
<td>16.7 (3)</td>
<td>6.3 (1)</td>
</tr>
<tr>
<td>Some College</td>
<td>11.1 (2)</td>
<td>31.3 (5)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>38.9 (7)</td>
<td>31.3 (5)</td>
</tr>
<tr>
<td>Master’s degree or higher</td>
<td>33.3 (6)</td>
<td>31.3 (5)</td>
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<tr>
<td>Marital Status</td>
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</tr>
<tr>
<td>Never Married</td>
<td>0.0 (0)</td>
<td>6.3 (1)</td>
</tr>
<tr>
<td>Married</td>
<td>38.9 (7)</td>
<td>43.8 (7)</td>
</tr>
<tr>
<td>Widowed</td>
<td>55.6 (10)</td>
<td>37.5 (6)</td>
</tr>
<tr>
<td>Divorced</td>
<td>5.6 (1)</td>
<td>12.5 (2)</td>
</tr>
<tr>
<td>Income</td>
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</tr>
<tr>
<td>$0-$12,999</td>
<td>5.6 (1)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>$13,000-$33,999</td>
<td>44.4 (8)</td>
<td>31.3 (5)</td>
</tr>
<tr>
<td>$34,000+</td>
<td>33.3 (6)</td>
<td>50.0 (8)</td>
</tr>
<tr>
<td>Declined to answer</td>
<td>16.7 (3)</td>
<td>18.8 (3)</td>
</tr>
<tr>
<td>Exercise Frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>38.9 (7)</td>
<td>18.8 (3)</td>
</tr>
<tr>
<td>Once or Twice a Month</td>
<td>5.6 (1)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>1-2 Times per Week</td>
<td>11.1 (2)</td>
<td>18.8 (3)</td>
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<tr>
<td>3-5 Times per Week</td>
<td>27.8 (5)</td>
<td>37.5 (6)</td>
</tr>
<tr>
<td>6-7 Times per Week</td>
<td>16.7 (3)</td>
<td>25.0 (4)</td>
</tr>
</tbody>
</table>
counterparts having limited/no music involvement. It was hypothesized that participants with extensive music involvement would have higher scores on the cognitive assessments and experience better psychological well-being than those who were not actively involved in music throughout their life. To test this hypothesis, the participants were divided according to their amount of participation in music – limited/no music experience (n=18) and extensive experience with at least 10 years of playing/singing (n=16). Independent samples t-tests were conducted on the pre-test scores for each group and a two-tailed significance value to .05 was used on all tests. Each test is presented separately.

Ryff’s Scales of Psychological Well-Being. Results did not indicate any statistically significant results on Ryff’s Scales of Psychological Well-Being. However, the results for all scales, except one (Purpose in Life) were contrary to the hypothesis, the limited music group had a higher score on this scale than those with extensive music involvement (see Table 5.2).

Controlled Oral Word Association Test. While not statistically significant, the extensive music group ($M = 54.75, SD = 6.53$) had a higher score on the initial assessment of the COWAT than the limited/no music group ($M = 50.50, SD = 12.15$), $t(26.65) = -1.29, p = 0.22, d = 0.44, power = 0.23$). It should be noted that the analysis was adjusted for unequal variances.

Digit Vigilance Test. There were no statistically significant results for the DVT and this assessment failed to support the hypothesis; t-score Total Time (limited music $M = 44.22, SD = 10.81$, extensive music $M = 47.50, SD = 8.72$, $t(32) = -0.97, p = 0.34, d =$
### Table 5.2

*T-Test Comparison for Pre-Test Ryff’s Scales of Psychological Well-Being*

<table>
<thead>
<tr>
<th></th>
<th>Limited/No Music</th>
<th>Extensive Music</th>
<th><em>t</em>(31)</th>
<th><em>p</em></th>
<th><em>d</em></th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Autonomy</strong></td>
<td>69.35 (9.66)</td>
<td>67.31 (6.93)</td>
<td>0.69</td>
<td>0.49</td>
<td>0.24</td>
<td>0.17</td>
</tr>
<tr>
<td><strong>Environmental Mastery</strong></td>
<td>66.53 (12.73)</td>
<td>66.44 (12.25)</td>
<td>0.02</td>
<td>0.98</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Personal Growth</strong></td>
<td>68.24 (8.85)</td>
<td>67.62 (7.64)</td>
<td>0.21</td>
<td>0.83</td>
<td>0.07</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Positive Relations With Others</strong></td>
<td>70.59 (13.27)</td>
<td>63.81 (8.70)</td>
<td>1.72</td>
<td>0.10</td>
<td>0.60</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>Purpose in Life</strong></td>
<td>64.65 (11.66)</td>
<td>66.44 (11.66)</td>
<td>-0.44</td>
<td>0.66</td>
<td>0.15</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Self-Acceptance</strong></td>
<td>68.47 (13.06)</td>
<td>68.12 (8.91)</td>
<td>0.09</td>
<td>0.93</td>
<td>0.03</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*p < .05, two tailed.*

0.33, power = 0.24) and t-score Total Errors (limited/no music *M* = 51.06, *SD* = 10.63, extensive music *M* = 50.00, *SD* = 9.71, *t*(32) = 0.30, *p* = 0.77, *d* = 0.10, power = 0.09).

**Grooved Pegboard.** On the GP, there were no statistically significant differences between the groups using their dominant hand (limited/no music *M* = 36.22, *SD* = 9.43, extensive music *M* = 40.94, *SD* = 7.78, *t*(32) = -1.58, *p* = 0.13, *d* = 0.55, power = 0.47). There was marginal significance on the left hand, indicating a larger change in time to complete the task using their non-dominant (left) hand (limited/no music *M* = 39.67, *SD* = 9.17, extensive music *M* = 44.88, *SD* = 5.97, *t*(32) = -1.94, *p* = 0.06, *d* = 0.62, power = 0.55).

**Judgment of Line Orientation.** The hypothesis for this aim, which stated that those with extensive music involvement would score higher than those with less
experience was not supported on the JLO. Results indicated that the mean for both
groups was essentially the same (limited/no music $M = 25.67$, $SD = 5.33$, extensive music
$M = 25.94$, $SD = 4.27$, $t(32) = -0.16$, $p = 0.87$, $d = 0.06$, power = 0.07).

**MAE Token Test.** Although not significant, results on the TOKEN indicated
that the extensive music group ($M = 62.44$, $SD = 4.56$) had a slightly lower average on
this test than the limited/no music group ($M = 62.78$, $SD = 3.69$, $t(32) = 0.24$, $p = 0.81$, $d$
$= 0.08$, power = 0.08), which went against the hypothesis.

**Rey Auditory Verbal Learning Test.** Results indicated statistically significant
differences on scores for several RAVLT trials: 2, 3, 4, 6, and T1 – T5, indicating the
extensive music group performed better on these tasks than the limited/no music group.
There was a marginal result on the DR score. The extensive music group scored higher
on all trials of the RAVLT (see Table 5.3).

**Rey Complex Figure Test.** While not significantly different, the extensive music
group (Immediate Recall $M = 55.94$, $SD = 13.98$, Delayed Recall $M = 54.82$, $SD = 17.15$)
had higher averages than the limited/no music group (Immediate Recall $M = 48.56$, $SD =$
12.31, Delayed Recall $M = 49.91$, $SD = 12.28$) on all sections of the RCFT. The
Immediate Recall t-score yielded $t(32) = -1.64$, $p = 0.11$, $d = 0.56$, power = 0.48. For the
Delayed Recall, the t-score was $t(20) = -0.77$, $p = 0.45$, $d = 0.33$, power = 0.18.

**Seashore Rhythm Test.** The SRT failed to support the hypothesis as there were
no statistically significant differences between the groups for this assessment (limited/no
music $M = 42.28$, $SD = 9.88$, extensive music $M = 46.38$, $SD = 9.05$, $t(32) = -1.26$, $p =$
0.22, $d = 0.43$, power = 0.34).
Table 5.3

*T-Test Comparison for Pre-Test RAVLT*

<table>
<thead>
<tr>
<th>Trial</th>
<th>T-score</th>
<th>Limited/No Music $M$ (SD)</th>
<th>Extensive Music $M$ (SD)</th>
<th>$t$ (df)</th>
<th>$p$</th>
<th>$d$</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>47.83 (11.55)</td>
<td>50.67 (8.10)</td>
<td>-0.80(31)</td>
<td>0.43</td>
<td>0.28</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td>47.27 (6.90)</td>
<td>55.64 (11.68)</td>
<td>-2.37(27)</td>
<td>0.03*</td>
<td>0.87</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td>46.94 (10.14)</td>
<td>58.33 (12.04)</td>
<td>-2.86(29)</td>
<td>0.08*</td>
<td>1.02</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Trial 4</td>
<td>45.88 (8.53)</td>
<td>56.20 (12.85)</td>
<td>-2.71(30)</td>
<td>0.01*</td>
<td>0.95</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Trial 5</td>
<td>47.33 (11.33)</td>
<td>53.69 (12.61)</td>
<td>-1.32(23)</td>
<td>0.20</td>
<td>0.53</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>Trial B</td>
<td>57.25 (11.50)</td>
<td>61.63 (11.46)</td>
<td>-0.76(14)</td>
<td>0.46</td>
<td>0.38</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>Trial 6</td>
<td>46.28 (12.20)</td>
<td>56.44 (12.07)</td>
<td>-2.44(32)</td>
<td>0.02*</td>
<td>0.84</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>DR</td>
<td>51.50 (12.76)</td>
<td>61.50 (6.56)</td>
<td>-1.47(12)</td>
<td>0.17</td>
<td>0.99</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>T1-T5</td>
<td>54.90 (10.30)</td>
<td>65.00 (6.26)</td>
<td>-2.16(14)</td>
<td>0.05*</td>
<td>1.19</td>
<td>0.96</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05, two tailed

**Stroop Neuropsychological Screening Test.** Although not statically significant, the extensive music group ($M = 69.50$, $SD = 22.67$) had a higher average score than the limited/no music group ($M = 63.44$, $SD = 22.71$) on the SNST ($t(32) = -0.78$, $p = 0.44$, $d = 0.27$, power = 0.19).

**Trails A & B.** There were no significant differences between the groups for the TRAILS. The analysis was adjusted for unequal variances on Trail B. T-score A analysis failed to find a difference ($t(32) = 0.82$, $p = 0.42$, $d = 0.28$) between limited/no music ($M = 39.33$, $SD = 10.03$) and extensive music ($M = 36.81$, $SD = 7.64$, power =
0.20) and t-score B failed to find a difference ($t(27.47) = -1.26, p = 0.23, d = 0.43$) between limited/no music ($M = 43.44, SD = 11.72$) and extensive music ($M = 47.50, SD = 6.65$, power = 0.33).

**The Benefit of Music for Participants with Limited/No Music Involvement (Aim 3)**

It was hypothesized that those with limited to no consecutive music involvement throughout their life would have a larger change in their pre- and post- scores on psychological well-being measures and cognitive functioning assessments than those who had extensive music involvement. In this analysis, only those participants in the experimental group were used, as the hypothesis related to those individuals receiving the music intervention. The amount of involvement in music was the predictor for change in this analysis. The scores from the assessments were converted into difference scores (post-test minus pre-test) and then regressions were run for the psychological well-being indicators and measures of cognitive functioning. A two-tailed significance value at .05 was used on all assessments. Each test is presented separately.

**Ryff’s Scales of Psychological Well-Being.** On Ryff’s Scales of Psychological Well-Being results indicated that for the Autonomy ($t(15) = -2.26, p = 0.04, \beta = -0.52$) and Purpose in Life ($t(15) = -2.33, p = 0.04, \beta = -0.53$) scales that as the amount of time playing a music instrument decreased, the change in scores increased, confirming the hypothesis that those with limited/no music involvement had a larger change in their scores. For the Positive Relations with Others scale, as the amount of time playing a music instrument increased, so did the change in score, going against the hypothesis, meaning that those with extensive music experience had more change (see Table 5.4).
Table 5.4

The Effect of Music Involvement on Pre-Post Changes on Ryff’s Scales of Psychological Well-Being (Note: Each row in the table represents a separate regression analysis)

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>t(15)</th>
<th>p</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>-0.52</td>
<td>-2.26</td>
<td>0.04*</td>
<td>0.27</td>
</tr>
<tr>
<td>Environmental Mastery</td>
<td>-0.20</td>
<td>-0.78</td>
<td>0.45</td>
<td>0.04</td>
</tr>
<tr>
<td>Personal Growth</td>
<td>-0.14</td>
<td>-0.53</td>
<td>0.60</td>
<td>0.02</td>
</tr>
<tr>
<td>Positive Relations With Others</td>
<td>0.31</td>
<td>1.20</td>
<td>0.25</td>
<td>0.09</td>
</tr>
<tr>
<td>Purpose in Life</td>
<td>-0.53</td>
<td>-2.33</td>
<td>0.04*</td>
<td>0.28</td>
</tr>
<tr>
<td>Self-Acceptance</td>
<td>-0.24</td>
<td>-0.94</td>
<td>0.36</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*p < .05, two tailed.

Controlled Oral Word Association Test. While not significant, results for the COWAT indicated that as the amount of time playing a music instrument increased, so did the amount of change in scores meaning that those with extensive music experience had more change (β = 0.03, t(16) = 0.11, p = 0.91, R² = 0.00).

Digit Vigilance Test. Music involvement was associated with a change in scores for the DVT but it was not statistically significant. Results for this test indicated that as the amount of time playing a music instrument decreased, the change in scores increased for all sections, indicating those with limited/no music experience had more change (Total Time β = -0.02, t(16) = -0.09, p = 0.93, R² = 0.00; Total Errors β = -0.39, t(16) = -1.64, p = 0.12, R² = 0.15).
**Grooved Pegboard.** Results on the GP indicated for the right hand that as the amount of time playing increased, so did the amount of change in scores. For the left hand, it was opposite, as the amount of time playing decreased, the change in scores increased. However, there was not a significant relationship between amount of time involved in music and the difference scores (right hand $\beta = 0.30$, $t(16) = 1.22$, $p = 0.24$, $R^2 = 0.09$; left hand $\beta = -0.24$, $t(16) = -0.98$, $p = 0.34$, $R^2 = 0.06$).

**Judgment of Line Orientation.** The JLO results indicated that as the amount of time playing increased, so did the amount of change in scores. However, there was not a significant relationship between the amount of music involvement and the difference scores on the JLO ($\beta = -0.05$, $t(16) = -0.20$, $p = 0.84$, $R^2 = 0.00$).

**MAE Token Test.** Analysis did not reveal a significant relationship between the amount of time playing a music instrument and changes in scores on the TOKEN. However, results indicated that as the amount of time playing increased, so did the amount of change in scores ($\beta = 0.22$, $t(16) = 0.86$, $p = 0.40$, $R^2 = 0.05$).

**Rey Auditory Verbal Learning Test.** Results failed to support the hypothesis on the RAVLT (see Table 5.5). For three trials (RAVLT Trial 2, 5 and 6) as the amount of time playing decreased, the change in scores increased.

**Rey Complex Figure Test.** For the RCFT, the Immediate Recall t-score ($\beta = -0.03$, $t(16) = -0.11$, $p = 0.91$, $R^2 = 0.00$), indicated that as the amount of time playing a music instrument decreased, the amount of change in score increased. The Delayed Recall was marginally significant ($\beta = 0.56$, $t(10) = 2.06$, $p = 0.07$, $R^2 = 0.32$) and indicated that those with more music experience had larger change.
### Table 5.5

*The Effect of Music Involvement on Pre-Post Changes on Rey Auditory Verbal Learning Test* (Note: Each line in the table represents a separate regression analysis)

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>t(16)</th>
<th>p</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1 T-score</td>
<td>0.09</td>
<td>0.34</td>
<td>0.74</td>
<td>0.01</td>
</tr>
<tr>
<td>Trial 2 T-score</td>
<td>-0.12</td>
<td>-0.45</td>
<td>0.66</td>
<td>0.01</td>
</tr>
<tr>
<td>Trial 3 T-score</td>
<td>0.00</td>
<td>0.01</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Trial 4 T-score</td>
<td>0.26</td>
<td>1.03</td>
<td>0.32</td>
<td>0.07</td>
</tr>
<tr>
<td>Trial 5 T-score</td>
<td>-0.03</td>
<td>-0.11</td>
<td>0.92</td>
<td>0.00</td>
</tr>
<tr>
<td>Trial B T-score</td>
<td>0.06</td>
<td>0.23</td>
<td>0.82</td>
<td>0.00</td>
</tr>
<tr>
<td>Trial 6 T-score</td>
<td>-0.24</td>
<td>-0.94</td>
<td>0.36</td>
<td>0.06</td>
</tr>
<tr>
<td>DR T-score</td>
<td>0.29</td>
<td>1.17</td>
<td>0.26</td>
<td>0.08</td>
</tr>
<tr>
<td>T1-T5 T-score</td>
<td>0.06</td>
<td>0.23</td>
<td>0.82</td>
<td>0.00</td>
</tr>
</tbody>
</table>

* p < .05, two tailed.

**Seashore Rhythm Test.** For the SRT t-score, results indicated that as the amount of time playing a music instrument decreased, the amount of change in scores increased, confirming the hypothesis ($β = -0.50$, $t(16) = -2.24$, $p = 0.04$, $R^2 = 0.25$).

**Stroop Neuropsychological Screening Test.** Analysis revealed a statistically significant relationship for the SNST ($t(16) = 2.27$, $p = 0.04$, $β = 0.51$ and $R^2 = 0.49$). As the amount of time playing increased, so did the amount of change in scores, going against the hypothesis.

**Trails A & B.** Results failed to show support for this hypotheses on the TRAILS. However, results indicated that as the amount of time playing increased, so did the
amount of change in scores (Trail A $\beta = 0.37, t(16) = 1.52, p = 0.15, R^2 = 0.13$; Trail B $\beta = 0.26, t(16) = 1.03, p = 0.32, R^2 = 0.07$).
Chapter 6

Discussion and Conclusions

This chapter summarizes and discusses the findings of the study and addresses factors that may influence the association between music and the trajectory of an older adult's psychological well-being and cognitive abilities. As there were three research aims and hypotheses of the study, discussion is presented for each aim and subsequent hypotheses. The chapter further addresses the limitations of this study and covers the practical applications of the study on the cognitive function and psychological well-being of older adults. Finally, recommendations are made for continued studies that focus on the role of music in promoting cognitive performance and psychological well-being across the life course.

The Effect of Music on Psychological Well-Being, Memory, and Cognitive Functioning (Aim 1)

The first aim of this study was to investigate whether learning to play a music instrument later in life influenced the cognitive and psychological state of non-institutionalized healthy seniors. It was hypothesized that those individuals who participated in the music intervention would maintain and/or improve memory, psychological well-being, and cognitive function when compared with their counterparts with no music. Some areas of psychological well-being provided support for the hypothesis; but findings related to speed of processing, visual-motor tracking, attention, and motor tracking were contrary to what was anticipated.

With respect to psychological well-being, Positive Relations with Others increased for those in the experimental group (see Table 4.3). The literature proposes
that it is a basic human need to come together for a common purpose and that actively making music can help with this need (Clair & Memmott, 2008; Gaston, 1968; Gfeller, 2002; Roskam, 1993). For example, it was observed that when the music groups met for the first time, the individuals did not talk with each other, as most were complete strangers to one another. However, by the end of the 6-weeks, new social connections had formed because, in addition to working together to make music, the participants were talking more to each other about things that happened to them outside of the music group.

By nature, humans are social creatures and thus, when coming together, it is natural for new relationships to form and occur. In fact, engagement in society appears to be a key factor in psychological well-being and satisfaction (Lawton, 2001). According to Johansson (2003), “relationship with others is one of the most powerfully documented contributors to both psychosocial and physical well-being” (pg. 243). Abu-Bader and colleagues (2002) state that when older adults are involved in social networks, their life satisfaction and quality are greater. Menec (2003) concludes that social activities are positively related to psychological well-being. Thus, based on the findings from this study, being involved in a music group is one means of promoting social engagement and positively impacting psychological well-being.

The results for hypothesis 1 indicate that music may help to increase older adults' psychological well-being, which ties in to existing literature that suggests taking up a new hobby and learning something new can modify psychological well-being for older adults (Hilleras et al., 2000; Menec, 2003). Consequently, these results, at least in part, do indicate that perhaps music makes a positive difference in psychological well-being for
older adults. Further research should continue studying the effects of music on psychological well-being (such as using music as a trigger for reminiscence).

The Impact of Duration of Music Involvement on Psychological Well-Being, Memory, and Cognitive Functioning (Aim 2)

The second objective of the study was to examine the extent to which extensive participation in music may serve as a protective factor in terms of psychological well-being and cognitive function. Results provide support for this hypothesis related to verbal learning, memory, and attention.

Support was found for the hypotheses on five out of nine trials of the RAVLT which revealed differences between those with extensive music involvement and limited/no music experience, meaning the scores were higher for those with more music experience (see Table 5.3). Research tells us that music is recognized in areas of the brain that also recognize language (Erdonmez, 1993; Ratey, 2001; Sousa, 2001). Since the RAVLT measures verbal learning, memory and retention, it is not surprising that those with a extensive involvement in music scored significantly higher on the RAVLT than those with limited to no music involvement. Persons who have been involved in music longer continually use those areas of the brain that also process language. These results also agree with what Franklin and colleagues (2008) found in their research. The extensive music group scored higher on every trial of the RAVLT, perhaps suggesting that those areas tapped by the RAVLT were also used to process various components of the music (Ratey, 2001; Sousa, 2001; Vuust et al., 2006).
The Benefit of Music for Participants with Limited/No Music Involvement (Aim 3)

The final aim, comparing the amount of time involved in music, maintained that participants with less music involvement would have a larger change in their scores when compared to those with extensive music involvement. Results that supported this hypothesis related to areas of psychological well-being, attention, working memory, and retention. Results failed to predict a relationship between amount of involvement in music and executive functioning.

For the psychological well-being measure, results indicated that even with a small amount of time involved in music (6-weeks), those with less music had a significantly higher change (post minus pre) on the scales of Autonomy and Purpose in Life (see Table 5.4). As the literature states, making music in a group is one way to increase the basic human need to belong and come together for a common purpose (Clair & Memmott, 2008; Gaston, 1968; Gfeller, 2002; Roskam, 1993). Perhaps those with less music experience in the experimental group increased their sense of belonging and ownership in a group. Even though the participants played as a group, each person was responsible for individual notes, which may have helped increase their autonomy. Each individual was a vital and key member in the group; if they were not there or did not play correctly, the entire group did not sound well. Thus, music possibly fostered a sense of community for these individuals and validated the hypothesis (Bruhn, 2002; Coffman, 2002a; Coffman, 2002b; Coffman & Adamek, 1999; Gibbons, 1984; Wise et al., 1992).

On the only music assessment, the SRT, a more extensive involvement in music did not have an impact on the scores, as those with less music had significantly more change in their attention, concentration, and immediate auditory memory when compared
to those with extensive music involvement. These results contradict research that found musicians, when compared with those with less music experience, have an increased ability to learn new tasks and improvement on listening tasks (Dowling, Bartlett, Halpern, & Andrews, 2008; Rosenkranz et al., 2007).

The SNST, which measured executive functioning, indicated that those with more music experience had significantly more change on this assessment, which was contradictory to the hypothesis. One possible explanation is that musicians, in order to play correctly, have to scan and correctly read music notation. For this assessment, the participants were asked to do something very similar. Thus, with more practice perhaps they were better on this test.

Results were mixed for the RCFT. On the RCFT - Immediate Recall portion of the test, there was not a strong relationship between music and test scores. However, those with less music demonstrated more change. On the RCFT - Delayed Recall part, the results were opposite; those with more music presented marginally significant more change.

The few results that supported the hypotheses indicate that for individuals with minimal amounts of music involvement, it is never too late to maintain or improve cognitive functioning by learning to play a music instrument. According to Wilson and colleagues (2007), what individuals experience in old age can contribute to structural and functional changes in the nervous system. Pascual-Leone (2001) stated that learning to play a music instrument results in a reorganization of the brain which could potentially help to maintain or improve cognitive functioning. For the results that showed significance or marginal significance in the opposite direction of the hypotheses, it brings
to light the music’s importance; meaning that those with a longer amount of time involved in music can help to maintain or improve their cognitive abilities by continuing to play their music instrument. Several research articles support this, as musical training can change the functional structural organization of the brain (Altenmuller, 2004; Franklin et al., 2008; Zatorre & McGill, 2005). Thus, the results revealed some benefits of music, even for those with a relatively short involvement time.

**Overall Discussion of Findings**

Previous research and anecdotal evidence suggests that music has an impact on cognitive functioning and psychological well-being. Research states that making music enables stronger neural connections in various areas and regions of the brain (Schlaug, 2009; Wan & Schlaug, 2010) and can aid in cognitive rehabilitation (Thaut, 2010). Other research found that learning to play a music instrument changes functional and structural organization in the brain (Altenmuller, 2004; Franklin et al., 2008; Pantev, Engelien, Candia, & Elbert, 2003; Zatorre & McGill, 2005). Unfortunately, the research reported in this dissertation was not able to support these notions. However, with regards to the three aims, some domains of psychological well-being and areas of cognitive functioning, including verbal learning, memory and retention, went in the direction of the hypotheses. These results indicate that music may have some sort of effect on these cognitive functions. But because of the lack of significant findings, it is difficult to draw definitive conclusions on how music aids in psychological well-being and cognitive functioning. Some possible explanations for the lack of significance will be described in the next section.
Limitations of the Study

Several limitations exist with respect to the current study. First was the particular design of the study. The music intervention relied heavily on oral language comprehension rather than visual processing, such as reading music. While visual cues (which does aid in visual processing) were read by the participants, the design may have lacked a complexity (such as reading musical notation) that may be needed to create a greater cognitive challenge. This could potentially have a greater impact on cognitive change during the course of the research. Perhaps the results would have been different if instead of responding to direct cuing, the participants had to read music in some form. Research on musical training indicates that part of learning to play a music instrument is also learning how to read music (Herdener et al., 2010; Lappe, Herholz, Trainor, & Pantev, 2008). Thus, having the participants only respond to direct cuing, which does not require a lot of focus and attention, may have hindered the results. However, if the research required participants to learn to read music, this additional challenge may have limited the willingness to participate.

The second limitation was logistics. Recruiting individuals who could meet two times a week at the same time as others to form a hand chime playing group, proved to be difficult. In order to adhere to random assignment, it was determined that 12 participants were needed in order to form a chime experimental group (6 participants) and a wait-list control group (6 participants). Because of scheduling issues, random assignment was not possible in the last pairing (experimental and wait-list control groups). However, the lack of random assignment did not appear to affect the results for this study. Nevertheless, it
is important for future experimental research to adhere to random assignment in order to ensure that participants have an equal chance of being assigned to any group in the study.

The third limitation was the duration of time in the study. The length of 6-weeks was determined by reviewing music therapy literature and based upon the researcher's experience. Other research that measured areas of cognitive functioning have either been held more days per week or for a longer duration of time (Herdener et al., 2010; Lappe et al., 2008; Pascual-Leone, 2001). Going longer than six weeks and playing more than two times a week would have perhaps provided more cognitive benefits. But, the older adults participating in this study were in good health and involved in the community, so it may have been even more difficult to schedule their playing times longer than the original twice weekly for six weeks.

The fourth limitation relates to the third in that actual time spent on the music instrument was limited to the scheduled sessions. These participants did not have access to hand chimes at other times, thus it decreased their opportunity to enhance/create new neural connections. Perhaps learning a more portable and easily accessible instrument (e.g., guitar or violin) would have been better. Research indicates the repetitive nature of practicing a music instrument is what helps aid new neural connections in the brain, which in turn can increase/improve cognitive functioning (Pantev, Ross, Fujioka, Trainor, Schulte, & Schulz, 2003; Sluming et al., 2002).

The fifth limitation was the lack of standardized measures that are appropriate for use with older adults. There were several assessments in this study that did not have norms for older adults (the COWAT scoring norms, for example, went to age 69).
Because of this limitation, the scores presented may not give an accurate representation of how music affected cognitive functioning for the participants in this study.

A sixth limitation was the lack of detail on lifelong music participation. For this study, participants were asked how long they had played a music instrument. However, the question did not take into account if participants had played for a few years, stopped and then re-started the instrument and/or took up playing a different instrument. The total time playing throughout their lifetime was calculated; not necessarily consecutive years of playing. It is this researcher's belief that the length of consistency playing a music instrument will greatly impact brain health more so than a shorter amount of time. Research indicates that playing a music instrument impacts neural connections (Bugos et al., 2007; Herdener et al., 2010; Pantev et al., 2003; Pascual-Leone, 2001; Thompson et al., 2005; Verghese et al., 2003). Because even a short amount of time learning to play a music instrument can contribute to brain health (Lappe et al., 2008), perhaps a longer time span will create and maintain more neural connections and pathways.

**Recommendations and Future Directions**

Music interventions potentially serve a dual purpose – it brings individuals together to participate in a cognitively engaging intervention and it increases positive social interaction, all of which may help with cognitive aging and psychological well-being. It becomes apparent when reviewing the data from this study, that music may make a positive difference in psychological well-being and cognitive aging in some areas for older adults. Whether continuing to sing or play a music instrument or learning to play or sing, music has the potential to effect change. In this sense, there is no harm in
recommending that older individuals engage in music making activities, and indications
from this and extant research suggest real benefits from well-structured programs.

Further research is needed to validate both the nature and magnitude of music’s
effect on cognitive aging and psychological well-being. Considerations for future
research include using a larger sample size and a more racially and ethnically diverse
sample. As noted previously, participants in this study began to socialize more with each
other. Thus, another future direction would be to investigate social and music
interventions to see if music makes more of a difference in psychological well-being
compared to other activities, such as reading books, recreational team sporting activities,
or playing board games. An additional direction would be to look at whether individual
or group music sessions are more beneficial. Would one-to-one interactions make a
difference in cognitive functioning for people? It would investigate the nature of music
engagement - are there differences between group and individual performances?
Individual performances may present a greater cognitive challenge, but the social
interaction component is sacrificed. It is suggested that researchers try various ways of
presenting the music (i.e., for this study, direct cuing was used – there are other ways
such as adaptive notation, 12-tone system, and traditionally scored music) and use
different music instruments. It is possible that other ways of presenting the instrument
and music may have a different effect on the scores of the assessments of cognitive
functioning. Another direction would be to investigate learning different music
instruments - would the choice of instrument make a difference? For example, does the
added complexity of involving finger placement for notes on a music instrument and
learning to play chords create more cognitive challenges? Also, looking at the choice of
songs used - the songs in this dissertation were chosen based upon the anticipated ages of the participants, but research indicates that personal preference is a key factor in how a person responds to music. Thus, a different direction would be to have the participants choose songs that they specifically want to learn and play. Finally, continue to explore the benefits of lifelong learning with music. Would early involvement in music, help to improve the cognitive reserve capacity of individuals? Wan and Schlaug (2010) argue for music making across the life course as a tool for promoting brain plasticity which can in turn aid in better cognitive functioning. Perhaps they are correct.

**Practical Applications and Implications**

While findings from this study did not illustrate a strong connection between music and cognitive functioning and psychological well-being for older adults, other research has found stronger associations. It would be interesting to conduct a modified version of this study again, taking into consideration and adjusting for the limitations mentioned above. Would adjusting for those variables make a more credible link between psychological well-being, cognitive functioning and music?

Even though the social aspect of playing music was not specifically addressed in this dissertation, every person (who played the chimes) regardless of group designation (wait-list control or experimental), expressed their enjoyment with being able to play the hand chimes with other individuals and making new friends. Despite the fact that the hand chimes may not be the most appropriate instrument to use when measuring the effect of music on cognitive functioning, it does seem to provide a positive social medium for people to come together. Thus, music increased socialization and perhaps
increased other domains of psychological well-being that were not tapped in the cognitive assessments.

Although this dissertation research did not achieve the desired overall results and did not show a strong connection between music, psychological well-being, memory and cognition, it did emphasize findings to explore in future research. Results did indicate some preliminary findings with regards to areas of psychological well-being, verbal learning, memory, and retention. Furthermore, this study presented older adults with the opportunity to make music and increase their social networks. The full benefit of music on psychological well-being and cognitive functioning will be revealed in continued music research. The findings represent the beginning on which future research relating to music and cognitive functioning and psychological well-being and involvement in music can build.
Appendix A:

Recruitment Flyer
Do you like music?

Shannon Bowles, a Ph.D. student at the University of Kentucky, is looking for individuals to help with a music study.

Criteria to participate include:
- no musical experience needed
- age 60 and older
- enjoy listening to music
- naturally right-handed
- not currently taking any type of formal music lessons (e.g., piano, voice, etc.)
- not currently playing in a handbell/chime choir

For more information, please contact Shannon at (502) 269-5026 or slbowl2@uky.edu
Appendix B:

Choir Chime Study Questionnaire
Choir Chime Study Questionnaire

Date: ____________________

BACKGROUND INFORMATION

Age: ______________ Place of birth (State/Country): ______________

Gender: ______________ Race: ______________

Languages: Primary: ______________ Other: ______________

What is the highest grade (or degree) you have completed in school?

_____________________________________________________________________

Have you ever served in the military? □ Yes □ No

If yes, what branch? ___________________________________

How long did you serve? _______________________________

Did you see combat? □ Yes □ No

If yes, where? ________________________________________

What is your current or former occupation? ___________________________

What type of work have you been employed in for the longest period? _________

_____________________________________________________________________

Do you attend church on a regular basis? □ Yes □ No

Do you have a specific denomination (please specify)?

_______________________________________________

Are you presently married? □ Yes □ No

If yes, how long have you been married?

_______________________________________________
In not presently married, are you divorced or widowed?

Divorced? □ Yes □ No

Widowed? □ Yes □ No

How long were you married? ___________________________

Do you have any children? □ Yes □ No  How many? __________

Do you have any grandchildren? □ Yes □ No  How many? __________

Are you taking medications for any of the following?

□ Allergies

□ Arthritis

□ Cholesterol

□ Depression

□ Diabetes

□ General Pain

□ Heart Disease

□ High Blood Pressure

□ Kidney or Liver Disease

□ Migraines

□ Osteoporosis/Calcium Deficiency

Do you take a multivitamin? □ Yes □ No

Do you take any type of vitamin? □ Yes □ No

If yes, what types of vitamins? ______________________________

Do you take other types of medications for things not listed above? □ Yes □ No

If yes, what do you take the medication for? _____________________
Approximately how many different medications do you take each day? _____________

Do you use tobacco in any form (please describe)? ______________________________
________________________________________________________________________

Do you consume any alcohol on a weekly basis? [ ] Yes  [ ] No

How often do you exercise (running, biking, tennis, etc.)?
[ ] once or twice a month
[ ] 6-7 times per week
[ ] 3-5 times per week
[ ] 1-2 times per week
[ ] None

How often do you lift weights?
[ ] once or twice a month
[ ] 6-7 times per week
[ ] 3-5 times per week
[ ] 1-2 times per week
[ ] None

How would you describe your exercise history?
[ ] I don’t exercise
[ ] I don’t have a set routine
[ ] I exercise off and on
[ ] I exercise every week

How would you describe your overall activity level?
[ ] Low
[ ] Light
[ ] Moderate
[ ] High

Do you consider yourself to eat healthy?
[ ] Yes  Why? ____________________________________________________________

[ ] No  Why? ____________________________________________________________
Do you eat any of the following?

Fruits □ Yes □ No If yes, how often? _____________
Vegetables □ Yes □ No If yes, how often? _____________
Whole grains □ Yes □ No If yes, how often? _____________
Milk products □ Yes □ No If yes, how often? _____________
Blueberries □ Yes □ No If yes, how often? _____________
Strawberries □ Yes □ No If yes, how often? _____________
Spinach □ Yes □ No If yes, how often? _____________

What is your annual household income?

□ $0-$12,999
□ $13,000-$33,999
□ $34,000+

What hobbies or recreational activities do you currently enjoy? ____________________
________________________________________________________________________

Do you have any former hobbies? ___________________________________________

MUSIC BACKGROUND INFORMATION

Does/did anyone in your immediate family (spouse, siblings, parents, and grandparents) sing or play any type of music instrument?

□ Yes □ No If yes, who and what did they play?

_________________________________________________________

Do you listen to music in free time or to relax? □ Yes □ No

If yes, what kind and how often? ________________________________

Do you use music to fall asleep? □ Yes □ No

If yes, what kind and how often? ________________________________

Have you ever played a music instrument? □ Yes □ No

If yes, what instrument(s) and for how long? _______________________

_________________________________________________________
Have you ever taken private music lessons?  □ Yes  □ No

If yes, what instrument(s) and for how long?  ________________________________

_________________________________________________________________

Do you currently sing in a choir?  □ Yes  □ No

If yes, where do you sing?  ______________________________________

Have you ever sung in a choir?  □ Yes  □ No

If yes, approximately what was your age at the time, and for how long did you participate?  ______________________________________________________

Do you have any previous musical experiences (vocal and instrumental) not asked about above?

________________________

MUSICAL PREFERENCES

Under each of the columns below, check the applicable boxes to indicate your likes and dislikes of music styles (check all that apply to you):

<table>
<thead>
<tr>
<th>LIKE:</th>
<th>DISLIKE:</th>
<th>MUSIC STYLE:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Big Band</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bluegrass</td>
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<td></td>
<td></td>
<td>Broadway/Musicals</td>
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<td>Classical:</td>
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<td>Instrumental</td>
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<td>Vocal</td>
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<td>Country and Western</td>
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<td></td>
<td></td>
<td>Easy Listening</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electronic/New Age</td>
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<tr>
<td></td>
<td></td>
<td>Ethnic (specify): __________________________</td>
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<tr>
<td></td>
<td></td>
<td>Folk</td>
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<td></td>
<td></td>
<td>Gospel</td>
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<td></td>
<td></td>
<td>Heavy Metal</td>
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<td></td>
<td></td>
<td>Jazz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marching Band</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meditative/Relaxation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Opera</td>
</tr>
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<td></td>
<td></td>
<td>Patriotic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pop Music (music of today)</td>
</tr>
</tbody>
</table>
Do you have a favorite song(s) (please specify)? _________________________

________________________________________________________________

Who is your favorite composer(s)/performer(s)? _________________________

________________________________________________________________

Do you have a favorite instrument(s) that you like to listen to (please specify)?

________________________________________________________________
Appendix C:

Research Consent Form
Consent to Participate in a Research Study

Memory, Cognition, and the Effect of Music Therapy on Healthy Older Adults

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?

You are being invited to take part in a research study about music therapy and older adults. You are being invited to participate as you are an adult over the age of 60 and have an interest in music. If you volunteer to take part in this study, you will be one of about 150 people to do so.

WHO IS DOING THE STUDY?

The person in charge of this study is Shannon L. Bowles, MME, MT-BC, a doctoral candidate in the Graduate Center for Gerontology and a board-certified music therapist. She is being guided in this research by John F. Watkins, Ph.D. There may be other people on the research team assisting at different times during the study.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to look at the effect of playing choir chimes on healthy older adults, in terms of memory and psychological functions. A second purpose is to examine if long-term participation in music makes a difference in overall health for seniors.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?

The research procedures will be conducted at a local church, senior center, or other place that is participating in the study. Once the initial tests have been
completed, you will need to come to the designated location 12 times (2 times per week) during the study. One additional time will be scheduled at the end of the study for re-taking of the initial tests. If you are randomly selected to the control group, you will be asked to complete the initial tests, but wait for six weeks before receiving the music therapy. The control group will also be asked to complete the initial tests after the first six weeks.

It is important to attend as many of the 12 sessions as possible to gain the most benefit from the study.

WHAT WILL YOU BE ASKED TO DO?

Prior to the beginning of the study, there will be two-phase recruiting to screen for cognitive/memory deficits.

**Phase 1:** During the 1st meeting, once you have read and signed this form and have had all of your questions answered, you will be asked to take the Mini Mental State Examination (MMSE). Also, hand strength and movement of forearms will be tested by holding two of the choir chimes and learning how to ring the chimes. If you meet the selection criteria as determined by Ms. Bowles, you will be given a questionnaire and one form to take home, fill out, and bring back with you the following week for your follow-up appointment. If you do not meet the inclusion criteria, you will be thanked for your time and you are finished with the study. Time for Phase 1: approximately 15-20 minutes.

If you meet the selection criteria during Phase 1, you will be randomly assigned (by chance) to either the experimental group (chime choir) or control group (no immediate music therapy). Each group will have the same number of people. The study will be conducted two times per week over a 6-week period for a total of 12 sessions. Each session will last 60 minutes and will be conducted with the same participants, in the same location, and at the same time of day for the duration of the study. The order of songs the choir chime groups will play will be varied to keep the participants engaged in the choir.

**Phase 2:** You will bring back the completed take-home forms. At that time Ms. Bowles will verbally go over the forms with you to clarify any areas.
Form C

and to make sure that you agree with what you have indicated on the forms. Ms. Bowles will then give you eleven neuropsychological assessments to assess cognitive functioning. Time for Phase 2: approximately 90 minutes - breaks will be given after each assessment to avoid fatigue.

The choir chime group will play various songs popular during your young adult years as well as general folk and well-known tunes.

All sessions will be video and audio taped.

Additionally, Ms. Bowles will interview two people after the study to evaluate the effectiveness of the study and to help provide greater detail into how an individual's life time music involvement has influenced the person’s life.

ARE THERE REASONS WHY YOU SHOULD NOT TAKE PART IN THIS STUDY?

A person will be excluded from the study if:

- Not over the age of 60
- Do not wish to be video and/or audio taped
- Does not have sufficient grasp in both hands
- Cannot hold hands steady
- Cannot extend both forearms
- Cannot adequately read English
- Cannot verbally converse
- Is not a naturally right-handed person
- Is colorblind
- Cannot follow verbal and visual cues and instructions
- Does not have adequate hearing
- Scores below 23 on the Mini Mental State Examination
- Currently taking any type of formal music lessons (i.e. piano, voice, etc.)
- Currently plays in a chime/handbell choir
Form C

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

There is no anticipated risk with this study. However, there is a potential for minimal hand, wrist, and arm fatigue. Breaks will be given between songs. If you feel muscle fatigue during the study, you will be asked to stop and rest and then join in again whenever you feel able or you will be able to withdraw from the study at any time.

WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?

There is no guarantee that you will get any benefit from taking part in this study. However, some benefits form this study could include: Increased range of motion in one or both arms and hands, increased hand strength in one or both hands, improvement in memory, the satisfaction of making music with an ensemble, and socialization with others.

DO YOU HAVE TO TAKE PART IN THE STUDY?

If you decide to take part in the study, it should be because you really want to volunteer. You can stop at any time during the study.

IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?

If you do not want to be in the study, there are no other choices except not to take part in the study.

WHAT WILL IT COST YOU TO PARTICIPATE?

There is no cost for participation in this study.

WHO WILL SEE THE INFORMATION THAT YOU GIVE?

I will keep private all research records that identify you to the extent allowed by law.

Your information will be combined with information from other people taking part in the study. When I write about the study to share it with other researchers, I will write about the combined information I have gathered. You will not be identified in these written materials. I may publish the results of
Form C

this study; however, I will keep your name and other identifying information private.

I will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from the information you give, and these two things will be stored in different places under lock and key.

CAN YOUR TAKING PART IN THE STUDY END EARLY?

If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. You will not be treated differently if you decide to stop taking part in the study.

Additionally, if you wish, you can skip any of the questions that are asked by Ms. Bowles.

The individual conducting the study may need to withdraw you from the study. This may occur if you are not able to follow the directions she gives you, or if she finds that your being in the study is more risk than benefit to you.

WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?

You will not receive any rewards or payment for taking part in the study.

WHAT IF YOU HAVE QUESTIONS?

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the investigator, Shannon L. Bowles at (859) 269-5026. If you have any questions about your rights as a volunteer in this research, contact the staff in the Office of Research Integrity at the University of Kentucky at 859-257-9428 or toll free at 1-866-400-9428. I will give you a copy of this consent form to take with you.
WHAT ELSE DO YOU NEED TO KNOW?

Each chime session will be videotaped and the interviews will be audio taped. Videotaping and audio taping of the sessions will be used for educational, training, and public education purposes. These tapes will be used in the education and training of gerontology, music and music therapy students and presentations for other professionals and others who have an interest in older adults, music therapy, active music making, and/or choir chimes. The tapes will be stored at the investigator’s home and no one will have access to the tapes unless access is granted by the investigator. If used outside of the above mentioned purposes, additional consent will be obtained. These audio and video tapes will be used until such time that they are deemed to be of no value to the above mentioned groups and then will subsequently be destroyed.

DO YOU GIVE PERMISSION TO SHARE THE VIDEO AND AUDIO TAPES WITH THE PUBLIC?

☐ YES

☐ NO

______________________________   __________________________
Signature of person agreeing to take part in the study   Date

______________________________
Printed name of person agreeing to take part in the study

______________________________   __________________________
Name of person providing information to subject   Date

______________________________
Signature of Investigator
Appendix D:

Songs played during study
Songs Played During Study

Amazing Grace
America (My Country Tis of Thee)
Dona Nobis Pacem
Don’t Sit Under the Apple Tree
He’s Got The Whole World in His Hands
Home on the Range
I Love You Truly
In My Merry Oldsmobile
In The Good Old Summertime
It’s a Long, Long Way to Tipperary
My Old Kentucky Home
My Wild Irish Rose
Old Grey Mare, The
Put On Your Old Grey Bonnet
Swing Low, Sweet Chariot
Take Me Out to the Ball Game
When Johnny Comes Marching Home
When The Saints Go Marching In
Yankee Doodle Dandy
You Are My Sunshine
You’re a Grand Old Flag
References


Psychological Assessment Resources, Inc. (2005e). Rey Complex Figure Test and Recognition Trial. Retrieved from http://www4.parinc.com


Shannon Leanne Bowles, ABD, MME, MT-BC

Date and Place of Birth:

March 2, 1973 - Louisville, Kentucky

Education:

Doctoral Candidate in Gerontology – University of Kentucky, Lexington, Kentucky
   (March 2005 – Present)
Doctoral Student in Gerontology – University of Kentucky, Lexington, Kentucky
   (August 2002 – March 2005)
Doctoral Student in Gerontology – University of Kansas, Lawrence, Kansas
   (August 2000 – June 2002)
MME (Music Education with an emphasis in Music Therapy) University of Kansas,
   Lawrence, Kansas (May 1999)
BME (Music Education with an emphasis in Music Therapy) University of Kansas,
   Lawrence, Kansas (May 1997)

Credentials:

Neurologic Music Therapist – Member, Academy of Neurologic Music Therapy
   (October 2003/Recertified 2006, 2009)
Activity Director – Certified from the National Certification Council for Activity Professionals
Music Therapist – Board Certified from the Certification Board for Music Therapists

Research Interests:

The effects of music on the aging brain, the life course perspective, neuropsychology of normal aging, music therapy and older adults, how music can help improve cognition and memory for elders, demography and population studies

Professional and Work Experience:

Contract Music Therapist, Louisville Music Therapy, LLC, Louisville, Kentucky
   (February 2012 – Present)

Contract Music Therapist and Gerontological Consultant, Louisville, Kentucky
   (May 2011 – Present)
Professional and Work Experience (continued):

Acting Director of Music Therapy, University of Louisville, Louisville, Kentucky
(August 2008 – December 2008)

Music Therapist, Norton Audubon Hospital, Louisville, Kentucky
(June 2008 – April 2012)

Music Therapist, MUSCL Senior Wellness Center at Schnitzelburg, Louisville, Kentucky
(October 2007 – May 2011)

University of Louisville faculty liaison with Norton Audubon Hospital, Louisville, Kentucky
(August 2007 – May 2010)

Assistant Professor of Music Therapy, University of Louisville, Louisville, Kentucky
(August 2007 – May 2010)

Part-time Music Therapy faculty, University of Louisville, Louisville, Kentucky

Music Therapy Consultant, the Music Institute of Lexington, Lexington, Kentucky
(March 2004 – January 2005)

Music Therapist, Music Institute of Lexington, Lexington, Kentucky
(July 2003 – March 2004)

Assistant Editor, *The Journal of Elder Abuse & Neglect* (JEAN)
(September 2002 – December 2003)

Graduate Research Assistant, University of Kentucky, Lexington, Kentucky
(August 2002 – July 2006)

Activities Director and Volunteer Coordinator, Eudora Nursing Center, Eudora, Kansas
(September 2001 – June 2002)

Activities Director, Life Care Center of Grandview, Grandview, Missouri
(March 2000 – September 2001)

Music Therapist/Adaptive Music Instructor in the Kansas City, Kansas School District – USD 500
(August 1998 – March 2000)
Professional and Work Experience (continued):

Contract and Consultant Music Therapist, various nursing homes in Northeastern Kansas  
(December 1997 – June 2002)

Handbell Choir Director of adults with developmental disabilities, First United Methodist Church, Lawrence, Kansas  

Graduate Thesis:


Research Report:


Publications:


Presentations:


Presentations (continued):


**Bowles, S. L.** (22 February, 2010). *Music therapy.* Presentation to K-8 school counselors working with the Archdiocese of Louisville, Louisville, Kentucky.

**Bowles, S. L.** (26 October, 2009) *The therapeutic uses of music.* Presentation for the University of Louisville’ Alpha Chapter of Alpha Epsilon Delta (AED), Louisville, Kentucky.


**Bowles, S. L.** (14 March, 2007). *The therapeutic uses of music therapy.* Presentation given to the Bluegrass Chapter of the National Association of Social Workers, Lexington, Kentucky.
Presentations (continued):


Bowles, S. L. (16 August, 2006). Music therapy. Presented to Dr. Carol Kramer’s Women’s Survivor & Support Group, Markey Cancer Center, University of Kentucky, Lexington, Kentucky.


Presentations (continued):


**Bowles, S. L.** (7 October, 2005). *Music therapy and older adults.* Presented to faculty, students and general public at the University of Louisville, Louisville, Kentucky.


**Bowles, S. L.** (17 June, 2004). *A controlled study on the effect of music therapy on memory and cognition in persons 65 years and older who have experienced a stroke.* Student plan presented at the 16th Annual Research Day, Department of Physical Medicine & Rehabilitation, Cardinal Hill Rehabilitation Hospital, Lexington, Kentucky.


Radio/Newspaper/Magazine Interviews:


Research Projects:


Teaching Experience:

**Music Therapy - Undergraduate**

Clinical Music Therapy Applications I (MUTH 213, University of Louisville, Louisville, Kentucky, Fall 2005; Fall 2006; Fall 2009; Fall 2010; Spring 2012)
Teaching Experience (continued):

Clinical Music Therapy Applications II (MUTH 214, University of Louisville, Louisville, Kentucky, Fall 2005; Fall 2006; Spring 2007; Spring 2008; Spring 2009; Fall 2009; Spring 2010; Fall 2010; Spring 2011; Fall 2011)

Clinical Music Therapy Applications III (MUTH 313, University of Louisville, Louisville, Kentucky, Fall 2006; Spring 2007; Fall 2007; Spring 2008; Spring 2009; Spring 2010; Fall 2010; Spring 2010; Fall 2010; Spring 2011; Fall 2011; Spring 2012)

Clinical Music Therapy Applications IV (MUTH 314, University of Louisville, Louisville, Kentucky, Spring 2006; Fall 2006; Fall 2007; Fall 2010; Spring 2011; Fall 2011; Spring 2012)

Clinical Music Therapy Applications V (MUTH 413, University of Louisville, Louisville, Kentucky, Spring 2006; Fall 2006; Spring 2007; Spring 2009; Fall 2010; Spring 2011; Fall 2011; Spring 2012)

Clinical Music Therapy Applications VI (MUTH 414, University of Louisville, Louisville, Kentucky, Spring 2007; Fall 2007; Fall 2010; Spring 2011; Fall 2011; Spring 2012)

Introduction to Music Therapy (MUTH 101, University of Louisville, Louisville, Kentucky, Fall 2008)

Music Therapy Techniques I (MUTH 201, University of Louisville, Louisville, Kentucky, Fall 2006; Fall 2007; Fall 2009; Fall 2010; Fall 2011)

Music Therapy Techniques II (MUTH 202, University of Louisville, Louisville, Kentucky, Spring 2007; Spring 2008; Spring 2009; Spring 2010; Spring 2011; Spring 2012)

Practicum in Music Therapy I (MUTH 321, University of Louisville, Louisville, Kentucky, Fall 2005; Fall 2006; Spring 2007; Fall 2007; Spring 2008; Fall 2008; Fall 2009; Fall 2010; Spring 2011; Fall 2011; Spring 2012)

Practicum in Music Therapy II (MUTH 322, University of Louisville, Louisville, Kentucky, Fall 2005; Spring 2006; Spring 2007; Fall 2007; Spring 2008; Spring 2009; Spring 2010; Fall 2010; Spring 2011; Spring 2012)

Practicum in Music Therapy III (MUTH 421, University of Louisville, Louisville, Kentucky, Fall 2005; Spring 2006; Fall 2006; Spring 2007; Fall 2007; Spring 2008; Fall 2008; Fall 2009)
Teaching Experience (continued):

Practicum in Music Therapy IV (MUTH 422, University of Louisville, Louisville, Kentucky, Fall 2005; Spring 2006; Fall 2006; Spring 2007; Fall 2007; Spring 2008; Fall 2008; Spring 2009; Spring 2010)

Principles and Practices of Music Therapy I (MUTH 431, University of Louisville, Louisville, Kentucky, Fall 2008)

Neurologic Music Therapy Training for University of Louisville Students

Fall 2010 – Norton Audubon Hospital, Louisville, Kentucky

Spring 2010 – Norton Audubon Hospital, Louisville, Kentucky

Spring 2007 – Sally’s Garden, Masonic Home of Louisville, Louisville, Kentucky

Music Therapy Clinical Supervisor

Clinical Practicum Supervisor to music therapy students at the University of Louisville, Louisville, Kentucky (August 2007 – May 2011)

Clinical Practicum Supervisor to music therapy students at the University of Missouri – Kansas City (UMKC), Kansas City, Kansas (August 1999 – December 1999)

Clinical Practicum Supervisor to music therapy students at the University of Kansas, Lawrence, Kansas (January 1998 – May 1998; August 1998 – December 1998)

Guest Lecturer

Music therapy lecture/demonstration presented to a graduate Music Education class, University of Louisville, Louisville, Kentucky (15 October, 2009)

Music therapy lecture/demonstration presented to the Introduction to Music Education class, University of Louisville, Louisville, Kentucky (17 April, 2009).

Music therapy lecture/demonstration presented to a graduate Music Education class, University of Louisville, Louisville, Kentucky (16 April, 2009)

Music therapy lecture/demonstration presented to COU 847 - Crisis and Abuse Counseling at Eastern Kentucky University, Richmond, Kentucky (22 June, 2006)
Teaching Experience (continued):

Music therapy lecture presented to alternative medicine class comprised of 2nd year medical students at the University of Louisville School of Medicine, University of Louisville, Louisville, Kentucky (10 January, 2006)

Evidence based music therapy lecture videotaped for online complementary and alternative medicine course (from The Integrative Care Project) offered Spring 2006 in the University of Kentucky College of Medicine and Health Sciences, Lexington, Kentucky (20 November, 2005).

Music therapy lecture presented to MUTH 101 – Introduction to Music therapy, University of Louisville, Louisville, Kentucky (21 October, 2005).

Music therapy lecture/demonstration presented to NUR 510 – Older Women and Their Health, University of Kentucky, Lexington, Kentucky (9 November, 2004)

Music therapy lecture presented to MUS 395 – Independent Study in Music: Music Careers, University of Kentucky, Lexington, Kentucky (27 April, 2004)

Gerontology – Undergraduate

Special Topics in Human Geography: Aging and Society (GEO 465, University of Kentucky, Lexington, Kentucky, Spring 2004)

Grant/Funding Activity:

2005 Sigma Alpha Iota Professional Music Fraternity Doctoral Grant ($2,500; April 2005)

Honors and Awards:

2005 Lois E. Layne Student Award, Kentucky Association for Gerontology (KAG) (April 2005).


2004-2005 Donovan Scholarship in Gerontology, University of Kentucky, Lexington, Kentucky (April 2004)
Professional Committees:

Library Committee, University of Louisville School of Music, Louisville, Kentucky  
(August 2008 – May 2010)

Kentucky Representative on Southeastern Region of the American Music Therapy Association (SER-AMTA) Membership Committee  
(January 2008 – March 2011)

Kentucky Representative on Southeastern Region of the American Music Therapy Association (SER-AMTA) Research Committee  
(January 2007 – March 2011)

Senior Emerging Scholar and Professional Organization (ESPO) Representative on the Arts and Humanities Committee of the Gerontological Society of America (GSA)  
(November 2006 – November 2007)

Junior Emerging Scholar and Professional Organization (ESPO) Representative on the Arts and Humanities Committee of the Gerontological Society of America (GSA)  
(November 2005 – November 2006)

Chair of the Fundraising Committee for the Music Therapy Association of Kentucky (MTAK)  
(January 2005 – Present)

Chair of the State Education Committee for the Music Therapy Association of Kentucky (MTAK)  
(October 2003 – January 2005)

Kentucky Representative on Southeastern Region of the American Music Therapy Association (SER) Intern Scholarship Committee  
(May 2003 – January 2007)

Honor Societies:

Golden Key International Honour Society  
Member (2008 – Present)

Sigma Phi Omega (SPO), Gamma Mu College Chapter, University of Kentucky  
Member (2003 – Present)  
Secretary/Treasurer (May 2004 – April 2005)
Honor Societies (continued):

Sigma Phi Omega (SPO), National Academic Honor and Professional Society in Gerontology
Member (2003 – Present)

Pi Lambda Theta, International Honor Society and Professional Association in Education
Member (2002 – Present)

Professional Affiliations and Offices Held:

National Center for Creative Aging (NCCA)
Member (2009 – Present)

Society for the Arts in Healthcare
Member (2009 – Present)

Sigma Alpha Iota (SAI), Lexington Alumnae Chapter, Lexington, Kentucky
Member (2004 – 2007)

Kentucky Association for Gerontology (KAG)
Member (2003 – Present)

Music Therapy Association of Kentucky (MTAK)
Member (2003 – Present)
Treasurer (January 2005 – Present)

The Gerontological Society of America (GSA)
Member (2002 – Present)

Southeastern Region of the American Music Therapy Association (SER-AMTA)
Member (2002 – Present)
1st Vice President (April 2011 – Present)

Sigma Alpha Iota (SAI), Lawrence Alumnae Chapter, Lawrence, Kansas
Member (1999 – 2001)
Treasurer (1999 – 2000)

American Music Therapy Association (AMTA)

Sigma Alpha Iota (SAI), International professional music fraternity
Member (Life Member since September 1996)
Professional Affiliations and Offices Held (continued):

Sigma Alpha Iota (SAI), Beta Beta College Chapter at the University of Kansas  
    Member (1992 – 1997)  
    President (October 1995 – May 1996)  
    Treasurer (May 1995 – May 1996)  
    Vice-President (May 1995 – October 1995)

National Association for Music Therapy (NAMT)  
    Member (1991 – 1998)

National Flute Association (NFA)  
    Member (1987 – Present)