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The older adult (65 years or older) population is growing. The probability of developing cognitive impairment increases as adults pass the age of 65 years old. Cognitive reserve theory proposed factors that influence the expression of cognitive impairment. The lifestyle factors, namely: (a) education, (b) occupation, (c) social, (d) physical, and (e) leisure activities, influence cognitive reserve, which may affect how older adults express existence of cognitive impairment. Studies on cognitive reserve however, lack a standardized instrument to measure its constructs. In assessing the construct of lifestyle factors in a lifetime perspective, the Lifetime Experience Questionnaire (LEQ) is the only known instrument available. Therefore, to advance the cognitive reserve theory, an evaluation of the LEQ using different populations is essential. The study used a descriptive, test-retest, correlational design to examine the reliability and validity of the LEQ among older American adults (N=90) in North Carolina. Self-administered questionnaires including demographic data, the Geriatric Depression Scale-Short Form, the Mini-Mental State Exam (MMSE), and the LEQ were collected. A test and retest of the LEQ were conducted for 30 randomly selected participants. Test-retest reliabilities of the three subscales (r = .79 - .91), and the total LEQ score (r = .93) were acceptable. The Cronbach's alpha of the LEQ was .65. The association of the MMSE and LEQ that evaluated the concurrent validity of LEQ demonstrated minimal positive correlation (r = .19) that is not statistically significant with low effect size (.10). Although not statistically significant, the group that had low LEQ scores showed lower scores on the MMSE. The exploratory factor analysis supported the multidimensionality of LEQ. The LEQ had satisfactory temporal stability and interpretable construct validity; however, revisions of three items may be needed to increase its internal consistency. Quantifying lifestyle factors in a lifespan perspective is an immense beginning to operationally define the broad construct of

cognitive reserve that may guide healthcare providers in individually planning interventions for maintenance or enhancement of older American adults' mental activities.

THE PSYCHOMETRIC PROPERTIES OF THE LIFETIME EXPERIENCE QUESTIONNAIRE (LEQ) IN OLDER AMERICAN ADULTS

by

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To my wife, Leila, my daughter, Camille, and my son, Kyle -

Thank you very much for your love, understanding, patience, and support.

APPROVAL PAGE

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CHAPTER I

INTRODUCTION

The possibility of developing cognitive impairment increases as adults pass the age of 65 years old (Wimo & Prince, 2010). Cognitive impairment is the alteration in cognitive processes that affect the life of a person (Center for Disease Control and Prevention [CDC], 2010; Craven & Hirle, 2000). The causes of cognitive impairment are varied such as nutritional deficiencies (CDC, 2010), stroke (Bennet, Schneider, Bienias, Evans, & Wilson, 2005; Knopman, D. S., Roberts, R. O., Geda, Y. E., Boeve, B. F., Pankratz, S., Cha, R. H.,…Petersen, R. C., 2009; Stephens et al., 2005), degenerative diseases (Aarsland, Bronnick, Larsen, Tysnes, & Alves, 2009; Chiaravalloti & DeLuca, 2009), and dementias (Bennet et al., 2005; Palmer, Bäckman, Winblad, & Fratiglioni, 2008). In addition, cognitive impairment can range from mild to severe (Plassma et al., 2008). Due to the vagueness of the criteria in identifying cognitive impairment (Artero, Petersen, Touchon, & Ritchie, 2006; Petersen et al., 2009), the prevalence of cognitive impairment without dementia among older adults can range from 15% (Petersen et al., 2009) to 22.2% (Plassma et al., 2009). Alzheimer's disease, the most common type of dementia, affected 5.2 million older adults and 0.2 million adults younger than 65 years old in 2011 (Alzheimer's Association [AA], 2011). This staggering quantity is projected to increase 50% by 2030 (AA, 2011). Thus, older adults are at a higher risk of developing cognitive impairment than any other group of population. The variances in the expression of the signs and symptoms of cognitive impairment may contribute to the vagueness of its identification or diagnosis (Petersen et al., 2009).

Cognitive reserve theory may explain the variances in the expression of cognitive impairment. Cognitive reserve theory posits that there are conditions or resources in the brain that can account for individual differences in cognitive functioning despite changes in aging or neuropathology (Richards & Deary, 2005; Stern, Y., 2009). Therefore, individuals with greater cognitive reserve will delay the expression, but not the rate of cognitive decline associated with aging or neuropathology. Factors that influence cognitive reserve include: (a) health behaviors (Deary, Whalley, Batty, & Starr, 2006; Richards & Deary, 2005; Stern, Y., 2009), (b) health comorbidities (Ahles et al., 2010; Richards & Deary, 2005; Roe et al., 2008; Stern, Y., 2009; Stern, R., Silva, Chaisson, & Evans, 1996), (c) genes (Richards & Deary, 2005; Stern, Y., 2009; Yaffe et al., 2011), and (d) lifestyle factors such as education, occupation, social, physical, and leisure activities (Richards & Deary, 2005; Stern, Y., 2009). These factors are built throughout the lifespan of an individual. Studies on cognitive reserve, specifically on lifestyle factors, have focused on only one or two stages of life and one to three lifestyle factors (Valenzuela & Sachdev, 2007). The explorations on the effects of lifestyle factors on earlier stages of life (Alley, Suther, & Crimmins, 2007; Dik, Deeg, Visser, & Jonker, 2003; Mortimer, Snowdon, & Markesbery, 2003; Richards, Hardy, & Wadsworth, 2003; Tucker-Drob, Johnson, & Jones, 2009) or even the present stage (Barnes, de Leon, Wilson, Bienias, & Evans, 2004; Glei et al., 2005; Zunzunegi, Alvarado, del Ser & Otero, 2003) of older adults found associations with their current cognitive performances. To add an understanding on the variances on the expressions of cognitive impairment among older adults, assessment of lifestyle factors in a lifetime perspective is essential. The Lifetime Experience Questionnaire (LEQ) is known as the only instrument available to quantify the different lifestyle factors in a lifetime perspective. The psychometric

properties of LEQ, however, were studied only once and limited to an Australian population. Therefore, the goal of the study is to evaluate the utilization of the LEQ among older American adults.

Background and Significance of the Problem

The older adult (65 years or older) population is growing. Currently, older adults encompass 11% (730 million) of the world's total population (6.7 billion) (World Health Organization [WHO], 2010). Although the growth rate for the world's total population decreased by an average of 0.30% (WHO, 2010), the older adult population increased due to the number of aging baby boomers (born between 1946-1964). In contrast to the world population, older adults contribute about 12.6% (38 million) to the 2009 U.S. total population estimate based on U.S. census 2000 (U.S., Census Bureau, American Factfinder, 2009). This estimate will increase to 20% (about 70 million) of the total population by 2030 (CDC & The Merck Company Foundation, 2007). North Carolina's older adult population (12%) mirrors the current U.S. and world populations and ranks 10th compared to other states in the U.S. (North Carolina Office of State Budget and Management [NCOSBM], 2011). Guilford and Forsyth counties ranked 3rd and 4th, respectively, among the counties in North Carolina with the largest older adult population (NCOSBM, 2011). The increase in life expectancy (Arias, 2007), healthcare delivery, and availability of information on health promotion contribute to the increasing trend of an older adult population. Higher life expectancy of older adults places them at risk of developing non-communicable health conditions (WHO, 2010) such as cognitive impairment.

The presence of cognitive impairment increases the cost in healthcare (Wimo & Prince, 2010). In 2004, the total cost for personal health expenditures of older American adults ($531 billion) was almost 75% that of all other ages combined ($814 billion) (U.S. Department of Health & Human Services [U.S. DHHS], Centers for Medicare & Medicaid Services [CMMS],

2011). Among older adults, the octogenarians had the highest Medicare expenditures ($23,000 per person in 2006) (U.S. DHHS, CMMS, 2011). A major part of the total income of older adults is allocated towards healthcare services which increase with age. The out-of-pocket expenditures for healthcare services by older adults are doubled when compared to adults between 55 and 64 years old (Federal Interagency Forum on Aging-Related Statistics, 2010). Advancing in age is not the only variable which contributes to the increasing healthcare costs, but also the presence of comorbidities including cognitive impairment. In 2004, the average total payment for all healthcare services for older adults with dementia alone amounted to $33,007 per person compared to $10,603 for older adults without dementia (Alzheimer's Association [AA], 2010). Moreover, the incurred hospital costs by older adults ($2,748 per person) is only a third compared to the cost if the patient has dementia ($7,663 per person) (AA, 2010). The projected amount of the total cost for healthcare services for older adults with dementia for 2010 is $172 billion (AA, 2010) and is estimated to reach an astounding $1 trillion by the year 2050 (AA, 2010). Furthermore, indirect healthcare costs which include unpaid caregiving hours, physical, emotional, and social burden from caregivers will likely increase.

In 2009, caregivers of older adults with dementia in the U.S. spent 12.5 billion unpaid caregiving hours amounting to $144 billion including the 400 million hours contributed by 356,851 caregivers in North Carolina which amounted to $4 billion (AA, 2010). The caregivers were also observed to have an increase in poor health outcomes, particularly when the recepient of care is in the severe stage of dementia (Cucciare, Gray, Azar, Jimenez, & Gallagheer-Thompson, 2010). The direct and indirect cost for dementia alone is overwhelming.

Adding the population of older adults with cognitve impairment without dementia to the population of older adults with dementia, the sum of both direct and indirect healthcare costs for older adults with cognitive impairment will be monstrous. The interventions, however, that can

delay the expression of cognitive impairment, for example, by six months can save the U.S. government as much as $18 billion annually by 2050 (Brookmeyer, Gray, & Kawas, 1998; Fernandez, Crucian, Okun, & Price, & Bowers, 2005). The different constructs of cogntive reserve theory such as lifestyle factors are hypothesized to delay the expression of cognitive impairment among older adults (Richard & Deary, 2005; Stern, Y., 2009). Therefore, advancing the cognitive reserve theory may not only benefit older adults, but also the society.

Statement of the Problem

The cognitive reserve theory lacks standard working definitions of its constructs. Several studies used one or more combinations of measures such as education (Christensen, Anstey, Parslow, Maller, Mackinon, & Sachdev, 2007; Le Carret et al., 2003; Fairjones, Vuletich, Pestell, & Panegyres, 2011; Roe et al., 2008; Solé-Padullés et al., 2009; Stern, R. et al., 1996; Stern, Y. et al., 2005), occupation (Ropacki, Bert, Ropacki, Rogers, & Stern, Y., 2007; Solé-Padullés et al., 2009; Stern, R.et al., 1996), genes (Yaffe et al., 2011), neuropsychological tests (Alchantis et al., 2005; Corral, Rodriguez, Amenedo, Sanchez, & Diaz, 2006; Ropacki et al., 2007; Solé-Padullés et al., 2009; Stern, Y. et al., 2005), and radiological examinations (Scarmeas et al., 2003; Stern, Y., Hilton, Flynn, De la Paz, & Rakitin, 2003) to define cognitive reserve. Thus, studies found inconsistent results on the association of cognitive reserve and cognitive impairment among older adults (Christensen et al., 2007; Ropacki et al., 2007). Specifically, the construct of lifestyle factors has been defined inconsistently (Valenzuela & Sachdev, 2007).

Attributes of lifestyle factors include education, occupation, social, physical, and leisure activities (Stern, Y., 2009). Educational attainment or number of educational years is usually the variable considered when studying cognitive performance of older adults. However, other forms of education taken even during the midlife have an impact on cognition of older adults (Hatch, Feinstein, Link, Wadsworth, & Richards, 2007). Similar to education, occupation is limited in its

definition. Occupation was either defined as skilled and unskilled (Gariboto et al., 2008), physical and sedentary (Anttila et al., 2002), or manual and non-manual (Fors, Lennartsson, & Lundberg, 2009). Moreover, studies focused on the midlife stage in gauging occupation. To grasp an understanding of the association of occupation on cognition of older adults, it is essential to comprehensively assess occupational history (Andel, Crowe, Kåreholt, Wastesson, & Parker, 2011) and its complexities (Andel, Kåreholt, Parker, Thorslund, & Gatz, 2007). Studies on association of social, physical, and leisure activities with cognition of older adults are mostly confined within the late-life stage (Barnes et al., 2004; Gallucci et al., 2007; Scarmeas et al., 2003; Verghese, et al., 2003; Zunzunegi et al., 2003). Social, physical, and leisure activities in early life stages were found to be associated with cognitive performance among older adults (Aartsen, Smits, Tilburg, Knipscheer, & Deeg, 2002; Dik et al., 2003; Everson-Rose, de Leon, Bienias, Wilson, & Evans, 2003; Singh-Manoux, Richards, & Marmot, 2003). Therefore, defining the construct of lifestyle factors in cognitive reserve theory implies an assessment of education, occupation, social, physical, and leisure activities in a lifespan perspective.

Studies on cognitive reserve assessed lifestyle factors using instruments that lacked psychometric properties. Most studies in cognitive reserve utilized retrospective questionnaires that the authors developed (Christensen et al., 2007; Fairjones et al., 2011; Le Carret et al., 2003; Ropacki et al., 2007; Stern, Y. et al., 2005) or used from previous studies (Solé-Padullés et al., 2009). The study by Christensen and colleagues (2007) employed the Self-Directed Search instrument to assess mentally stimulating leisure activities. The instrument, however, was developed mainly for career or vocational counseling (Gottfredson (2002); Gottfredson & Holland, 1975) and focused on the current stage of life. Similar to studies on cognitive reserve, most studies on association of cognitive performance with lifestyle factors used surveys or questionnaires that were developed by authors (Hatch et al., 2007; Karp et al., 2004; Fitzpatrick et

al., 2004; Kuh, Cooper, Hardy, Guralnik, & Richards, 2009; Singh et al., 2003) or from previous study protocols (Antilla et al., 2002; Lee, S., Kawachi, Berkman, & Grodstein, 2003). Instruments that gauge specific lifestyle factors, such as the International Physical Activity Questionnaire (Craig et al., 2003) and Leisure Time Exercise Questionnaire (Godin & Shephard, 1997), exist; however, they lack the capacity to assess the lifestyle factors in a lifetime perspective. Thus, an instrument that assesses the lifestyle factors associated with cognitive reserve is scarce. The LEQ measures the lifestyle factors in a lifespan perspective.

The LEQ was developed by Dr. Valenzuela and Dr. Sachdev (2007). It is the first instrument that operationally defined the contribution of education, occupation, and various activities from young adulthood to late life stage of an individual. It was tested only once in Australia. The utilization of the LEQ in healthcare facilities may be to screen older adults that are at a higher risk of developing cognitive impairment. Interventional and health promotional studies on lifestyle factors may use the LEQ in conjunction with other assessment tools to gauge the effectiveness of their study protocols. Therefore, it is imperative to examine the psychometric properties of the LEQ in different populations.

Assumptions

The major assumption of this study is the belief that complex lifestyle factors affect the cognition at the late stage of life. The second assumption is that the lifestyle factors are measured by the LEQ. Third, differences in cognition exist among older adults with various lifestyle factors. Finally, older adults are able to recall their lifestyle factors since they were at young adulthood stage.

Specific Aims

1. Examine the reliability of the LEQ.

Q1. What is the correlation of the items, subscales, and total score of LEQ on two separate time points?

Q2. What is the internal consistency of the LEQ?

2. Examine the concurrent and construct validity of the LEQ.

Q3. What is the correlation between the LEQ and the Mini-Mental State Exam (MMSE)?

Q4. Is there a difference in MMSE scores between the groups of older adults with high and low LEQ scores?

Q5. What are the different dimensions of the LEQ?

Conceptual Definitions

1. Older adult - any person who is 65 years and older as identified by the participant (Administration on Aging, Department of Health and Human Services, 2010).

2. Young adulthood - a life stage which encompasses the ages of 13 years old up to 30 years old (Valenzuela & Sachdev, 2007).

3. Midlife stage - a life stage which refers to the ages of 30 years old to 64 years old (Valenzuela & Sachdev, 2007).

4. Late-life stage - a life stage which covers the ages of 65 years old and older (Valenzuela & Sachdev, 2007).

5. Cognition - a systematic approach using memory, attention, learning, and communication to interact meaningfully and purposely with the environment (Craven & Hirle, 2000).

6. Cognitive reserve - capacity of an older adult to efficiently use brain networks in response to challenging tasks or presence of brain pathology or insult (Stern, Y., 2009).

7. High LEQ score - has an LEQ score equal to or higher than the mean of the study participants (Valenzuela & Sachdev, 2007).

8. Low LEQ score - has an LEQ score lower than the mean of study participants (Valenzuela & Sachdev, 2007).

Summary

The older adult (65 years or older) population is growing. The probability of developing cognitive impairment increases as adults pass the age of 65 years old (Wimo & Prince, 2010). Delaying the expression of cognitive impairment benefits the older adults and the society (Petersen et al., 2009; Plassma et al., 2009). Cognitive reserve theory proposes factors which influence the expression of cognitive impairment (Richard & Deary, 2005; Stern, Y., 2009). A measuring instrument and working definition of its constructs, particularly the lifestyle factors, is lacking. To the knowledge of this author, the LEQ is the only instrument which operationally defines lifestyle factors in a lifespan perspective but no data exists in its utilization among older American adults. Therefore, the goal of the proposed study is to evaluate the psychometric properties of the LEQ among older American adults.

CHAPTER II

REVIEW OF LITERATURE

This chapter examines the literature that pertains to lifestyle factors, namely: (a) education, (b) occupation, (c) physical, (d) leisure, and (e) social activities, which influence cognitive reserve resulting in modification of the manifestations of cognitive decline among older adults. A discussion on cognitive reserve theory lays the foundation of this chapter. It is followed by general descriptions of the different stages of life which start at young adulthood and end at the late-life phase. Lastly, the lifestyle factors are examined in relation to cognitive functions and their assessment in a lifetime perspective as essential in advancing the cognitive reserve theory.

Cognitive Reserve Theory

An average adult brain, which only weighs 1500 grams (Banasik, 2000), is the most complex organ in the human body. It integrates information from the internal and external environment resulting in various responses. Anatomically, the brain is divided into hindbrain, midbrain, and forebrain. Cognitive aging is particularly interested in the forebrain where the cerebrum, the largest part of the brain, resides. Billions of neurons constitute the brain.

The neurons are the basic unit of the brain which processes information coming from various organs and tissues of the body. Neurons have dendrites, cell bodies, and axons that are responsible in transmitting and processing nerve impulses. In contrast to axons, dendrites are projections that conduct nerve impulses towards the cell bodies which process the nerve impulses. The connections of neurons form networks or tracts enabling the different divisions of the brain to communicate. The thalamocortical tract is an example of a major tract in the brain that

connects the cerebral cortex and the thalamus (Guyton & Hall, 2000). Cognition depends on the efficiency of the neurons and their connections.

Cognition is a systematic approach using memory, attention, learning, and communication to interact meaningfully and purposely to the environment (Craven & Hirle, 2000). Cognitive functions or processes involve the mechanisms of working memory, speed of processing, inhibition, and sensory system (Park, 2000). Working memory is the cognitive processes of simultaneously storing, retrieving, and processing information (Park, 2000). Processing speed is the amount of time performing mental operations (Park, 2000). Inhibition involves the process of saving cognitive resources for important tasks at hand while the sensory system allows an individual to be aware of the internal and external environment through perception of stimuli (Park, 2000). Normal changes in the brain such as atrophy (Raz, Dixon, Head, Dupuis, & Aker, 1998; Raz, Rodriguez, Kennedy, Acker, 2007), ventricular hypertrophy (Jacoby, Levy, & Dawson, 1980), and decreases in cerebral metabolism (Sophie, 2007) may explain the alterations of the four mechanisms that are observed in normal cognitive aging (Ball, Edwards, & Ross, 2007; Finkel, McArdle, Reynolds, & Pedersen, 2007; Pichotz & Malamut, 2008). However, the biological changes that occur with aging do not have a linear relationship in cognition. Variabilities in cognitive performances exist among older adults. A theoretical perspective such as cognitive reserve theory, may explain the differences in cognitive performance among older adults (Stern, Y., 2009).

Cognitive reserve theory posits that there are conditions or resources in the brain that can account for individual differences in cognitive functioning despite changes in aging or neuropathology (Richards & Deary, 2005; Stern, Y., 2009). Cognitive reserve refers to the individual differences in functional or processing conditions of the brain that accounts for how people cope due to neuropathology or changes with aging. Stern, Y. (2009) categorized cognitive

reserve into neural reserve and compensation. Neural reserve refers to inter-individual differences in optimizing or maximizing brain networks in response to increased demands in a cognitively healthy individual (Stern, Y., 2002; 2009). Neural compensation refers to recruitment of brain networks not normally used to cope with neuropathology (Stern, Y., 2002; 2009). Therefore, individuals with greater cognitive reserve will delay the expression but not the rate of cognitive decline associated with aging or neuropathology. Constructs in the proposition of cognitive reserve theory are inter-variability among individuals in brain networks processing and cognitive changes or neuropathology. Figure 1 illustrates a proposed model for cognitive reserve theory.

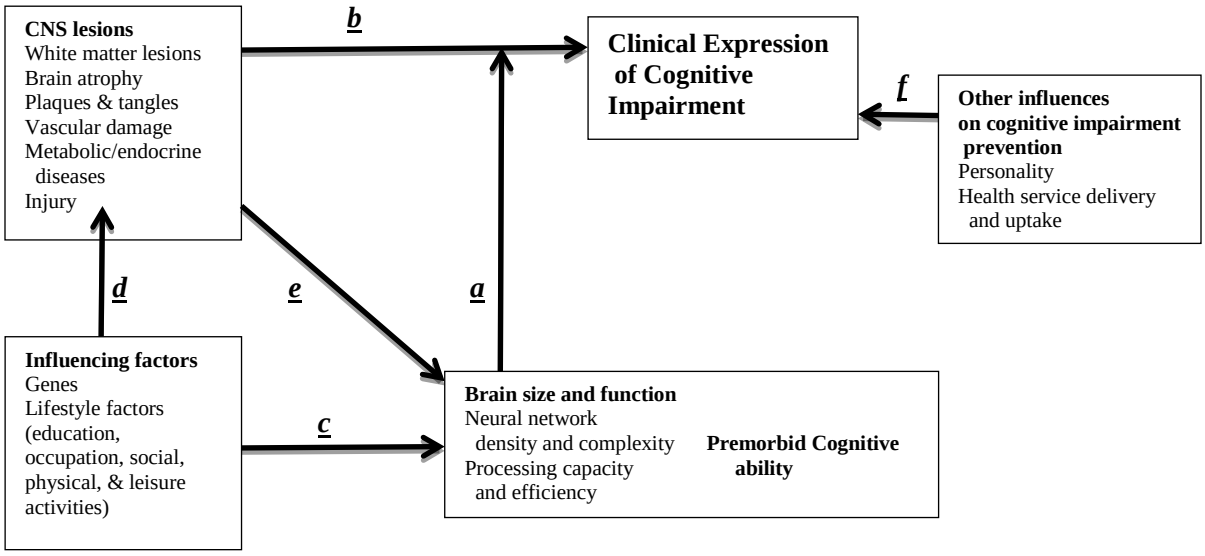

Figure 1. A proposed model for cognitive reserve theory. (a) cognitive reserve; (b) cognitive reserve modifies the expression of cognitive decline; (c) Lifetime influencing factors affects cognitive reserve; (d) Lifetime factors are associated with development of the central nervous system (CNS) lesions; (e) CNS lesions have effects on cognitive reserve; and (f) Other factors that affect the expression of cognitive decline. Adapted from "A Life Course Approach to Cognitive Reserve: A Model for Cognitive Aging and Development?" by M. Richards and I. J. Deary, 2005, *Annals of Neurology, 58*, p. 619. Copyright 2005 by the American Neurological Association.

Inter-variability refers to physiologic variability on how efficient brain networks are used to maintain or maximize cognitive performance. Stern, Y. (2009) used lifestyle factors and genetics as indirect measures of cognitive reserve since it is hypothesized that these variables are associated with the differences observed in cognitive functioning. Lifestyle factors include education, occupational attainment, and activities (Richard & Deary, 2005; Stern, Y., 2009). Higher educational levels may buffer the expression of cognitive decline with aging (Mortimer, Snowdon, & Markesbery 2003; Tucker-Drob, Johnson, & Jones, 2009; Valenzuela & Sachdev, 2006). Having worked in an occupation that deals with higher intellectual demands improves cognitive functions (Potter, Plassman, Helms, Foster, & Edwards, 2006). Mentally stimulating leisure activities such as reading or playing games improves the perceptual speed and semantic memory but not the episodic and working memory (Wilson, Barnes, & Bennett, 2003). Education, occupation, and leisure activities may be predictors for general knowledge, vocabulary and verbal abilities (Fritsch, et al., 2007). Physical activity may have a different mechanism in protecting older adults' cognition against aging. Engaging in physical activity decreases the risk of cognitive impairment (Podewils et al., 2005). The buffering effect of physical activity to aging or cognitive impairment may be attributed to an increase in cerebral metabolism independent from an increase in blood pressure (Ide & Secher, 2000) or an increase in antioxidant activity that reduces the oxidative damage to the brain during stressful situations (Radak, Taylor, Ohno, & Goto, 2001). Thus, the lifestyle factors may assist in the delay of the expressions of cognitive impairment but their effects on the brain and cognitive processes differ.

Several studies have evaluated whether lifestyle factors provide cognitive reserve. Scarmeas et al. (2003) studied the correlation of activities, cognitive performances, and regional cerebral blood flow (rCBF). The study participants were composed of 9 patients (5 male) with mild Alzheimer's disease (AD) and 16 healthy patients (6 male) for control. Infusion of 150

labeled water ($H_2{}^{15}O$) intravenously was used to measure rCBF. Cognitive performance was assessed by modified Mini Mental State Examination (MMSE), Nelson Adult Reading Test (NART), Blessed Dementia Rating Scale part I (BARD-I) and 18 activity scores. Findings revealed that simultaneously controlling for age, MMSE and NART activity scores negatively correlated with rCBF at temporal and temporal-parietal-occipital association areas of patients with AD. This suggests that individual differences in activity may contribute to cognitive reserve that moderate the expression of AD. The small number of participants decreased the power of the study. Perneczky and colleagues (2009) studied the contribution of education to cognitive reserve by using a Fluoro-deoxy-glucose (F-FDG) intravenous infusion to measure rCBF. They used the Bayer Activity of Daily Living (B-ADL) scale to measure impairment of activities of daily living (ADL). Twenty-one patients with dementia with lewy bodies (DWL), mean age of 69.52±5.7, participated in the study. Findings revealed that the rCBF had a significant inverse association with B-ADL at the right temporoparietal cortex. Length of education significantly and negatively correlated with area of Brodmann 19, which supported the findings of Scarmeas, et al. (2003) that engagement in various activities contributed to cognitive reserve.

The study of Christensen and colleagues (2007) revealed a different result. Their study investigated the relationship between brain burden (atrophy and white matter hyperintensities) and measure of reserve (education, creativity and intelligence), relationship of cognitive decline and reserve, whether measures of reserve mediate the effect of atrophy on estimated cognitive decline, and the association between brain risk factors, education, and atrophy. They had 446 participants with a mean age of 62.7±1.4 years for male participants and 62.6± for female participants. The findings revealed there was no interaction effect with atrophy and education on white matter hyperintensities (WMH) ($F_{(4,227)}$= 0.56, p=0.13 for males; $F_{(6,\ 209}$=1.05, p=0.39 for females). There was no association between creativity and activity with atrophy and WMH. The

study by Christensen, et al. (2007) involved Magnetic Resonance Imaging (MRI) of the whole brain. In contrast, the studies of Scarmeas, et al. (2003) and Perneczky, et al. (2009) involved rCBF of a specific area of the brain. The differences between the two studies involved a structural examination (MRI) of the whole brain versus a functional examination (rCBF) of a specific part of the brain. Cognitive reserve assumes that the processing of the brain moderates the expression of cognitive aging or neuropathology and specific networks are associated with specific cognitive tasks.

Stress may also be associated with decreases in cognitive performance among older adults (Lee, B. et al., 2008). A decrease in response to stress is a similar reason for the buffering effect of social activities (Glei et al., 2005) and increases vulnerability with Apolipoprotein genotype for cognitive decline. Human Apolipoprotein is an arginine-rich glycoprotein that is a structural component of cholesterol (Sepehrnia et al., 1989). The common types of apolipoprotein (APOE) are APOE ε2, APOE ε3 and APOE ε4. APOE ε2 is responsible for lowering the total cholesterol and low density lipoprotein while APOE ε4 has the opposite effect of APOE ε2 and is associated with Alzheimer's disease (AD) (Sepehrnia et al., 1989). Thus, lifestyle variables, genes, and the intelligent quotient (IQ) affect the brain in different mechanisms that may result in the inter-variability in cognitive aging. However, there is no unanimous answer on how to increase cognitive reserve. One reason may be due to the lack of a standard measurement of cognitive reserve. All the studies analyzed used different measures of cognitive reserve. Therefore, it is imperative to operationalize cognitive reserve in general and its constructs in particular.

Life Stages

Young Adulthood

Adolescence.

The adolescent period is defined as being between 12 to 18 years of age (Newman, Newman, Landry-Meyer, & Lohman, 2003), where biological (Cheng et al., 2009; Coldwell, Oswald, & Reed, 2009; Gunnar, Wewerka, Frenn, Long, & Griggs, 2009), psychological (Seiffge-Krenke, Aunola, & Nurmi, 2009), and social (Hall-Lande, Eisenberg, Christenson, & Neumark-Sztainer, 2007) aspects of life demonstrate rapid development (Newman et al., 2003). Biological changes vary individually but a growth spurt is common (Aksclaede, Olsen, Sørensen, & Juul, 2008; Jackowski et al., 2009). Specifically, brain changes include but are not limited to an increase in intracranial white matter density (Ashtari et al., 2007; Barnea-Goraly et al., 2005; Tamnes et al., 2010) and a decline in the amount of gray matter (Blakemore, den Ouden, Choudberry, & Frith, 2007; Gogtay et al., 2004; Giedd, 2008; Toga, Thompson, & Sowell, 2006). An increase in intracranial white matter density implies axonal development that is responsible in transmitting impulses within the cortical networks (Ashtari et al., 2007), whereas, a decline in gray matter volume signals synaptic pruning for efficient cognitive processing (Blakemore & Choudry, 2006; Blakemore et al., 2007). Self-consciousness (Newman et al., 2003), self-exploration (Germeijs & Verschueren, 2007), and impulsive thinking (Dahl, 2004; Gardner & Steinberg, 2005) are the major psychological characteristics of adolescence. The importance of peers dominates the social world of adolescence (Bower, Bukowski, Hymel, & Sippola, 2000; Buehler, 2006; Cavanagh, 2007; Kiesner, Cadinu, Poulin, & Bucci, 2002; Newman, Newman, Landry-Meyer, Lohman 2003; Steinberg & Monahan, 2007). The interaction of the biological, psychological, and social aspects of their lives may affect their physical and intellectual activities.

Adolescents have the capabilities to engage in physical activities. However, a considerable proportion of them do not achieve the recommendations of the amount needed for physical activity (Dunton, Whalen, Jamner, & Floro, 2007). Female adolescents engage less in physical activity (Atkin, Gorely, Biddle, Marshall, & Cameron, 2008) but have higher individual artistic activities (Mota, Santos, & Ribiero, 2008) compared to their male counterparts. Even though male adolescents engage more in physical activity, they have longer durations of sedentary activities such as watching television or playing video games than female adolescents (Atkin et al., 2008; Mota et al., 2008). It was strongly recommended that adolescents need a daily 60 minutes or more of moderate to vigorous age appropriate physical activity (Hallal, Victora, Azevedo, & Wells, 2006; Strong et al., 2005). In 2007, the majority of adolescents engaged more in vigorous activity (64%) compared to 26% engaged in moderate activity (Healthy People 2010 & CDC, 2010). The decrease in physical activity among adolescents was associated with limited time and support from peers, parents, and teachers (Neumark-Sztainer, Story, Hannan, Tharp, & Rex, 2003). Adolescents were likely to participate in physical activity with their peers and during school days (Dunton et al., 2007). Physical activity benefits not only their overall health but may also be advantageous to their academic performance (Taras, 2005).

The major intellectual activity of adolescents is academic participation (Newman et al., 2003). High school educational attainment may be the peak of their intellectual career. With the stress in the school environment and an increase in academic expectations (Kaplan, Liu, & Kaplan, 2005), the development of the white matter and the pruning of the gray matter in the brain allows the adolescents to cope with the different demands of cognitive tasks (Barnea-Goraly et al., 2005; Durston et al., 2006; Fryer et al., 2008). School is a place of social engagement for adolescents (Hall-Lande et al., 2007). With supportive friends, peers (Nelson R. & DeBacker, 2008), or mentors (Rhodes, Grossman, & Resch, 2000) the motivation for school achievement is

enhanced. Thus, the adolescent stage is a period of brain development, varied social experiences through peer relationships, and self-exploration, which is observed by how they engage in physical, social, and leisure activities.

Emerging adulthood.

Emerging adulthood is the stage between the late teens and late 20s where preparations for adult roles are experienced (Arnett, 2001, 2007). It is a continuation of the period of self-identity (Arnett & Eisenberg, 2007), intimacy (Gottlieb, Still, & Newby-Clark, 2007), and further maturation of gray (Blakemore, 2008; Lenroot & Giedd, 2006) and white matter (Giedd, 2008) in the brain. Self-identity may be guided by new friendships, parents, or mentors (Liang, Spencer, Brogan, & Corral, 2008). Intimacy is enhanced through the development of romantic and sexual relationships which may lead to cohabitation (Meier & Allen, 2008). The maturation of the intracranial gray and white matter is needed for cognitive processes (Luna, Garver, Urban, Lazr, & Sweeney, 2004), which assist in various independent decision making. The different lifestyle factors in this period also contribute to variability in cognitive abilities (Khun, 2006).

The trend in the lifestyle factors in adolescence continues in the stage of emerging adulthood. Engagement in physical activity still declines (Racette, et al., 2008; Ströhle et al., 2007). Sedentary activities such as watching television consume a great portion of their daily activities (Gunter & Moore, 1975; Nelson T. et al., 2007). The exploration of self-identity may also affect the physical activity of emerging adults, in that a positive self-image increases participation in physical activity (Werch et al., 2007) or an escalation in risky activities which may impede involvement in physical activities (Adams & Moore, 2007). Furthermore, emerging adults lack awareness of the information that they should have at least 30 minutes of moderate-intensity physical activity daily (McArthur & Raedeke, 2009). Reasons for participating in physical activity include improvement of their body image and health (McArthur & Raedeke,

2009; Scott, Rhodes, & Downs, 2009). The benefits on cognitive performance among emerging adults vary such that those who have lower cognitive performance have greater gains when they engage in physical activity (Sibley & Beilock, 2007).

Social network size outside the family increases among emerging adults (Gottlieb, Still, & Newby-Clark, 2007; Meier & Allen, 2008) which may lead to a loosening of their social ties with their families (Newman et al., 2003). In congruence to self-exploration and the age of possibilities, new friendships and romantic relationships are developed (Arnett & Eisenberg, 2007; Gottlieb, Still, & Newby-Clark, 2007). Accepting and supportive friendships assist them in developing self-esteem (Bagwell et al., 2005). Social networks are very important particularly at this stage when they are learning about independent living. Their social networks allow them to seek support when they are under stress and foster secure attachments (Laible, 2007). Marriage may be postponed while they enjoy the bliss of teenage years but are ambivalent about adult responsibilities (Arnett, 2007). Self-exploration also means choices of vocations or careers. Career-marriage conflict may be present for those who marry while launching their vocations (Barnett, Gareis, James, & Steele, 2003).

Although this stage is characterized by decisions about their vocation (Germeijs & Verschueren, 2007), frequent changes in vocational interest is not uncommon (Lounsbury, Hutchens, & Loveleand, 2005; Low, Yoon, Roberts, & Rounds, 2005). Higher educational pursuits to attain the perceived vocation after high school are widespread among emerging adults (Arnett, 2007). Stability in vocational interest improves during higher educational periods and endures through midlife (Low et al., 2005). Those who were systematic during their younger years, had parents who were conscientious, and/or had encouragement from teachers and counselors are more likely to experience stability with their career decision (Lounsbury et al., 2005; Staff & Mortimer, 2007) and academic success (O'Connor & Paunonen, 2007). As

pruning of intracranial gray matter (Blakemore et al., 2007; Durston et al., 2006) and maturation of white matter (Giedd, 2008) continues, better decision making is expected. Brain development assists in cognitive performance at the same time while experiences help fine tune the intracranial gray and white matter (Steinberg, 2005). In sum, emerging adulthood is a stage wedged between adolescence and early adulthood, which means that characteristics of the adolescent period exist and yet they are beginning to establish intimate relationships and their careers through education and social networks.

Early adulthood.

The early adulthood stage, which is described as the coalesce of nurturing intimate relationships, balancing of commitments (Dwyer, Smith, Tyler, Wyn, 2003), and career choices, starts at the end of emerging adulthood and continues to the early 30s (Newman et al., 2003). Traditionally, marriage may signify the start of adulthood (Arnett, 2001). Currently early adults delay marriage, however, they are still involved in intimate relationships (Oppenheimer, 2003). Marriage is related to a stable career (Oppenheimer, 2003), education (Oesterlerle, Hawkins, Hill, & Bailey, 2010), exclusive dating, and the means to balance between work and family (Peake & Harris, 2002).

Balancing career, family, and education necessitates excellent problem solving skills. At this stage the myelinization of the intracranial white matter still continues, particularly at the occipital lobe (Craik & Bialystok, 2006), which is very helpful in communication and understanding the external environment (Haier, White, & Alire, 2003). Perception and understanding of the environment, particularly in the work area, allows the early adult to confront many transformations into the world of occupation (Cohen-Scali, 2003). Because early adults have little experience in job roles, they select occupations with greater job rewards (Johnson, 2001). The values that they place on their occupation changes and become more limited as they

advance in age (Johnson, 2001); this may result in a more stable career. Success in career choice is also associated with a supportive social network in the work area, family, and friends (McDonald, Erickson, Johnson, & Elder, 2007). However, generational cohort differences exist on career choices and values they employ at their jobs (Twenge, Campbell, Hoffman, & Lance, 2010).

The five generational cohorts are: (a) the Traditionalist, (b) the Baby Boomer, (c) Gen X, (d) Millennial, and (e) Gen Y. The Gen Y will not be discussed in this chapter. The Traditionalist or Silent Generation, born between 1900 and 1945, saw two major wars and experienced the great depression. They are described as family focused, hard working, patriotic, and civic minded. Meanwhile, the Baby Boomers, born between 1946 and 1965, experienced the Vietnam War, the rise of technology, and the post-industrial era. They are ambitious, optimistic, and competent. Individuals born between 1966 and 1981 are called Generation X. Compared to Baby Boomers, the Generation X lived with a greater proportion of dual-income families (Putman, 1996), Watergate, and an energy crisis. They are highly educated, pragmatic, and the balance between work and life is important. Lastly, the GenMe or Millennials, born between 1982 and 2000, encountered the digital age, terrorist attacks, and a child focused era. They are civic minded, confident, and highly educated.

The different events which may have shaped the various generational cohorts affected physical, social, and leisure activities, and their education. When Traditionalists were at their young adulthood stage, they were naturally active and not concerned about scheduling their daily activities (Symond, 1936) compared to the Millennials, who have more sedentary activities such as watching television or playing computer games (Atkin et al., 2008; Mota et al., 2008). While the young adulthood stage is characterized by social network expansion, the Traditionalists and Baby Boomers relied on face to face meetings and the telephone (Westley & Elkin, 1955) as their

armaments for social expansion compared to the addition of digital networking used by the Gen X and Millennials. Lastly, there were more Traditionalists who did not finish high school than the other generational cohorts (Putman, 1996).

In sum, even with the presence of generational cohort differences, young adulthood is a stage of development where educational attainment is a specific accomplishment. It is also a stage where the social network is expanded by the development of intimate relationships and new friendships. The commencement of career choice may be baffling, especially when marriage is involved. Lastly, physical activity may decline as young adults' progress through this stage.

Midlife

Midlife is the stage from the 30s to 64 years old and is characterized by the balancing of career, relationships, and various physical or leisure activities (Newman et al., 2003). Involvement in a career in midlife is important and may encompass either a full-time or part-time job, volunteering, or a homemaking (Lachman, 2004). The post-industrial period saw an increasing number of women entering the labor force (Nye, 1955). As a result, the generations after the Traditionalists have experienced dual income families (Shaw, Liang, Krause, Gallant, & McGeever, 2010). The Baby Boomers and Traditionalists were hard workers while the Gen X'ers advocated for the balance of work and life (Twenge et al., 2010). Individuals who are currently in the midlife stage have higher demanding jobs than previous generations (Dziegielewski, Heyman, Green, & Gichia, 2002), as portrayed by working more hours, taking fewer vacation days, bringing work home, or remaining connected to work through the internet (Nevidjon, 2004). Individuals in the midlife stage switch to different occupations, move to different levels such as from manual labor to a supervisory role, or maintain the same occupation for the entire period (Jepsen & Choudhari, 2001). Changing their occupation may either be due to intrinsic (Ginn & Fast, 2006) or extrinsic (Lachman, 2004) reasons. Intrinsic factors include

job satisfaction (Ginn & fast, 2006) or lack of required skills (Packard & Babineau, 2009). Continuing adult education, which may not be the norm for Traditionalists, may play an important role in the maintenance or change of an occupation by allowing them to acquire new skills (Bills, 2005) or enhancing current skills (Davey, 2002) and fostering a sense of security in a changing labor market (Elman & O'Rand, 2002). In contrast to intrinsic factors, extrinsic reasons for changing an occupation include financial constraints, family obligations (Packard & Babineau, 2009), and layoffs (Lachman, 2004).

A stable career may not necessarily mean job satisfaction. Jepsen and Choudhuri (2001) found that compared to people with a stable career, individuals who changed careers were more likely to have both satisfaction with their job and career. Other factors that contribute to job satisfaction include work-based and personal social support (Marcinkus, Whelan-Bery, & Gordon, 2007), and the ability to present their best qualities at work (Roberts, Dutton, Spreitzer, Heaphy, & Quinn, 2005). As midlife adults advance in age, they might experience job discrimination (Dziegielewski et al., 2002; Lachman, 2004). An entrenched factor in career management is the presence of social support whether changing careers (Motulsky, 2010), unsurpassed performance at work (Marcinkus et al., 2007), or coping with job strain (Lachman, 2004).

A positive relation with others is undeniably a key factor for the well-being of midlife adults (Lachman, 2004). The majority of Americans in midlife are married and others are either divorced, never married, or widowed (U.S. Census Bureau, 2011). Although midlife is a period where relationships are nurtured, the divorce rate for all phases of life peaks between 45-64 years old (U.S. Census Bureau, 2011). Furthermore, the Traditionalists have experienced a lower divorce rate than other generational cohorts (Shaw et al., 2010; Putman, 1996). Thus, it is a phase of life where there may be wide swings in intimate relationships. Extramarital affairs may break

marriages while openness to communicate with each other may stabilize marriages (Dziegielewski et al., 2002). Having social support may assist in handling crisis situations, rebuilding marriage relationships, while at the same time maintaining the bond with the social networks (Huber, Navarro, Womble, & Mumme, 2010).

Social networks include family, networks beyond the family, and professional groups (Drummond, Kysela, McDonald, & Query, 2002; Libler & Sandefur, 2002). The maintenance of positive relationships may result in the acquisition of different roles which include being a spouse, parent, and a caregiver (Dziegielewski et al., 2002; Lachman, 2004). Midlife adults may experience being a caregiver for both their children and elderly parents (Dziegielewski et al., 2002; Evandrou & Glaser, 2004; Glaser, Evandrou, & Tomassini, 2006; Lachman, 2004). As a parent, it is a responsibility and an accomplishment when the psychological, emotional, physical, and social needs of children are met. For some, parenthood may be associated with adverse health outcomes (Evandrou & Glaser, 2004), particularly with lack of social support or financial resources. Being a caregiver for elderly parents is not uncommon for midlife adults. Without proper resources, caring for older adults, especially when they are frail, may cause significant stress (Evandrou & Glaser, 2004; Glaser, Evandrou, & Tomassini, 2006). Therefore, midlife adults are bequeathed with different social roles. Balancing their personal and social roles necessitates the presence of supportive social networks. The maintenance of homeostasis between career and family not only affects their social roles but also the engagement in physical activities.

Similar to young adulthood, the stage of midlife is characterized by declining physical activity (Kuh, Cooper, Hardy, Guralinik, & Richards, 2009; U.S. Department of Health and Human Services, Center for Disease Control and Prevention [CDC], & National Center for Health Statistics, 2010). Adults who were physically active during the adolescent stage are more

likely to continue being physically active compared to those who were not physically active during the adolescent stage (Azevedo, Araújo, da Silva, & Hallal, 2007). A minimum of 30-minute, five days a week of moderate intensity or 20-minute, three days a of week vigorous intensity aerobic physical activity is recommended to maintain personal fitness among midlife adults (Haskell et al., 2007). Only 5% of American adults are in compliance with the minimum recommendations (Troiano, Berrigan, Dodd, Masse, Tilert, & McDowell, 2008). Financial and time constraints, fatigue, and the dislike of exercise are frequent reasons for midlife adults not to engage in physical activity (Rechert, Barros, Domingues, & Hallal, 2007). Fatigue, financial, and time constraints may be related to their present social roles (Evandrou, & Glaser, 2004; Glaser, Evandrou, & Tomassini, 2006; Lachman, 2004). Compared to the other generational cohorts, the Traditionalists, during their midlife stage, may have different physical activities according to their social stratum (Havighurst, 1957). The upper class favor sports activities while lower and middle classes enjoy manipulative activities and watching television (Havighurst, 1957). Personal fitness, as well as maintenance of cognitive performance (Kramer & Erickson, 2007; Kuh et al., 2009), are a few of the benefits of physical activity among midlife adults.

Adults in the midlife stage experience the start of biological changes in the brain (Jones et al., 2006; Marner, Nyengaard, Tang, & Pakkenberg, 2003; Salat et al., 2005). Degeneration of intracranial white matter is a major change in midlife adults (Jones et al., 2006; Salat et al., 2005). The myelinated fibers which are important in relaying information to the different brain networks decrease in numbers by 10% for every decade (Marner, Nyengaard, Tang, & Pakkenberg, 2003). The reduction in intracranial myelinated fibers affects white matter integrity, which influences the cognitive performance of midlife adults (Kennedy & Raz, 2009; Thomas et al., 2008). Although degeneration of intracranial white matter is apparent, evidence of neurogenesis on some parts of the brain of adult mice was observed such as in the hippocampus, occurring through the

stimulation of brain derived neurotrophic factors by mechanisms such as enriched environment and physical activity (Brown et al., 2003; Cotman & Berchtold, 2002). The same neurotrophic factors are elevated when human adults engage in physical activities (Chan, Tong, & Yip, 2008). Thus, lifestyle factors do not have a global effect on the brain (Brown et al., 2003), which might explain the different effects on cognitive performances among midlife adults (Cerhan et al., 1998; Seeman et al., 2010; Singh-Manoux, Richards, & Marmot, 2003; Whiteborne, Neupert, & Lachman, 2008).

Career development is a major and specific focus of adults in midlife stage. Similar to young adulthood, education, social, and physical activities are associated with how adults traverse the different events in midlife. Consequently, lifestyle factors affect the cognitive performance of midlife adults and eventually continue through the late-life stage.

Late-Life

Late-life phase is the stage 65 years and older and can be described as personal exploration of meaning in life (Newman et al., 2003). There are imbalances of losses and gains in major spheres of their lives. Manifestations of biological decline are evident as health comorbidities are increasing and functional limitations are constraining their activities of daily living (Gitlin, Winter, Dennis, Corcoran, Schinfeld, & Hauck, 2006). Cerebral atrophy and intracranial white matter hyperintensity are examples of biological changes that accompany aging (Firbank, Wiseman, Burton, Saxby, O'Brien, & Ford, 2007; Fotenos, Mintun, Snyder, Morris, & Buckner, 2008), affecting the cognitive performance of older adults (Brickman et al., 2008; Verdelho et al., 2007). The regression in the speed of processing (the rapidity in processing information) (Park, 2000), and working memory (the capacity of the brain to manipulate and simultaneously save information in memory) (Park, 2000 ; Salthouse, 1996), may influence the decision making, planning, and execution of activities of older adults in their daily lives. Older

adults, however, have the ability to compensate for biological changes through the manipulation of their environment and exploitation of lifestyle factors.

Although the majority of older American adults are retired at this stage, 17.2% of them are still in the labor force (U.S. Department of Health and Human Services [DHHS], Administration on Aging [AoA], 2011). Older adults who are still in the labor force prefer flexible hours (Loi, 2007), part-time work, and occupations near their homes (Hovbrandt, Fridlund, & Carlsson, 2007). Living with constrained circumstances from the biological changes, they draw upon available resources at work to overcome environmental barriers (Hovbrandt et al., 2007). Engagement in an occupation not only provides life satisfaction (McKenna, Broome, & Liddle, 2007), but also fringe and social benefits (Loi, 2007).

The social theme of older adults is diverse. Social networks include family, friends, and other acquaintances (Fiori, Antonucci, & Cortina, 2006). In 2009, more than half (54.8%) of older, noninstitutionalized American adults lived with their spouse (U.S. DHHS), AoA, 2011). Moreover, 716,000 have grandchildren living with them (U.S. DHHS, AoA, 2011). The social networks, however, may be shrinking in size due to the deaths of their peers and spouses. Five out of six older adults adjust well to the death of their spouse, but the rest may experience chronic grief syndrome (Reichstadt, Depp, Palinkas, Folsom, & Jeste, 2007) which may hinder their capability to engage in social activities. Furthermore, traveling to nurture relationships with friends or families may be restricted due to personal and environmental barriers in driving (Baldock, Mathias, McLean, & Berndt, 2006). For older adults who have satisfactory health, some of them usually increase their social networks by engaging in volunteer civic works (Kaskie, Imhof, Cavanaugh, & Culp, 2008). Engagement in social activities such as volunteering brings about continued stimulation, learning, and a sense of meaning in their life (Reichstadt, Depp, Palinkas, Folsom, & Jeste, 2007).

Similar to the social aspect of older adults, engagement in physical activity by older adults is diverse. Even though functional limitations exist in the older adult population (Gitlin et al., 2006), the trend to engage in physical activity is increasing (Borodulin, Laatikainen, Juolevi, & Joussilahti, 2008; CDC, 2009). Common physical or leisure activities in which older adults engage include playing card games, solving crossword puzzles, going to cinemas or theatres, artistic activity, reading, walking, and gardening (Akbaraly et al., 2009; Ashe, Miller, Eng, & Noreau, 2009; Wilson, Barnes, & Bennett, 2003). Recommendations for the amount of physical activity for older adults to maintain physical fitness are the same as for adults in midlife. Fewer health comorbidities (Acree et al, 2006), fervent social support (Akbaraly et al., 2009; McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006), and favorable socioeconomic status (Ashe et al., 2009; Akbaraly et al., 2009) are associated with an increased participation in physical activities. Positive effects of engagement in physical activity include personal fitness, maintenance of cognitive performance, and higher satisfaction in various dimensions of life (Acree et al., 2006).

Adults in the late-life stage have a good sense of the limitations which biological changes and health comorbidities present. They adapt to the limitations by their continued and conscientious effort to engage in stimulating activities that may construct what successful aging means (Newman et al., 2003; Reichstadt, Depp, Palinkas, Folsom, & Jeste, 2007).

The three life stages were described utilizing the different areas of education, occupation, physical, leisure, and social activities. Even though generational cohort differences exist, each stage undertakes major tasks: (a) educational attainment for young adulthood, (b) balance of work-life for midlife, and (c) redirection of energy to new roles and activities for late-life (Newman et al., 2003). Throughout the lifespan of an individual, the lifestyle factors are constantly modified which may influence their cognition as they become older adults.

Lifestyle Factors

Education

Education, an example of an external environment, is the process of learning from school (Agnes, 2003). In general, formal education in the U.S. is accomplished by eight years in elementary and four years in high school (U.S. Census Bureau, American Factfinder, 2009). The time spent pursuing education beyond high school varies. Current estimated school enrollment based on the U.S. Census 2000 revealed 40.4% are in elementary education, 21.6% in high school, and 26.6% in college or graduate school level. African Americans and Caucasians were similar on frequency of educational level at high school graduate and some college years or associate degree (30%) (U.S. Census Bureau, American Factfinder, 2009). The differences are observed on the educational levels of undergraduate and college graduate. African Americans have a higher frequency of high school undergraduates than Caucasians (19.3% vs. 12.8%) (U.S. Census Bureau, American Factfinder, 2009). In contrast to high school undergraduates, fewer African Americans have a college degree (6%) than Caucasians (10.7%) (U.S. Census Bureau, American Factfinder, 2009). Education affects individuals over their lifespan (Craik & Bialystok, 2006). Studies have found that race is not associated with cognitive performance; it is the differences in educational levels which affect cognitive performance (Wagner, et al., 2007).

Higher educational attainment is associated with higher cognitive performance (Alley, Suthers, & Crimmins, 2007; Tucker-Drob & Johnson, 2009; Tyas, et al., 2007; Wagner, et al., 2007). A cross sectional prospective population cohort study by Ganguli et al. (2010) evaluated the effects of age and education on cognitive performances of older adults from an urban town in the U.S. The mean age of the participants was 77.6±7.4 years. They discovered that higher education was significantly associated with higher cognitive performance. A study by Tucker-Drob and Johnson (2009) from a subset sample of the Advanced Cognitive Training for

Independent and Vital Elderly (ACTIVE) study examined to see if education and vocabulary knowledge are associated with higher levels of functioning in older adults. The ACTIVE study was a five-year longitudinal randomized trial conducted at six field sites and had a goal of investigating the effects of cognitive training on cognitive functioning. Six hundred ninety no-contact control participants (age range= 65-90 years) were selected. Seventy-four percent were female with Mini-Mental State Exam (MMSE) scores ranging from 23-30, and a mean of 13.4±2.7 formal educational years. Measures for cognitive performance included memory, reasoning, and processing speed. The findings revealed that education and vocabulary knowledge were associated with cognitive functioning but not with the rate of cognitive decline. Meanwhile, Alley, Suthers, and Crimmins (2007), conducted a study to determine whether the number of formal educational years would differentiate cognitive changes among older American adults. The study was a retrospective longitudinal in design and recruited a national representative of 3,541 participants. Assessments of general cognitive status and verbal and working memory revealed that education was significantly associated with general cognitive status even after adjusting for covariates. The studies had different designs and employed different cognitive tests, however, they unanimously concluded that the number of formal educational years have significant effects on cognitive performance. The evaluation of cognitive performances is associated with diagnoses of cognitive dysfunctions.

Studies have shown that educational attainment is predictive of cognitive impairment (Lièvre, Alley, & Crimmins, 2008; Mortimer, Snowdon, & Markesbery, 2003; Ngandu, et al., 2007; Roe, Xiong, Miller, & Morris, 2007; Scarmeas, Albert, Manly, & Stern, Y., 2006; Valenzuela & Sachdev, 2006). Mortimer, Snowdon, and Markesbery (2003) studied a subset of participants from the Nun Study. The participants of the Nun study (N=678) were members of the Catholic Sisters of Notre Dame congregations who volunteered to be evaluated cognitively

and donated their brains after death. The Catholic Sisters were cognitively assessed using the Consortium to Establish a Registry for Alzheimer's Disease (CERAD). The subset samples (N=297) were all Caucasian females with a mean age of 89.34 years and a mean length of education of 15.79 years. The study findings revealed that participants with less than 16 years of education were four times as likely to present with dementia as those with more than 16 years of education. Sixty participants from the subset had available autopsy data. Data revealed that 34 participants fulfilled the neuropathological criteria for Alzheimer's disease (AD). Sixteen of the 34 participants remained non-demented through the last evaluation. The results suggest that higher education may buffer the effects of dementia in later life. Unlike the study of Mortimer and his colleagues, Lièvre, Alley, and Crimmins (2008) conducted a retrospective longitudinal design of 7,228 older adult participants from the Assets and Health Dynamics of the Oldest Old (AHEAD) study. The AHEAD study, which started in 1993 and terminated in 2000, collected data from older adults born in the year 1923 or earlier to determine their cognitive and economic status as well as their family structure (Soldo, Hurd, Rodgers, & Wallace, 1997). Lièvre and colleagues (2008) examined the correlation of memory, language, and orientation in respect to education among the participants. Education was stratified into less than high school and completed high school. Their findings revealed that higher educational attainment decreases the likelihood of developing cognitive dysfunction. Unlike the study of Mortimer and colleagues (2003) and the group of Lièvre (2008), Perneczky and colleagues (2009) studied the contribution of education in predicting the risk of the development of dementia by using a Fluoro-deoxy-glucose (F-FDG) intravenous infusion to measure regional cerebral blood flow (rCBF). A decrease in rCBF or hypometabolic state is associated with dementia. Twenty-one patients with dementia with lewy bodies (DWL) and a mean age of 69.52±5.7, participated in the study. Educational attainment was defined as the number of formal years in school. Findings revealed

rCBF has a significant inverse association with length of education controlling for activities of daily living. Valenzuela and Sachdev (2006) conducted a meta-analysis of 18 cohort studies of longitudinal studies of cognitive change. Studies showed that education was associated with less cognitive decline. Ten studies showed a significant effect of education and three studies showed otherwise. Therefore, similar to studies from cognitive performances, studies that associated education with the risk of developing cognitive decline revealed an inverse relationship with education being defined by the number of years in school.

Although education was associated with cognitive performance and risk of developing cognitive dysfunction, its definition was narrowly defined as years of school completed (O'Bryant et al., 2007). Other forms of education after formal schooling in the lifespan of the participants were not assessed. Hatch and colleagues (2007) studied the impact of adult education on cognitive performance in midlife. Adult education was defined as an involvement in accredited or unaccredited learning activities after formal schooling. A descriptive analysis of 1,934 participants who were 53 years old from a retrospective study revealed that adult education significantly contributed to cognitive performance irrespective of formal educational attainment. Moreover, participants who completed their formal education by the age of 26 years old were more likely to engage in adult education. Therefore, participants from the above studies who had a greater amount of formal schooling may have engaged in adult education which contributed to higher cognitive performances or a buffering effect from the expression of cognitive dysfunction. Thus, it is imperative to assess not only the formal educational years, but also the informal education gained in one's lifespan.

Social Environment

Socialization is the process of involving oneself in a group (Agnes, 2003). Studies have demonstrated the benefit of socialization to cognitive functioning of older adults (Barnes, et al.,

2004; Bennett, Schneider, Tang, Arnold, & Wilson, 2006; Glei et al., 2005; Seidler, Bernhardt, Neinhaus, & Frölich, 2003; Wang, Karp, Winblad, & Fratiglioni, 2002; Zunzunegi, Alvarado, Del Ser, & Otero, 2003). Limited data exists to gauge the social environment of older Americans. According to the Behavioral Risk Factor Surveillance System in 2006, 9.2% of older American adults in North Carolina reported they rarely or never received the social support they needed compared to 12.2% nationwide (Strine, Chapman, Balluz, & Mokdad, 2008). Healthy People 2020 (n. d.) introduced the social factors, particularly the nature of social relationships, as a determinant of health. Currently there are no established objectives for social determinants of health (Healthy People 2020, n. d.). The definition of the social factors also varies (Fratligionin, Pailard-Borg, & Winblad, 2004).

The social environment of older adults can be described through their social networks (Bennett, Schneider, Tang, Arnold, & Wilson, 2006; Fratligionin, Pailard-Borg, & Winblad, 2004; Seidler, Bernhardt, Neinhaus, & Frölich, 2003) and social activities (Glei et al., 2005; Zunzunegi, Alvarado, Del Ser, & Otero, 2003). Social networks describe the social ties. Social ties not only identify the number of children, friends, relatives, and marital status; but also the frequency of communication among them (Barnes, et al., 2004; Fratligionin, Pailard-Borg, & Winblad, 2004; Bennett, Schneider, Tang, Arnold, & Wilson, 2006; Seidler, Bernhardt, Neinhaus, & Frölich, 2003; Zunzunegi, Alvarado, Del Ser, & Otero, 2003). In contrast to social network, social engagement involves the participation in social activities such as going out of the house for entertainment purposes (Barnes, et al., 2004; Wang, Karp, Winblad, & Fratiglioni, 2002), attending religious activities (Barnes, et al., 2004; Seeman, Albert, Lusignolo, & Berkman, 2001), playing cards or games with others (Wang, Karp, Winblad, & Fratiglioni, 2002), and volunteer work (Galucci et al., 2007). Social engagement may be viewed as a leisure or physical activity, however, the participation of older adults in these activities with another person or group of

individuals may delineate it from leisure or physical activity. The benefits of social network and engagement to the cognitive functioning of older adults may be due to: (a) availability of resources in responding to stressful situations (Zunzunegi, Alvarado, Del Ser, & Otero, 2003), (b) stronger motivation to confront challenges of fading neurological capacity (Barnes, et al., 2004), (c) more robust self-concept of usefulness and competence (Wang, Karp, Winblad, & Fratiglioni, 2002), and/or (d) increasing cognitive reserve (Fratligionin, Pailard-Borg, & Winblad, 2004; Stern, Y., 2009).

The majority of studies revealed a significant association of a robust social network to a higher cognitive functioning or lower risk of developing cognitive impairment. A review by Fratligionin and colleagues (2004) of seven longitudinal studies on social network revealed that five studies observed a higher risk of cognitive decline for older adults with few social networks, while three studies associated dementia and limited social networks. They observed that the assessment of social network was performed at baseline only. Engagement in social activities and satisfaction with social network were included in the definition of social network. Zunzunegi et al. (2003) assessed the influence of social network on cognitive decline among older adults using a population-based longitudinal study. According to the study, social network meant the number and proximity of ties and the frequency of contact. Similar to the review of Fratligionin et al. (2004), social network was measured at baseline. They found men were more likely to be married ,whereas women were more likely to attend religious activities and either live alone or with family members. Additionally, the study demonstrated that poor social connections predicted the risk of cognitive impairment among older adults. Meanwhile, Barnes et al. (2004), examined the association of social networks with the rate of cognitive decline among older adults through a population-based (6,102 participants) longitudinal study. The mean age in the study was 73.94±6.46 years. Majority of the participants were female and married. Social network was

assessed at baseline and defined as the number of children, relatives, and friends seen at least once a month. After adjusting for demographic variables, socioeconomic status, level of cognitive and physical activity, depression, marital status, and chronic medical conditions, the number of social networks was associated with cognitive decline. Marital status was not included in the definition of social network but used as a control for the effect on social network.

Including the marital status in the social network may have a different effect since older adults have more contact with relatives, including spouses, than friends as they advance in age (Zunzunegi, Alvarado, Del Ser, & Otero, 2003). Seeman and colleagues (2001) performed a retrospective longitudinal study of 1,189 highly functioning older adults (70-79 years old) to evaluate the association of social environment and cognitive function. Social environment was assessed twice in the study. They found men who were married have a larger social network size, while women who were married have fewer close ties and less group membership. Moreover, married women demonstrated poorer cognitive function which may have been due to their caregiver roles as their spouses became ill with chronic medical conditions, which posed an additional burden for them. They also observed that married women who had greater emotional support from friends, spouses, and relatives had significantly less cognitive decline. Although the majority of the studies conferred the benefits of social network with cognitive functioning, they only measured social network at baseline or at two time points and varied in their definitions of social network.

Social engagement or activities may also buffer older adults from the effects of biological aging of the brain. Glei et al. (2005) examined the changes in cognition of 2,387 older adults (mean age= 71.8±5.2). Their study included both community dwelling and institutionalized adults. Social activities included: (1) playing games (chess), (2) socializing with friends, neighbors, and relatives, (3) joining organized groups, (4) performing volunteer work, (5)

participating in religious groups, (6) business associations, (7) political groups, (8) clan associations, and (9) elderly organizations. After adjusting for sociodemographic factors, health status, and the presence of cognitive impairment; participants who engaged in three or more social activities had fewer failures in cognitive tasks compared to participants who had less than two social activities. Follow-up assessments for social activities were accomplished at three time points. Moreover, they found social activities outside the family ties have a larger impact on cognitive function compared to social activities within the family circle. Galucci et al. (2007), who had fewer but older participants (670; mean age 84±8) revealed a strong correlation between social activities and cognitive function after controlling for health comorbidities. Visiting friends and social centers, as well as volunteer work, were identified as social activities. In contrast to the studies of Glei et al. (2005) and Galucci et al. (2007), Wang, Karp, Winblad, & Fratiglioni (2002) evaluated the association of social activities with the incidence of dementia through a population-based longitudinal study. They defined social activities as: (1) attending theatres, concerts, or art exhibitions, (2) traveling, (3) playing cards/games, and (3) participating in social groups. Their study showed an inverse relationship of social activities and dementia incidence. The studies mentioned commonly defined social activities as participation in social groups. They only assessed social activities at the current stage of life of participants. Engagement in social activities early in life may positively contribute to the cognitive functioning of older adults (Fritsch, et al., 2007).

Studies which associate social integration and cognitive functioning of older adults vary in their definition of social network and engagement. Social activities in particular have a physical activity component. Physical activities are also known to positively benefit the cognitive functioning of older adults and may be an unknown confounding variable that was not adjusted in the studies mentioned. Aartsen, Smits, Tilburg, Knipscheer, & Deeg (2002) found a positive

effect of social activities on the cognitive performance of older adults; however, when the error correlation (unknown confounding variables) was added to the equation, the absence of positive effect was revealed. Likewise, the studies only measured the social integration at the current life stages of participants. Early life social activities may have confounded the results of their studies. Therefore, assessments of social integration in a lifespan may provide a clearer picture when examining the relationship with the cognitive functioning of older adults.

Leisure Activity

Similar to social environment, Table 1 shows that leisure activities have varied definitions. Leisure activities were either defined as a form of life satisfaction (Aartesen, et al., 2002) associated with more mental rather than physical activities (Fratligionin, et al., 2004; Singh-Manoux & Marmot, 2003), or simply as spare-time activities(Richards, Hardy, & Wadsworth, 2003).

Table 1. Definitions of Leisure Activities Affecting Cognitive Functioning or Risks of Cognitive Impairment

Authors	Leisure Activities	Findings
Aartsen, et al., 2002	-Experiential activities (trips to forests, cultural institutions, and cafés or restaurants) -Developmental activities (attending courses or study)	-Developmental activities have a positive effect on information processing.
Richards, et al., 2003	-Playing chess or similar games, religious activities, attending cinema/theatres/concerts, participation in group activities, volunteer work	-Engagement in leisure activities at 36 years old were associated with a higher memory score at 43 years. No change in memory score was observed at 53 years of age.

Scarmeas, et al., 2003	-Knitting or other hobby, walking for pleasure, visiting friends/relatives, being visited by friends/relatives, physical conditioning, going to movies/restaurants/sporting events, reading magazines/newspapers/books, watching television, listening to radio, going to clubs/centers, attending classes, and religious activities	- Activities such as walking for pleasure, going out to watch movies, visiting friends, and reading were associated with a decreased risk of cognitive impairment. -The combination of low education and low engagement in leisure activities were most positively associated with cognitive impairment.
Singh-Manoux, Richards, & Marmot, 2003	-Low cognitive effort (household tasks, practical activities such as pottery, visiting friends/relatives, going to pubs/clubs, and religious activities) -High cognitive activities (use of home computers, cultural visits, social indoor games, reading, listening to music, position at office, involvement in organizations, volunteer work, engagement in study courses/evening classes)	-Cognitive activities were associated with cognitive functioning; however, a greater association was observed in highly cognitive activities.
Verhese, et al., 2003	-Playing board games, reading, playing musical instruments, crossword puzzles, writing, participating in group discussions	-Activities in reading, playing board games and musical instruments were associated with a lower risk of cognitive impairment. -A greater frequency in leisure activities resulted in a lower risk of cognitive impairment. -Leisure activities were positively associated with episodic memory.
Wilson, et al., 2002	-Viewing television, listening to radio, reading newspapers/magazines/books, playing games such as cards/checker, crossword puzzles, and going to museums	-Leisure activities were associated with a reduced decline in global functioning, working memory, and perceptual speed.

Not all leisure activities have a positive impact on the cognitive functioning of older adults. Klumb and Maier (2007) studied the effects of daily activities of older adults on their mortality risk. Daily activities were categorized into regenerative and discretionary. Regenerative activities were defined as activities to maintain one's physical existence while

discretionary activities were activities freely chosen by the individual that could (productive activities) or could not (consumptive activities) be delegated to another person. Examples of productive activities were gardening, house cleaning, shopping, and paid work. Consumptive activities included meeting with friends, reading a novel or watching television. They found that consumptive but not productive activities lower the risk of mortality. They inferred that the consumptive activities and mortality were linked by a psychosocial pathway. Singh-Manoux, Richards, & Marmot (2003) classified leisure activities differently from Klumb and Maier (2007). Leisure activities had either a low or a high cognitive component (Table 1). Their prospective longitudinal study was comprised of adults' ages 35-55 years old at baseline and 47- 67 years old at follow-up. The study uncovered that leisure activities have a positive relation with cognitive function but a greater association was observed with activities with a high cognitive effort. Verghese and colleagues (2003), in their prospective cohort study of community dwelling older adults, did not categorize leisure activities. Out of six leisure activities: reading, playing board games, and musical instruments were associated with a lower risk of developing cognitive impairment. Additionally, the greater frequency of performing the leisure activities resulted in an inverse relationship in developing cognitive impairment. Thus, activities that an individual prefers and which are more cognitively challenging, are positively associated with cognitive function.

The association of leisure activities and cognitive functioning were studied in different stages of life. Richards, Hardy, & Wadsworth (2003) studied 1,919 participants who were part of the British 1946 birth cohort study. Leisure activities were assessed at 36 and 43 years of age and verbal memory scores at 43 and 53 years old. Leisure activities significantly remained associated with verbal memory scores at 43 years of age even after adjusting for covariates. No change in verbal scores were observed at 53 years of age which may mean that engaging in leisure activities

may have prolonged effect on verbal memory. However, the activities of going to a cinema, theatre, or concerts were not reassessed at 43 years of age. To demonstrate if leisure activities have a lasting effect in cognitive functioning, Everson-Rose and colleagues (2003) studied the association of leisure activities during childhood years and cognitive functioning at late adulthood stage. The prospective longitudinal study revealed these activities were positively associated with cognitive functions even after controlling for education. It also showed leisure activities at childhood were not associated with a less rapid decline in cognitive functions. In contrast to Richards, Hardy, & Wadsworth (2003), who did not include visiting a cinema, theatre, and concerts in their reassessments of research participants at 43 years of age, Scarmeas et al. (2001), found that walking for pleasure, going out to movies, visiting friends, and reading were linked with participants' cognitive functions. Although their participants were older (more than 70 years old), participants were either cognitively intact or cognitively impaired. Leisure activities significantly reduced the risk of cognitive impairment. Moreover, less engagement in leisure activities and fewer educational years were synergistic in producing a higher risk of cognitive impairment. Therefore, leisure activities in different stages of life have positive effects in adulthood. However, the studies only assessed the leisure activities at specific stages of adulthood or associated these activities with a specific younger stage of life and adulthood. Moreover, different kinds of leisure activities have different bearings on cognitive functions (Richards, Hardy, Wadsworth, 2003; Scarmeas, Levy, Tang, Manly, & Stern, Y., 2001).

Physical Activity

The CDC (2011) suggests for older adults to be physically active due to the health benefits. It is recommended that if an older adult does not have any health and physical limitations, they should engage in at least 150 minutes of moderate intensity or 75 minutes of vigorous intensity of aerobic and muscle strengthening exercises per week (CDC, 2011).

However, only 25% of 65-74 years old and 16% of 75 years and older American adults commit to moderate regular physical activities (Healthy People 2010, 2011). The proportion drops by about 10% for vigorous activities (Healthy People 2010, 2011). Physical activities benefit not only the cardiovascular health, but the cognition of older adults as well(CDC & Alzheimer's Association, 2007). Biological cognitive benefits of physical activity in older adults include decreases in sympathetic nervous stimulation (Motivala, Sollers, Thayer, & Irwin, 2006), increased brain volume particularly at the frontal lobe (Colcombe, et al., 2006), and maintenance of brain structures (Adlard, Perreau, & Cotman, 2005). The CDC (2011) defines physical activities as aerobic and muscle-stretching exercises. However, various studies which examined the association of physical activities and cognition of older adults had varied definitions of physical activities.

The definition of physical activities yields different cognitive results for older adults. Wilson and colleagues (2002) studied aerobic exercises as a form of physical activity. The participants belonged to a religious group. A prospective longitudinal study revealed that physical activity was neither associated with global nor specific cognitive function. A contrasting result was observed from the study of Galluci, et al. (2009) who had community dwelling older adults as their participants. Although the definition of physical activity was limited to walking and gardening as forms of aerobic exercise, global cognitive function was positively associated with physical activity**.** Differences exist between the studies. The study of Wilson and colleagues(2002) was a longitudinal study, had more homogenous participants, and included a greater number of neuropsychological tests and more broadly defined aerobic exercise than the study of Galluci et al. (2009). Chan and colleagues (2005) differentiated physical activity into mind-body (Tai-Chi) and aerobic (dancing and playing tennis) exercises. Cognitive performance for both aerobic and mind-body exercises were similar and declined less with increasing age. The

physical activities in the study by Chan et al. (2005) had a social component which may have affected the results. Meanwhile, Lam and colleagues (2009) limited the aerobic, mind-body, and stretching exercises to activities performed leisurely. They found that older adults who engage in aerobic and mind-body exercises have a higher cognitive performance than those performing muscle-stretching exercises. Moreover, physical activities were associated with socialization among older adults. Thus, results varied when physical activity was defined as aerobic, mind-body, or muscle-stretching exercises. Furthermore, there is a synergistic effect of socialization for most of the physical activity of older adults that may have contributed to their cognitive performances.

Some studies on cognition among older adults focused on the late adult stage (Gallucci, et al, 2009; Larson, et al., 2006; Verghese, et al., 2003). Limited studies pondered the effect of physical activities during the early stages of life on the cognition of older adults (Deary, Whalley, Batty, & Starr, 2006). Dik and colleagues (2003) examined early life physical activities with cognitive performance of older adults through a prospective longitudinal study. Physical activity was broadly defined as any sports activity or activities which made them sweat or become exhausted when the participants were between ages 15-25 years old. The study revealed engagement in physical activity early in life was associated specifically with information processing speed but not global cognitive functioning. Likewise, Lam et al. (2009) found that physical activities in midlife significantly reduced the risk of developing cognitive impairment. Therefore, extrapolating the definite association of cognition and physical activity among older adults may be difficult since physical activities are associated with socialization, the definition varies, and engaging in it during early stages of life may confound the results.

Occupation

In 1948, almost 30% of the older adults were contributing to the labor force (U.S. Department of Labor, Bureau of Labor and Statistics, 2008). Since then, a steady decline to as few as 10% was observed in the 1980's (U.S. Department of Labor, Bureau of Labor and Statistics, 2008). However, the number of older adults engaging in labor continued to rise in the 1990's (U.S. Department of Labor, Bureau of Labor and Statistics, 2008). In 2008, 15.5% of older adults nationwide were currently employed (U.S. Census Bureaus, 2009). North Carolina mirrored the proportion of older adults in the labor force nationwide (U.S. Census Bureau, 2009).

Occupation is culturally defined and classified. For example, in Japan, occupation represents the work with compensation that an individual performs and is grouped not only by the work and knowledge to perform the job, but also takes into account the role of the individual in the establishment, the type of goods being manufactured or served, the equipment used in performing the job, the work environment, and the qualifications or licenses needed to perform the job (Ministry of Internal Affairs and Communications, n. d.). In the revised U.S. Occupational Classification (Cosca & Emmel, 2010), jobs were classified primarily according to the level of work performed and maybe took into account the education and training of the individual performing that particular job. For example, therapists belonged to a major group of health practitioners, a minor group of health diagnosing and treating practitioners, and a broad group of therapists. The broad group of therapists included physical, speech, occupational, recreational, radiation, and other therapists. They belonged to the same broad category since they perform similar jobs, but have different educational attainment or training. In contrast to the therapists, nurses, who also belong to the same major and minor groups as the therapists, have different broad categories due to different educational attainment and training.

It is imperative to understand the contribution of occupation to variances in cognition of older adults (Hauser, 2010). A study by Garibotto et al. (2008) showed the association of glucose metabolism in the brain and occupational status. Increases in brain metabolism observed using magnetic resonance imaging demonstrates increases in utilization of resources to achieve cognitive performance. They found lower occupational status such as unskilled or skilled laborers were associated with higher brain glucose metabolism compared to higher occupational status such as a senior academic or management position. To achieve similar cognitive performance, participants with a higher occupational status efficiently utilized brain resources to achieve cognitive performance. It seems that the more physical the work, higher brain metabolism will be observed. Fors, Lennartsson, and Lundberg (2009) performed a retrospective study on community and institutionalized older adults to find how manual and non-manual classifications of occupation in midlife affected the cognitive performance of older adults. Based on 970 participants, manual labor demonstrated a significant association to lower cognitive functioning in later stages of life. Instead of classifying occupation into manual and non-manual, Anttila and colleagues (2002) classified occupations into physical and sedentary to examine the risks of cognitive impairment among older adults. Although the study participants of Anttila et al.(2002) were much younger (65-79 years old) than Fors and colleagues (2009), they still found that those having physical occupations in midlife such as farming, animal husbandry, factory and construction work were at a higher risk of cognitive impairment in late-life stage. Thus, adults whose occupations in midlife involve a greater physical component are at a higher risk of lower cognitive performance and are predicted to utilize greater cognitive resources to maintain or achieve similar cognitive performance at later stages of their lives compared to adults with midlife jobs which entail a higher intellectual component.

Greater intellectual work may indicate that the job entails more complexity and control. Andel and colleagues (2007) measured job complexity in three dimensions: data, people, and things. Synthesizing data was more complex than simply comparing them. In contrast to data, mentoring or negotiating with another person had greater complexities than merely taking instructions. Lastly, setting up or precision working with things carried a higher job complexity than just handling things. Greater complexities on all three dimensions during adulthood were significantly associated with a higher cognitive performance in later stages of life even when adjusted for age, sex, and education. Later, Andel and colleagues (2011) evaluated the association of job control, cognitive performance, and the risks of cognitive impairment through a cross-sectional study. Job control was defined as the amount of personal judgment and assertiveness involved when working. After controlling for covariates such as age, sex, education, self-rated health, and midlife factors (depression and social activities), their study revealed that jobs demanding low control were associated with poorer cognitive performance and a higher risk of cognitive impairment than jobs demanding high control. Therefore, jobs involving greater decision making or control, and higher complexities in working with data, people, and things have cognitive benefits during late-life stage. However, studies only either measured occupations during midlife (Andel et al., 2007; Andel et al., 2011; Antilla et al., 2002; Fors et al., 2009) or defined occupations as the longest job they held (Antilla, et al., 2002; Karp, et al., 2004). To fully appreciate the effect of occupation on cognitive function, it is imperative to measure the full occupational history of older adults (Andel et al., 2011).

Lifestyle factors influence the cognitive functions of older adults. However, studies only examined one or two lifestyle factors and not in a lifetime perspective. There is no study in the literature which evaluated all the influences of lifestyle factors mentioned in a lifetime perspective to cognitive function of older adults.

Summary

Chapter II illustrated how lifestyle factors, namely: education, occupation, social, physical, and leisure activities are modified in each of the three life stages. Lifestyle factors influence cognitive reserve, which may affect how older adults express existence of cognitive impairment. However, studies on cognitive reserve lack a standardized instrument to measure its constructs. In assessing the construct of lifestyle factors in a lifetime perspective, the LEQ is the only known instrument available. The study on the LEQ, however, only used Australian participants and was tested only once. Therefore, to advance the cognitive reserve theory, an evaluation of the LEQ using a different population is essential.

CHAPTER III

METHODS

Design

The study used a descriptive, test-retest, correlational design. Test-retest data was gathered from the same selected participants of the study. A correlational design was utilized which assisted in the comprehension of the relationships or associations between variables under study (Polit & Beck, 2008). The study examined the reliability and validity of the Lifetime Experience Questionnaire (LEQ) among older American adults.

Setting and Sample

The study took place in a county in the Piedmont region, north-central North Carolina. From the population estimate based on year 2000 census, the county had an estimated 45,511 older adults in 2010 (North Carolina Division of Aging and Adult Services [NCDAAS], 2011a). From the total older adults of this county, 24.8% did not graduate from high school, 78.2% were Caucasians, and 19.6% were African Americans who comprised the majority of the minority population. Additionally, 31.4% of them lived alone, their median household income was $34,814, and 13.7% were actively in the work force (NCDAAS, 2011). Two senior centers with the designation of Centers for Excellence exist in the county (NCDAAS, 2010).

A convenience sample of 90 older adults from independent residential facilities, senior centers, and wellness centers were recruited. Differences in the means of the LEQ from older adults between the test (46.21) and the retest (52.92) from a pilot study conducted by the Principal Investigator (PI) was used to calculate an effect size and determine the sample size. A significance level of 0.05, 80% power, a mean difference of 6.71, a standard deviation of 20.16,

and an estimated effect size of 0.33, yielded a total of 75 participants. Allowing for a 20% attrition rate; however, changed the total number of participants to 90 in order to provide adequate power of the tests used in answering the research questions (Faul, Erdfelder, Lang, & Buchner, 2007).

Inclusion criteria were: (a) at least 65 years of age and older, (b) able to speak and read English, and (c) able to use one extremity for writing. The exclusion criteria were: (a) Geriatric Depression Scale-short Form score (GDS-SF) of 5 or higher, (b) head injury, (c) organic brain disorder as identified by participants and (d) a Mini-Mental State Exam (MMSE) score of below 23.

Recruitment

The study began after a full approval from the Institutional Review Board (IRB) of the University of North Carolina at Greensboro (UNCG). Senior and wellness centers, and independent residential facilities in the Piedmont triad area were accessed after permission was granted from the organizational leaders. Flyers were posted on each facility's bulletin areas. A face-to-face appointment at a place convenient for participants was scheduled for potential participants who were recruited from the flyers. Verification of inclusion and exclusion criteria was accomplished, including the administration of the GDS-SF and the MMSE. Consent was acquired from the participants meeting the inclusion criteria prior to answering the LEQ.

Data Collection

Self-administration data was gathered either at participants' homes or any convenient and private place agreed upon by the participants and the researcher. A two week appointment was scheduled after the initial completion of the questionnaire to retest the LEQ for 30 randomly selected participants. Twenty dollars was given to each participant after they answered the LEQ as a token of appreciation for their time.

Human Subjects Protection

Approval to conduct the study was obtained from the IRB of UNCG. The PI explained the study to the participants and answered any questions they had. The participants were informed about the protection of their identities and security of the data obtained. Written consent was obtained and a copy of the signed consent form was given to the participants. Protection of the participants' identities was accomplished through the use of identification numbers instead of their names. A password protected computer file was created for both the identification numbers linked with the master list and the collected data. Raw data from the questionnaires was kept in a locked file cabinet in the PI's home office.

Minimal risks were anticipated such as feelings of embarrassment from not being able to answer questions from instruments and mild fatigue from the surveys. Participants were reassured that (a) there was no time constraint in answering the questions and rest was important while answering the LEQ to avoid fatigue; (b) support was available if or when they were unable to understand questions; and (c) the study did not look for wrong answers.

Instruments

Age, gender, marital status, physical health problems, and number of medications was measured using a researcher developed demographic instrument (see Appendix A).

Lifetime Experience Questionnaire

The LEQ (see Appendix B) is an instrument that assesses the cognitive reserve construct which is a complex mental activity that develops through the lifespan (Valenzuela & Sachdev, 2007). The LEQ, developed in Australia, is composed of 42 closed and open ended questions which examine two dimensions: life stages and specific versus non-specific mental activities. A Likert-type scale is used to respond to most of the closed ended questions. The life stages include young adulthood (13 years old to 30 years old), midlife (30 years old to 64 years old), and

late-life (65 years old or from retirement until present time). Questions for specific versus non-specific mental activities are embedded in the dimension of life stages. The LEQ takes an average of 30 minutes to complete (Valenzuela & Sachdev, 2007). Appendix C explains the process of scoring the LEQ. Concurrent validity of the LEQ was demonstrated through the zero-order intraclass correlation between total LEQ and Cognitive Activities Scale (CAS) (r = .41, p < .001), and change in performance (r =.37, p = .003) (Valenzuela & Sachdev, 2007). The reliability of the LEQ was established through the examination of Cronbach's alpha (α) and test-retest reliability. Most of the life stages subscales had a Cronbach's α greater than .77 and the overall α was .66 (Valenzuela & Sachdev, 2007). The test-retest reliability of LEQ was significant (r = .98, p < .001) (Valenzuela & Sachdev, 2007). The LEQ was determined to be a reliable and valid instrument for the Australian population.

Mini-Mental State Exam

The MMSE, shown in Appendix D, was developed to assess global cognition and successive documentation of cognitive changes (Folstein, Folstein, & McHugh, 1975; Tombaugh & McIntyre, 1992). The MMSE is composed of two sections that can be evaluated in less than 10 minutes (Cockrell & Folstein, 1988; Folstein et al., 1975; Tombaugh & McIntyre, 1992). The first section of the tool contains five items which require a vocal response and measures orientation, attention, and memory (Cockrell & Folstein, 1988; Folstein et al., 1975; Tombaugh & McIntyre, 1992). The second section includes the last six items which examine the identification of objects, the ability to follow both verbal and written commands, and the ability to write sentences and copy a figure (Cockrell & Folstein, 1988; Folstein et al., 1975; Tombaugh & McIntyre, 1992). The items are summed with a cut-off score of 24, which means that if a participant scores below 24 points, cognitive impairment exists and warrants further cognitive examination (Cockrell & Folstein, 1988; Folstein et al., 1975; Tombaugh & McIntyre, 1992).

Different population groups according to age (Anthony, LeResche, Niaz, von Korff, & Folstein., 1982; Crum, Anthony, Bassett, Folstein 1993; Hensel, Angermeyer, & Riedel-Heller, 2007; McDowell, Kristjansson, Hill, & Hébert, 1997; Schultz-Larsen, Kreiner, & Lomholt , 2007a), socioeconomic status (Anthony et al., 1982; McDowell et al., 1997; Schultz-Larsen et al., 2007a), and racial or ethnic background (Anthony et al., 1982; Teresi et al., 1995) have been studied to assess the MMSE. The limitation of the MMSE is its association with age and education as previously discussed. Adjustments of the cut-off score may be necessary to accurately use the MMSE in different groups of individuals (Anthony et al., 1982; Schultz-Larsen, Lomholt, & Kreiner, 2007b).

Folstein et al. (1975) used the Mann-Whitney U test, the Wilcoxon T test, and a correlation coefficient to examine the psychometric properties of the MMSE. Subsequently, various statistical analyses have been used. Correlation coefficients (Barbarotto, Cerrri, Acerbi, Molinari, & Capitani, 2000; Crum et al., 1993; Hensel et al., 2007) and analysis of covariance (McDowell et al., 1997) were utilized to examine the MMSE with other variables. Item analyses including assessment of dimensionality were assessed using factor analysis (Teresi et al., 1995) and receiver operating characteristics (Schultz-Larsen et al., 2007a). Statistical analyses using both parametric and nonparametric tests have been employed to analyze the psychometric properties of the MMSE. Although the MMSE has been used widely and in different languages (Nguyen, Black, Ray, Espino, & Markides, 2002; Yamashita et al., 2007), issues regarding reliability and validity still exist which have led to the development of different versions (Teng & Chui, 1987; Schultz-Larsen et al., 2007b). The following subsections evaluate the MMSE's reliability, validity, responsiveness, sampling and statistical analyses, strengths, and weaknesses.

Reliability is the property of an instrument to consistently measure an attribute being studied (Polit & Beck, 2008; Vogt, 2005). Evaluation of the internal consistency, test-retest

reliability, and inter-rater reliability assess the reliability of the MMSE. Internal consistency is the extent to which the items of an instrument are correlated to measure the same attribute or dimension (Polit & Beck, 2008; Vogt, 2005). The Cronbach's α, which measures the inter-item correlation and estimates the proportion of variance in all the items (Gliner & Morgan, 2000; Vogt, 2005), showed a coefficient of .54 - .78 (Jorm, Scott, Henderson, & Kay, 1988; Mcdowell et al., 1997). However, Cronbach's α may not necessarily measure the homogeneity of the MMSE (Gliner & Morgan, 2000), and if an instrument is measuring more than one dimension, then using Cronbach's α may underestimate the internal consistency (Lopez, Charter, Mostafavi, Nibut & Smith, 2005). The MMSE is said to measure five cognitive domains: orientation, recall, registration, attention-calculation, and language (Folstein et al., 1975). Using the Gilmer-Feldt procedure, which assesses internal consistency when there are more than three domains, the internal consistency coefficient of the MMSE was .76 when using the item of serial 7's or alternatively, .79 when using the word "world" (Lopez et al., 2005). Another method of assessing the internal consistency of the MMSE is using the split-half method. The split-half method measures the correlation of the halves of the MMSE (Gliner & Morgan, 2000) which showed a coefficient of .76 (Mcdowell et al., 1997). Evaluating the coefficients from Cronbach's α, Gilmer-Feldt procedure, and split-half method, the MMSE demonstrated a strong internal consistency (Cohen, 1998).

Test-retest reliability measures the correlation of test scores when administered more than once on the same subject (Gliner & Morgan, 2000; Vogt, 2005). The 24-hour test-retest reliability of the MMSE was .89 on individuals with various types of depressions (Folstein et al., 1975), .85 when individuals do not have dementia or delirium, .90 with dementia and .56 with delirium (Anthony et al., 1982). A low test-retest reliability of MMSE is observed when used on patients with delirium since delirium is characterized by fluctuating courses (Anthony et al.,

1982). The MMSE demonstrated a high reliability in different health conditions with the exception of delirium.

Inter-rater reliability measures the degree to which different observers judge an attribute or phenomena identically (Gliner & Morgan, 2000; Vogt, 2005). Two studies, although seven days apart determined the inter-rater reliability of the MMSE to be .82 (Folstein et al., 1975; Anthony et al., 1982). Examining the internal consistency, test-retest reliability, and inter-rater reliability of the MMSE showed that the MMSE is a reliable instrument to measure global cognitive function. However, its accuracy still needs to be evaluated.

In contrast to reliability, validity is the property of an instrument which accurately measures an attribute (Koretz & Reuben, 2003; Polit & Beck, 2008; Vogt, 2005). A panel of experts assessed the presence of face and content validity of the MMSE (Folstein et al., 1975). The validity of the MMSE is carefully discussed utilizing criterion-related and construct validity and examining item bias. Criterion validity was used to infer the result of the MMSE to another criterion and has two categories: predictive and concurrent validity (Gliner & Morgan, 2000; Waltz, Strickland, & Lentz, 2005). Concurrent validity was examined using the Wechsler Adult Intelligence Scale (WAIS) and physiological measures such as apolipoprotein (APOE). The MMSE showed a correlational coefficient of .78 and .66 for the WAIS' verbal IQ category and performance category, respectively (Folstein et al., 1975). Carriers of APOE, a protein which increases the risk of developing Alzheimer's disease, were noted to have a significant decline in visio-spatial construction and naming items of the MMSE (Ercoli, Siddarth, Dunkin, Bramen, & Small, 2003). No study was found that evaluated the predictive category of criterion-related validity. Criterion validity showed the MMSE as a valid instrument to measure cognitive function. Criterion validity is simpler to assess than construct validity.

Construct validity examines how the construct of a theory is operationally defined (Vogt, 2005, Waltz, Strickland, & Lenz, 2005). Construct validity is assessed by convergent, discriminant and factorial evidence (Gliner & Morgan, 2000). Hill and Bäckman (1995) studied the convergent validity of the MMSE among cognitively intact older adults. Factor analysis showed a three factor loading for the MMSE: recall, attention, and calculation loaded on first factor; items on orientation to place and time and copy design loaded on a second factor; and items on three-stage verbal command and writing a sentence loaded on a third factor. Moreover, the items on registration, the first two items of language and the written command did not contribute to the assessment of episodic memory and visio-spatial ability. Therefore, when evaluating cognitively intact older adults, these items may be spared, thereby reducing the amount of administration time (Hill & Bäckman, 1995). Discriminant validity is evident when different scores are obtained from contrasted groups (Waltz et al., 2005). A study by Folstein et al. (1975) found that participants with depression had a mean MMSE score of 25.1 while participants with both depression and cognitive impairment had a mean MMSE score of 19.0. The results demonstrated the MMSE can discriminate cognitive impairment among individuals with depression and therefore has discriminant validity.

In addition to content, construct, and criterion validity, the analysis of items of the MMSE are examined to ensure each item measures the same attribute through statistical analyses such as differential item function (DIF) and factor analysis (Vogt, 2005; Waltz et al., 2005). Item response theory (IRT) uses DIF, which assumes that different groups with the same abilities will have similar scores (Vogt, 2005; Waltz et al., 2005). A study by Schultz-Larsen and colleagues (2007a) found a significant DIF (90, $p < .001$) among the items of the MMSE which may mean a presence of potential item bias (Waltz et al., 2005). The items "identifying state location," reading and obeying "close your eyes," and "sentence writing" were found to be racially as well

as educationally biased by requiring literacy (Teresi et al., 1995). The two items repeating the three words “apple, table, penny” and “folding a paper” were found to be educationally biased (Teresi et al., 1995). The item “serial 7’s” was easier for Caucasians than African Americans and Hispanics (Teresi et al., 1995). The overall validity of the MMSE is respectable, however, item bias exists which may result in an overall test bias which can affect its sensitivity and specificity.

Sensitivity refers to the ability of the MMSE to identify cognitive impairment among those who have cognitive impairment (Newman, Browner, Cummings & Hulley, 2007; Vogt, 2005). The sensitivity of the MMSE depends on the cut-off score utilized (Anthony et al., 1982; McDowell et al., 1997: Schultz-Larsen et al., 2007a). The sensitivity of the MMSE is .63 - .87 when the standard cut-off score of 24 is utilized (Anthony et al., 1982; McDowell et al., 1997; Schultz-Larsen et al., 2007a) and .70 when using a cut-off score of 21 (Anthony et al., 1982). The characteristics of the study population also affect the cut-off score. A study by Anthony et al. (1982) demonstrated that with a standard cut-off score of 24, the sensitivity of the MMSE when used among adults less than 60 years old is .71 while in older adults 65 years old and over it is .94. The sensitivity of the MMSE among study participants with less than eight years of education is .92 compared to .71 for those having more than eight years of educational years and employing a cut-off score of 24 (Anthony et al., 1982). The higher sensitivity of the MMSE among older adults and having less than eight years of education reveals a floor effect of the MMSE (Schultz-Larsen et al., 2007a). In contrast, adults less than 60 years of age with longer educational years are prone to ceiling effect (Crum et al., 1993). Adjusting the sensitivity of the MMSE will have an inverse relationship with specificity which means a higher sensitivity yields a lower specificity (Anthony et al., 1982).

Specificity refers to the ability of the MMSE not to detect cognitive impairment among the populations that do not have cognitive impairment (Newman et al., 2007; Vogt, 2005).

Employing the cut-off scores of 21, 24, and 25, the specificity of MMSE is .93 (Anthony et al., 1982), .82 - .89 (Anthony et al., 1982; McDowell et al., 1997) and .77 (McDowell et al., 1997), respectively. The characteristics of the study population also affect the specificity of the MMSE. The specificity of the MMSE with a cut-off score of 24 when used among adults who were less than and greater than 60 years old was .92 and .65, respectively. The length of educational experience affects the specificity of the MMSE such that its specificity among individuals with less than eight years of education (.63) was lower than the individuals with higher educational attainment (1.0) (Anthony et al., 1982) Therefore, individuals that are older than 60 years old and have less than eight years of education will have as much as a 39.4% chance of an incorrect diagnosis of cognitive impairment (Anthony et al., 1982). Therefore, the MMSE should be applied with caution to the elderly and individuals with low educational attainment by adjusting the cut-off score to increase sensitivity or specificity.

The weaknesses of the MMSE come from its validity. The MMSE is associated with age (Anthony et al., 1982; Crum et al., 1993; Hensel et al., 2007; McDowell et al., 1997; Schultz-Larsen et al., 2007a) and education (Anthony et al., McDowell et al., 1997: Schultz-Larsen et al., 2007a) such that these variables produce different sensitivities and specificities (Anthony et al., 1982). A ceiling effect is observed in MMSE with lower sensitivity (Crum et al., 1993) and the opposite is seen for the floor effect (Schultz-Larsen et al., 2007a). A floor effect is observed with individuals who have low educational attainment and advanced age while the opposite is observed in a ceiling effect (Schultz-Larsen et al., 2007a). Therefore, older adult populations with lower educational attainment such as African Americans (U. S. Census Bureau, American Factfinder, n. d.) are at risk of receiving lower scores with the MMSE.

Geriatric Depression Scale-Short Form

Older adults have increased risks of developing depression as they progress in age (Okura et al., 2010). Depression may have a similar clinical presentation as cognitive impairment (Tsuno & Homma, 2009). The Geriatric Depression scale (GDS) was developed by Yesavage and colleagues (1982) to screen for depression without assessing somatic complaints among the older adult population. The GDS is a 30-item scale with a dichotomous answer of 'yes' or 'no' for each item. Items will be summed. A cut-off score of 11 provides a specificity of 95% and sensitivity of 84%; therefore, a score greater than 10 was established to contribute in the diagnosis of depression (Brink et al., 1982). Its alpha coefficient of .94, split-half reliability of .94, and test-retest reliability of .85 demonstrate an excellent reliability (Yesavage et al., 1982). A high correlation with the Research Diagnostic Criteria for depression showed concurrent validity (Yesavage et al., 1982).

Since older adults are susceptible to fatigue and poor concentration, a shorter version of the GDS (GDS-SF) (see Appendix E) was developed (Yesavage & Sheikh, 1986). Similar to the original GDS, the short form has a "yes" or "no" answer for each of the 15 items. Of the 15 items, positive answers for 10 items and negative responses for the other 5 items point to depression (Yesavage & Sheikh, 1986). Older adults from various settings participated in examining the effectiveness of the GDS-SF in screening for depression.

Since its inception, the GDS-SF has been studied with sample sizes ranging from 20 (Cwikel & Ritchie, 1989) to 4,253 (Nyunt, Fones, Niti, & Ng, 2009) older adults of various nationalities (Bijl, van Marwijk, Adér, Beekman, & de Haan, 2006; Boey, 2000; Chachamovich, Fleck, & Power, 2010; Isella, Villa, & Appollonio, 2002; Mui, 1996; Nyunt et al., 2009; Smallbrugge, Jongenelis, Pot, Beekman, & Eefsting, 2008; Zalman, Aizenberg, Sigler, Nahoni, & Weizman, 1998). Furthermore, the study participants of Yesavage & Sheikh (1986) were from

unspecified communities and various treatment settings; but since then, the GDS-SF had been evaluated in settings such as long-term care facilities (Aikman, & Oehlert, 2001; Lelito, Palumbo, & Hanley, 2001; Smallbrugge et al., 2008; Nyunt et al., 2009), acute care environments (Wall, Lichtenberg, Macneill, Walsh, & Deshpande, 1999), senior centers (Mui, 1996; Nyunt et al., 2009), congregate meal sites (Mui, 1996), adult day care centers (Nyunt et al.,2009), and in clinical general practice areas (Bijl et al., 2006). Study participants included older adults with (Bijl et al., 2006; Isella et al., 2002; Smallbrugge et al., 2008; Wall et al., 1999) and without cognitive impairment (Bijl et al., 2006; Chiang, Green, & Cox, 2009; Friedman, Heisel, & Delavan, 2005; Ingram, 1996; Nyunt et al., 2009; Wall et al., 1999; Yesavage & Sheikh, 1986), needed assistance with the activities of daily living (Chiang et al., 2009; Iglesias, 2004; Smallbrugge et al., 2008), and who were physically active (Ingram, 1996). The diverse characteristics of the study participants and settings were used to study the psychometric properties of the GDS-SF.

The initial modification of the GDS to GDS-SF by Yesavage & Sheikh (1986) had only 35 study participants and limited its psychometric evaluation by their correlation ($r = .84$, $p < .001$); however, subsequent studies further showed its reliability and validity. Reliability of the GDS-SF was examined utilizing Chronbach's α, inter-item correlation, and test-retest. The Cronbach's α ranged from .75 (Friedman et al., 2005) to .83 (Chiang et al., 2009; Iglesias, 2004). The inter-item correlation was .80 -.82 (Iglesias, 2004). Finally, the test-retest revealed a correlation of .67 (Ingram, 1996). The validity of the GDS-SF was demonstrated using concurrent and divergent validity. Several studies showed that the GDS-SF had a high correlation with GDS (Aikman et al., 2001; Ingram, 1996; Wall et al., 1999; Yesavage & Sheikh, 1986) that ranged from .84 (Yesavage & Sheikh, 1986) to .91 (Aikman et al., 2001). Concurrent validity with other instruments such as the Mini-International Neuropsychitric Interview ($r = .42$,

p <0.001) (Friedman et al., 2005), Zung Self-Rating Depression scale (r = .761, p < 0.01) (Iglesias, 2004), Hamilton Depression Rating scale (r = .79, p < .005) (Zalman et al., 1998), Geriatric and Extended Careline Depression Screen (r = .72, p < .01) (Lelito et al., 2001), and Life Satisfaction scale (r = .43, p < .001) (Friedman et al., 2005) was demonstrated by the GDS-SF. Likewise, the divergent validity was established by the assessment of the relationship between the GDS-SF and the Dementia Rating scale (r = -0.22, p < .001) (Wall et al., 1999). Thus, the GDS-SF seems to be a reliable and valid instrument to screen for depression among older adults.

In addition to the concurrent and divergent validity of the GDS-SF, two studies used Rasch analysis (Chiang et al., 2009), and the traditional factorial analysis (Freidman et al., 2005) to inspect its dimensionality. Chiang et al. (2009) included 177 cognitively intact older American adults to show the GDS-SF to be unidimensional (dimensionality coefficient of 0.94) using Rasch analysis. In contrast to the study of Chiang et al. (2009), Friedman and colleagues (2005) used exploratory factorial analysis to analyze the dimensionality of the GDS-SF. Their study found five factors that may account for 54% of the variance in the construct. The first factor only accounted for 23.7% variance while two factors (depression and positive affect) accounted for 33% variance. Commonly endorsed items by different groups accounted for the factors (Nunnnaly & Bernstein, 1994). An item in a test may have a different discrimination or meaning from different groups of individuals, therefore, yielding different responses (Nunnally & Bernstein, 1994). The analysis of the variances may be achieved through differential item functioning (DIF). The DIF of the GDS-SF revealed that four items of the GDS-SF probably contributed to a misfit (Chiang et al, 2009). The study participants of Friedman et al. (2005) were dominately Caucasians from New York. Participants may have immigrated from other countries and placed different understandings to the items of the GDS-SF (Chachamovich & Power, 2010;

Cwikel & Ritchie, 1989; Mui, 1996). In contrast to the study of Freidman et al. (2005), Chiang and colleagues (2009) had a more homogenous population that may have resulted in a unidimensionality of the GSD-SF.

Further analysis of the accuracy of the GDS-SF involves sensitivity and specificity. Older African Americans dominated (70%) the study of Wall et al.(1999) that showed a sensitivity of 93.8% and a specificity of 90.1% for cognitively intact participants, while a sensitivity of 71.6% and specificity of 94.4% resulted from cognitively impaired participants. For a more heterogenous sample, a sensitivity of 78.6 % and a specificity of 67.2% was demonstrated (Bijl et al., 2006). Furthermore, utilizing a cut-off score of 5 resulted in a higher sensitivity (89.5%) than a cut-off score of 6 (81.45%). In contrast to sensitivity, the specificity was lower when a cut-off score of five (65.3%) was used rather than a cut-off socre of 6 (75.36%) (Friedman et al., 2005). Thus, the sensitivity of the GDS-SF is much higher when participants belong to a homogenous group, are cognitively intact, and a cut-off score of 5 is employed. Therefore, upon examination of reliability and validity of the GDS-SF including its dimentionality, specificity, and sensitivity; it appears to be an excellent instrument to screen older adults for depression.

Data Analysis

Descriptive statistics were used to determine the means, standard deviations, percentages and frequencies of variables. Univariate analysis for checking the normality of continuous variables such as age and the MMSE evaluated using box plot, Q-Q plot, and the Kolmogorov-Smirnov test.

Specific aim #1: Examine the reliability of the LEQ.

Q1. What is the correlation of the items, subscales, and total scores of the LEQ at two separate time points (week 1 and week 3)?

A paired t-test was used for the test-retest reliability of the LEQ.

Q2. What is the internal consistency of the items of the LEQ?

The Cronbach's α and the Spearman Rho were used to examine the internal consistency of the LEQ. The Spearman Rho assessed the magnitude and direction of relationships between the item-subscale, item-total LEQ score, subscale-subscale, and subscale-total LEQ score.

Specific aim #2. Examine the concurrent and construct validity of the LEQ.

Q3. What is the correlation between the LEQ and the MMSE?

The Pearson's r correlation examined the strength of the linear relationship between the LEQ and the MMSE.

Q4. Is there a difference in MMSE scores between the groups of older adults with high and low LEQ scores?

An indicator variable for the LEQ below the mean score was created. The study participants who had an equal or greater than the LEQ score mean belonged to the high LEQ score group. Then Analysis of Variance (ANOVA) examined the differences between the LEQ and the MMSE scores.

Q5. What are the different dimensions of the LEQ?

Exploratory factor analysis (EFA) was utilized to examine the dimensionality of the LEQ. Prior to EFA, a Kaiser-Meyer-Olkin statistic was done to assess the sampling adequacy (Polit, 1996). Inclusion criteria for extraction of factors included: (a) an eigenvalue equal to or greater than 1 (Polit,

1996), (b) factor loading of .40 (Rencher, 2002), (c) a break in the linearity on scree plot (Figure 1) (Polit, 1996), (d) total variance equal to or greater than 70%, and (e) items should only load on one factor. Analyses was performed in PASW 18.

Summary

The study used a descriptive, test-retest, correlational design to examine the reliability and validity of the LEQ among older American adults. The study began after a full approval from UNCG. A convenience sample of 90 older adults from independent residential facilities, senior and wellness centers were recruited from a county in the Piedmont region, north-central North Carolina. Verification of inclusion and exclusion criteria was accomplished, including the administrations of the GDS-SF and the MMSE. Consent was acquired from the participants meeting the inclusion criteria prior to answering the LEQ. Self-administration data was gathered either at participants' homes or any convenient and private place agreed upon by the participants and the researcher. A two week appointment was scheduled from the initial completion of the questionnaire to retest the LEQ for 30 randomly selected participants. Five research questions were answered to achieve two specific aims using a paired t-test, Cronbach's α, Spearman Rho, Pearson's r correlation, ANOVA, and an exploratory factor analysis. Analyses were performed in PASW 18.

CHAPTER IV

RESULTS

The Lifetime Experience Questionnaire (LEQ) (Appendix B) is the first instrument which operationally defined the contribution of various mental activities from young adulthood to the late-life stage of an individual. The Australian version of the LEQ has 42 items; however, only 36 items were scored. Furthermore, several phrases and words may not be applicable to older American adults. Therefore, the American version of LEQ was reduced to 36 commensurate items and some words and phrases (Table 2) were modified.

Table 2. Modification of Words and Phrases between Australian and American Versions of the LEQ

Items	Australian Version	American Version
Specific questions		
Young adulthood stage		
Item 1	"How many years of High School (i.e. *secondary school or grades after Year 6*) did you complete?"	"How many years of High School (i.e. ***grades after year 8***) did you complete?"
Item 3		
Under the column of "Type of Courses"	"Other Technical Courses"	"Other Technical Courses ***or Associate degree***"
	"*University Undergraduate***"**	"***Bachelors degree***"
	"*University* Masters"	"***Masters degree***"
	"*University* Phd/Doctorate	"***Phd degree***"
Midlife stage		
Item 1	Presence of column for "Job Classification"	Deleted the column on "Job Classification"
Late-life stage		
Item 1b	Presence of choices for occupation classification	Participants were instructed to write the occupational title
Non-specific questions		
Choice of answer	"*Fortnightly*"	"***Every two weeks***"

Note: Italicized words were changed to bolded italicized words.

The 36 items of the LEQ belonged to three stages (subscales) and two specificities under each stage. The three stages included: (1) young adulthood, (2) midlife, and (3) late-life. Each of the life stages were composed of specific and non-specific items. Each of the young adulthood and midlife stage had two specific questions which focused on education and occupation, respectively. The late-life stage had nine specific questions which concentrated on occupation and various physical and social activities. Compared to specific items, the same seven non-specific items were present in all three life stages that asked social, physical, and reading activities, artistic pastime, practice of a second language or a musical instrument, and places traveled. Appendix C showed how the LEQ scores were obtained for each of the study participants.

The original version of the LEQ was tested only once in Australia. Therefore, prior to its utilization, its psychometric properties were examined for the older American adults. This chapter describes the demographic characteristics of study participants and provides answers to research study questions.

Demographic Characteristics

Study participants were recruited from a Piedmont County in north central North Carolina. As presented in Table 3, more than a third of the study participants were recruited through a snowball method in the communities. They were either referred by study participants or had seen the posted flyers during their visits at the recruitment sites. The participants from the senior and community centers contributed almost half (44.4%) of the total number of study participants, while the participants from a senior day care center, who were caregivers of demented individuals, provided the least contribution (3.3%).

Table 3. Study Participants' Affiliation, N = 90

Affiliation	N (Percentage)
Snowball/No affiliation	32 (35.6)
Senior center #1	17 (18.9)
Senior center #2	16 (17.8)
Independent living	
Community	11 (12.2)
Apartment complex	4 (4.4)
Community center	4 (4.4)
Senior center #3	3 (3.3)
Senior day care	3 (3.3)

Table 4 describes the demographic characteristics of the study population. The age range of study participants was from 65 to 94 years old, with a mean age of 75.98 years (*SD* = 7.05). The majority of study participants were female (78.9%), highest level of education was high school (36.7%) widowed (45.6%), hypertensive (62.2%), and had total household income below $50,000 (66.3%).

Table 4. Demographic Characteristics of Older American Adult Participants, N = 90

Demographic characteristics	Mean(SD)	N (Percentage)
Age	**75.98±7.05**	
Gender		
Female		**71 (78.9)**
Male		**19 (21.1)**

Race	
African American	**38 (42.2)**
Caucasian	**51 (56.7)**
Hispanic	**1 (1.1)**
Marital status	
Single	**7 (7.8)**
Married	**33 (36.7)**
Divorced	**9 (10)**
Widowed	**41 (45.6)**
Educational level	
Less than high school	**13 (14.6)**
High school/GED	**30 (33.7)**
Technical/Associate degree	**3 (3.4)**
College level	**13 (14.4)**
Bachelor's degree	**15 (16.7)**
Graduate degree	**15 (16.7)**
Household income	
Less than $15,000	**23 (25.8)**
Less than $25,000	**16 (18)**
Less than $50,000	**20 (22.5)**
Less than $75,000	**14 (15.7)**
Less than $100,000	**14 (15.7)**
More than $100,000	**2 (2.2)**
Total number of health problems	
Hypertension	**56 (62.2)**
Diabetes	**19 (21.1)**
Arthritis	**22 (24.4)**
High cholesterol	**17 (18.9)**
MMSE	**27.32±2.11**
LEQ	**50.31±29.53**

Note. MMSE = Mini-Mental State Examination; LEQ = Lifetime Experience Questionnaire

Research Questions

Two specific aims were developed to examine the psychometric properties of the American version of the LEQ.

Research questions were formed under each specific aim.

Specific aim #1. Examine the reliability of the LEQ.

Research Question 1. What is the correlation of the items, subscales, and total score of the LEQ on two separate time points?

The paired t-test was used to measure the temporal stability of the LEQ. The LEQ was administered to 30 randomly selected study participants approximately two weeks after its initial administration. No self-identified significant life events or changes occurred between the two time points of test administration.

Table 5 shows the test-retest reliability of the three subscales and the total score of the LEQ. In contrast to the means of the young adulthood subscale ($p = .87$) and late-life subscale ($p = .07$) that were not statistically significantly different for the two time points, the means of midlife subscale ($p < .001$) and the total LEQ score ($p < .001$) were significantly different from the initial test (Time 1) to the retesting (Time 2) (Table 5). The correlation coefficient can be classified as: (a) very high (.90 to 1.0), (b) high (.70 to .80), (c) moderate (.50 to .69), (d) low (.26 to .49), and (e) minimal to very low (.00 to .25) (Munro, 2005, p.249). A coefficient of .70 is desirable to establish test and retest reliability (Polit, 1996). The test-retest reliability of each subscale and the total score of the LEQ had a significantly high to very high test-retest reliability; therefore, it had acceptable temporal stability.

Table 5. Descriptive Statistics of Time 1 and Time 2 and Test-retest Pearson's r Correlation of Subscales and Total Score of the LEQ, N = 30

	Time 1				Time 2			
	Young Adulthood	Midlife	Late-Life	Total LEQ score	Young Adulthood	Middle Adulthood	Late-Life	Total LEQ score
M	36.48	38.73	31.03	53.51	36.75	28.85	32.60	44.41
SD	14.17	11.60	7.19	32.31	13.66	9.61	7.72	30.71
Test-retest correlation	.79**	.91**	.81**	.93**				

Note: LEQ = Lifetime Experience Questionnaire; **$p < .01$

Research question 2. What is the internal consistency of the LEQ?

The Spearman Rho was used to examine the internal consistency of the LEQ items with magnitude and direction of relationships between the item-subscale, item-total LEQ score, subscale-subscale, and subscale-total LEQ score. The relationships showed how each item contributed to each subscale and total LEQ score (internal consistency).

Item to Subscale Correlations

The evaluation criterion for item-subscale correlation is .50 to .65 (Nunnally & Bernstein, 1994). The specific items, *Years in high school* ($r = .35$, $p < .01$) and *Post high school education* ($r = .92$, $p < .01$), under the young adulthood subscale had positive, significant item-subscale correlations (Appendix G, Table 1). In contrast to the young adulthood stage, the specific items, *Job* ($r = .65$, $p < .01$) and *Supervisory* ($r = .58$, $p < .01$), in the midlife subscale had positive, moderate, significant item to subscale correlation (Appendix G, Table 3). The specific items of the late-life subscale, *Entertainment* ($r = .54$, $p < .01$) and *Typical day activities* ($r = .69$, $p < .01$), had correlation coefficients greater than .50 (Appendix G, Table 5). The majority of the specific items of the LEQ failed to meet criteria for item-subscale correlation.

In contrast to the item to subscale correlations of specific items, the correlation coefficients of the non-specific items of the LEQ were lower. All the non-specific items in young adulthood subscale had low (r = .24 - .47, p < .05) positive, significant item to subscale correlations except the items *Physical activity* (r = -04, p > .05) and *Socialization* (r = .10, p > .05) (Appendix G, Table 2). The non-specific items that composed the midlife (r = .26 - .47, p < .05) (Appendix G, Table 4) and late-life (r = .36 - .43, p <.01) (Appendix G, Table 6) subscales had low to moderate, positive, significant item to subscale correlations. The non-specific item of the midlife subscale, *Language* (r =.51, p < .01) was able to reach the criteria for item-subscale correlation. Except the item, *Language*, all of the item-subscale correlations of non-specific items of the LEQ did not reach the criteria for item-subscale correlation.

Item to Total Correlations

The evaluation criterion for item-total correlation is ≥ .30. The specific items *Years in high school* (r = .29, p < .01) and *Post high school* (r = .71, p < .01) (Appendix G, Table 1) had low to high, positive, significant item to total correlations. The specific items, *Job* (r = .59, p < .01) and *Supervisory* (r =.48, p < .01), under the midlife subscale had moderate, positive, significant item to total correlations (Appendix G, Table 3). Eight out of nine items of the late-life subscale had low to moderate, positive, significant item to total correlations (r = .26 - .47, p < .05) (Appendix G, Table 5). The specific item, *Companionship*, had relatively the lowest and non-significant item to total correlation (r =.13, p > .05) in the late-life subscale. The specific items of the late-life subscale, *Companionship* and *Social club* (r = .26, p < .05), and the young adulthood subscale, *Years in high school*, failed to meet the criteria for item-total correlation.

Similar to specific items, the majority of the non-specific items of the LEQ met the criteria of item-total correlation (Nunnally & Bernstein, 1994). Non-specific items which had below .30 item-total correlation coefficients include: (1) *Socialization* (r = .19, p > .05) and

Physical activities (r =.02, p > .05) of the young adulthood subscale (Appendix G, Table 2), (2) *Physical activities* (r = .18, p > .05) of the midlife subscale (Appendix G, Table 4), and *Socialization* (r = .22, p < .05), *Artistic pastime* (r = 21, p < .05), and *Physical activities* (r = .20, p > .05) of the late-life subscale (Appendix G, Table 6). The non-specific item, *Physical activities*, consistently failed to meet the criteria for item-total correlation. Thus, majority of the items of the LEQ met the item-total correlation criteria.

Subscale to Subscale and Subscale to Total Correlations

An acceptable subscale to subscale correlation is .40 to .65 (Nunnally & Bernstein, 1994). Table 6 shows moderate to very high, significant, positive correlation between the different subscales of the LEQ except the correlation between the stages of young adulthood and late-life (r = .41, p < .01). The three subscales of the LEQ had desirable subscale to subscale correlations.

The evaluation criterion for subscale to total correlation is ≥ .55 (Nunnally & Bernstein, 1994). The three subscales of the LEQ were highly correlated to the total LEQ score; however, the midlife subscale had a higher correlation (r = .90, p < .01) than the young adulthood (r = .86, p < .01) and the late-life (r = .71, p < .01) stages. Thus, the correlations of the subscale to subscale and subscale to total score have acceptable internal consistencies (Table 6).

Table 6. Spearman Rho Correlation of Subscale to Subscale and Subscale to Total Score of LEQ, N = 90

Subscales (Stages)	1	2	3	4
1. Young adulthood	***.28***	.68**	.38**	.87**
2. Midlife		***.45***	.62**	.91**
3. Late-life			***.63***	.70**
4.Total score				***.65***

** p < .01; ***Bold italics*** = Cronbach's alpha coeffcient

The Cronbach's alpha coefficient also characterizes the internal consistency of an instrument. An instrument should have at least .60 Cronbach's alpha coefficient (Heath & Martin, 1997), however, Nunnally and Bernstein (1994) proposed at least a .70 Cronbach's alpha coefficient for a newly developed instrument. Thus, a Cronbach's alpha of less than .60 may have low internal consistency or may be measuring multiple dimensions. The Cronbach's alpha coefficients of the different subscales of the LEQ ranged from .28 to .63 (Table 6). The 36 item LEQ questionnaire has a Cronbach's alpha of .65. Therefore, the Cronbach's alpha coefficients show that the subscales of the LEQ measures different dimensions; however, the total items of the LEQ may be measuring one attribute.

Specific aim #2: Examine the concurrent and construct validity of the LEQ.

Research question 3. What is the correlation between the LEQ and the Mini-Mental State Exam (MMSE)?

The Pearson's r correlation examined the strength of the linear relationship between the LEQ and the MMSE. The MMSE measures global cognition (Folstein, Folstein, & McHugh, 1975; Tombaugh & McIntyre, 1992). Since the LEQ considers the different activities in a lifespan of an individual which affect them mentally, then the presence of a relationship between the MMSE and the LEQ may provide concurrent validity for the LEQ.

The study participants had a mean MMSE score of 27.32 (SD = 2.11) while the mean of the LEQ was 50.31(SD = 29.53) (Table 3). In addition, the standard error measurement of the LEQ was 22.44. The LEQ had a low positive correlation with the MMSE (r = .19, p = .08). The analysis of the association of the 11 items of the MMSE and the LEQ score revealed that the item, *Orientation to place*, had relatively the highest and significant correlation (r = .25, $p < .05$) (Appendix H).

Research question 4. Is there a difference in the MMSE scores between the groups of older adults with high and low LEQ scores?

To answer research question 4, the LEQ score mean (50.31) was used to initially divide the study population into two groups. The study participants who had equal or greater than the LEQ score mean belonged to the high LEQ score group. Analysis of Variance (ANOVA) was used to further explore the concurrent validity of the LEQ with the MMSE by assessing the MMSE score differences among the groups of the study participants based on the LEQ score. The high LEQ score group (M = 27.52, SD = 2.07) had a greater MMSE score than the low LEQ score group (M = 27.11, SD = 2.16) (Table 7). The group difference on the MMSE score, however, was not significant, F (1, 88) = .837, p = .36 (Table 8). Analysis of the effect size, which assesses the strength of relationship between the MMSE and the LEQ groups (Polit, 1996), was .10. Criteria for effect size include: .10 =small, .25 = medium, and .40 = large (G*Power Version 3.1.2). Thus, the effect size of the data was low.

Table 7. Mini-Mental State Examination Score Means for High and Low LEQ groups, N = 90

LEQ groups	*n*	*M*	*SD*	Minimum value	Maximum value
High LEQ	44	27.52	2.07	24	30
Low LEQ	46	27.11	2.16	23	30

Table 8. ANOVA for MMSE Score by High and Low LEQ groups, N = 90

Source	*df*	Sum of squares	Mean squares	*F* Ratio	*p*-value
Between	1	3.75	3.75	.837	.36
Within	88	393.91	4.48		
Total	89				

Research question 5. What are the different dimensions of the LEQ?

Exploratory factor analysis (EFA), a data reduction technique, was utilized to examine the dimensionality of the LEQ. The LEQ is composed of several items that belong to different dimensions, which together should measure one attribute. Inclusion criteria for extraction of factors included: (a) an eigenvalue equal to or greater than 1 (Polit, 1996), (b) factor loading of at least .40 (Rencher, 2002), (c) a break in the linearity on scree plot (Figure 2) (Polit, 1996), (d) total variance equal to or greater than 70%, and (e) items should only load on one factor. Prior to EFA, a Kaiser-Meyer-Olkin (KMO) statistic was done to assess the sampling adequacy (Polit, 1996). A score of greater than .50 for a KMO test meant an adequate sample (Polit, 1996). The KMO score for the study was .61 which suggested sampling adequacy. Factor analysis utilized the principal axis factoring method and an oblique promax rotation that allowed for correlated factors. The first run of EFA resulted in items: (1) *High school*, (2) *Late-life (LL) volunteer*, (3) *Supervisory*, and (4) *LL education bonus* having factor loadings less than .40. The four items were removed. The second run of EFA produced items (*LL job and LL companionship*) loading on two factors which resulted in their removal from the analysis. The third run of the EFA resulted in a factor which was composed of items *LL reaching out* and *Education bonus* which were not congruent with each other. Prior to the final run of EFA, the items *LL reaching out* and *Education bonus* were removed.

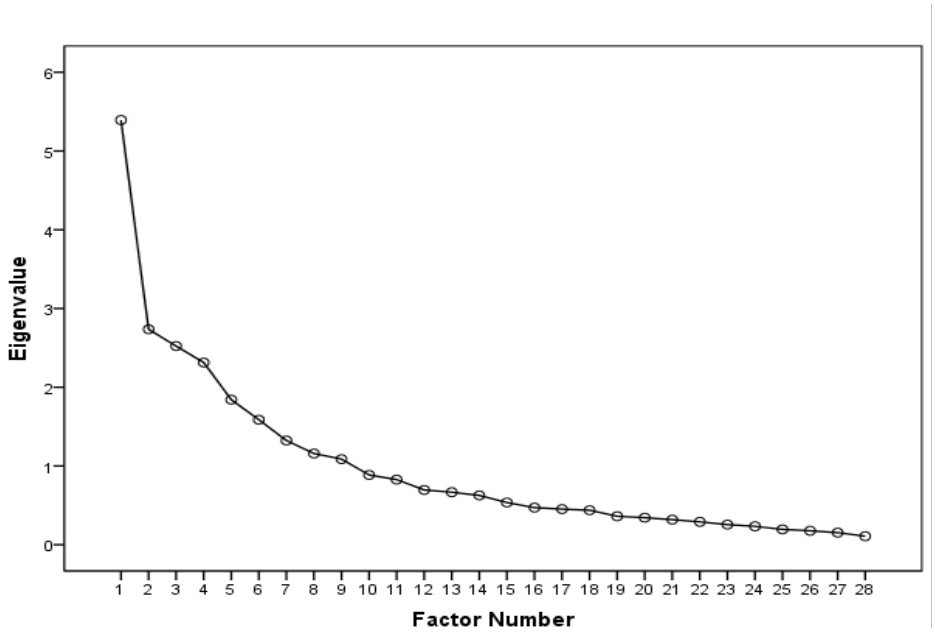

Figure 2. Scree Plot for Exploratory Factor Analysis of the LEQ. Nine factors were identified from break in the line.

The final result of factor analysis was interpretable (Table 9). Nine factors were extracted based on the four inclusion criteria. The first factor, which included three items that described how often study participants engaged in an artistic pastime accounted for19.26% of the variance. The second factor had the most number of items compared to the other factors (8). The second factor accounted for 9.77% of the variance. It captured the attribute of where the study participants traveled, how they acquired information, and the kind of reading materials. The third, fourth, and fifth factors were composed of items which focused on how often the study participants read, spoke a second language, and played a musical instrument, respectively. Three items comprised the sixth factor which represented how often the participants engaged in mild, moderate, and vigorous physical activities. The seventh and eighth factors centered on social activities, however, the items in the seventh factor identified the kind of social activities while the items in the eighth factor specified the frequency of socialization. Factor 9 had the least number of items which suggested the association of education after high school in the young adulthood

stage and occupation in the midlife stage. Factors 7, 8, and 9 individually contributed less than 5% to the cumulative proportion of variance.

Item communality (h^2) of less than .40 may suggest a poor relationship with other items (Costello & Osborne, 2005). Communality or common factor variance denotes the variance that factors share in common for each item (Polit, 1996). The item communalities of the LEQ ranged from .32 to .90 (Table 9). The items, *LL social club* (h^2 = .36) and *ML socialization* (h^2 = .32), may have a poor relationship with other items.

Cronbach's alpha assessed the internal consistency of items under each factor. All factors have a Cronbach's alpha coefficient greater than .60 except Factors 7 (α = .50) and 9 (α = .54) (Table 9). Thus, the LEQ is composed of different dimensions, however, as a whole, the nine factors extracted accounted for 71.30% of the variance.

Table 9. Exploratory Factor Analysis of LEQ items, N = 90

Item	F1	F2	F3	F4	F5	F6	F7	F8	F9	Communalities
ML Artistic pastime	**.94**	-.07	-.03	.08	.00	-.01	-.01	-.03	.01	.90
LL Artistic pastime	**.91**	-.16	.00	.00	.03	-.04	.10	.00	-.10	.80
YA Artistic pastime	**.54**	.20	.08	-.02	.10	.14	-.37	.01	.11	.53
ML Travel	-.04	**.76**	.12	.01	-.24	-.07	-.10	-.03	.11	.60
YA Travel	-.08	**.70**	.10	.07	.21	.01	-.18	-.10	-.18	.52
LL Information	-.17	**.63**	-.13	-.14	-.03	.08	.16	.08	.05	.49
LL Travel	.05	**.56**	.03	.12	-.11	-.07	.23	-.04	-.23	.40
LL Source of information	.08	**.41**	-.20	-.08	.18	.09	.16	.12	.13	.48
ML Language	-.08	-.01	**.88**	.00	-.03	.07	.03	.07	.05	.81
LL Language	.08	.08	**.77**	-.06	.05	-.05	.13	.04	-.09	.60
YA Language	.00	-.01	**.74**	-.02	.03	.04	.01	.04	.12	.60
ML Reading	.05	-.04	-.06	**.81**	.03	.01	.00	-.01	.12	.68
LL Reading	.01	-.05	-.02	**.75**	-.04	.02	.17	.09	-.00	.62
YA Reading	.03	.12	-.01	**.70**	.07	.15	-.04	-.02	.10	.71

ML Instrument	.04	-.05	.08	-.02	**.91**	-.02	-.09	-.02	-.08	.76
LL Instrument	.07	-.18	.02	.06	**.62**	-.08	.13	.05	-.02	.42
YA Instrument	-.04	.18	-.08	.01	**.58**	-.11	.08	.01	.11	.52
ML Physical activity	.02	.03	.08	.07	-.07	**.83**	.14	-.20	-.12	.68
LL Physical activities	.14	-.07	.00	-.07	-.16	**.67**	.03	.12	.17	.61
YA Physical activity	-.20	.02	-.07	.19	.06	**.57**	-.11	.14	-.19	.52
LL Social club	-.13	-.12	.10	.12	.01	.02	**.62**	-.08	-.04	.36
LL Typical ADL	.22	.32	.04	-.06	.01	.08	**.58**	-.03	-.10	.58
LL entertainment	-.02	.12	.00	.00	.11	.08	**.47**	.14	.17	.50
YA Socialization	-.11	-.22	.09	-.10	.13	.13	.07	**.70**	-.02	.53
LL socialization	.02	.15	.03	.25	-.13	-.23	-.03	**.67**	-.14	.59
ML Socialization	.10	.14	.06	.02	-.01	-.01	-.15	**.47**	.07	.32
ML Job	.01	-.13	.03	.09	-.05	-.03	-.07	.00	**.89**	.70
Higher Education	-.10	.09	.11	.13	.08	-.14	.22	-.19	**.47**	.53
Eigenvalue	5.39	2.74	2.52	2.31	1.84	1.59	1.32	1.16	1.09	
% of variance explained	19.26	9.77	9.01	8.26	6.58	5.67	4.72	4.13	3.88	
Cronbach's alpha	.84	.70	.84	.85	.72	.73	.50	.63	.54	

Note: YA = Young Adulthood; ML = Midlife; LL = Late-Life. Extraction of factors by principal axis factoring with promax rotation.

Summary

Examination of the psychometric properties of the LEQ employed study participants who were mostly female, had a high school level of education, widowed, hypertensive, with income below $50,000, and attended senior centers. Test-retest reliabilities of the three subscales, and the total LEQ score were acceptable. Evaluation of internal consistency through item-subscale, item-total LEQ score, subscale-subscale, and subscale-total LEQ score were mostly acceptable, however, the Cronbach's alpha of each subscale was below .60 and the total LEQ score was .65. Validity was assessed through the correlation of the MMSE and the LEQ and exploratory factor analysis. The association of the MMSE and the LEQ which evaluated the concurrent validity of the LEQ demonstrated minimal positive correlation that is not statistically significant with low

effect size. Although not statistically significant, the group who had a low LEQ score had a lower MMSE score. Finally, the exploratory factor analysis, which assessed the construct validity of the LEQ, yielded nine factors. The exploratory factor analysis supported the multidimensionality of LEQ.

CHAPTER V

DISCUSSION

The Lifetime Experience Questionnaire (LEQ) is an instrument which measures the various mental activities from 13 years old until the current age of an older adult. Occupation, education, socialization, leisure, and physical activities in a lifespan may affect the mental health of an older adult. The LEQ is the first survey questionnaire that measures the various mental activities in a lifespan of an older adult; however, its psychometric properties were evaluated only once with Australian study participants. Therefore, the purpose of this study was to examine the psychometric properties of the LEQ for older American adults.

While a goal of any study is the generalization of the results to the targeted population, convenience sampling limited this study from generalizing the result to older adults of a Piedmont County in north-central North Carolina. The study deliberately increased participation of the African-American population (42.2%) compared to the population of older African American adults in North Carolina (15.7%) (U.S. Census Bureau, 2011) and the county (19.6%) (NCDAAS, 2011). In addition to the population of older African Americans, there were more study participants (52.2%) who lived alone than there were older adults in the Piedmont County (31.4%). The study had several nearly identical characteristics with the demographic characteristics of North Carolina or the Piedmont County. Similar to North Carolina (32.2%) (U.S. Census Bureau, 2011) and the Piedmont County (34.8%) (NCDAAS, 2011), the majority of the study participants' (33.3%) highest level of education was high school. The percentage of study participants (10%) nearly matched the Piedmont County's older adults who were in the

work force (13.7%) (NCDAAS, 2011). The majority of the study participants (66.3%) had household income of less than $50,000 that may be comparable to the Piedmont County's median income of $34, 814 (NCDAAS, 2011). Although convenient sampling limited the generalization of the study to a Piedmont County in North Carolina, similarities in demographic characteristics existed. Moreover, the demographic characteristics of the study were congruent to the study findings of Ganguli, Lytle, Reynolds, and Dodge (1998) that community dwelling participants from non-probability sampling were mostly women and frequently availed themselves of community resources.

Reliability

Reliability measures the consistency of the pattern of study participants' responses across items or time (Helms, Henze, Sass, & Mifsud, 2006). The reliability of the LEQ was examined through assessment of its temporal stability and internal consistency. Evaluation of the correlation between the responses at week 1 and week 3 provided the test-retest reliability of the LEQ, which was acceptable. The means of the midlife subscale and the total LEQ score were significantly different between both time points. The sum of the three subscales produced the LEQ score, hence, it follows that if a subscale is affected then the total LEQ score will be altered as well. Compared to the young adulthood and late-life subscales, the two specific questions on the midlife subscale necessitate the use of episodic memory. Episodic memory relies on contextual information to retrieve specific autobiographical events (Craik, 2000; Spaniol, Madden, & Voss, 2006). Excluding the two specific items of the midlife subscale, the rest of the items of the LEQ rely on semantic memory. Semantic memory is the ability to recollect factual knowledge (Craik, 2000). Although both episodic and semantic memories are responsible for factual knowledge, episodic memory involves discrimination of events, or the place and time the facts were learned (Craik, 2000; Spaniol, Madden, & Voss, 2006). Furthermore, unlike semantic

memory, episodic memory is not robust with changes in aging (Craik, 2000; Luo & Craik, 2008; Spaniol, Madden, & Voss, 2006).

Unlike temporal stability that considers reliability at between periods of time, reliability examined via internal consistency is performed through item analysis and Cronbach's alpha coefficient. The study of Valenzuela and Sachdev (2007) produced a Cronbach's alpha coefficient of .66, which was comparable to the current study of .65. Due to the multidimensionality of the LEQ, its internal consistency may have been underestimated (Lopez, Charter, Mostafavi, Nibut & Smith, 2005).

The item-total correlations and corrected item-total correlations (Appendix G) presented generally a satisfactory reliability. The item-total correlation had 27 item-total correlations that met the criteria of $\geq .30$. The *Post high school-Total* correlation of .71 demonstrated characteristic of redundancy (Ferketich, 1991), however, it has a major contribution to the total score. A corrected item-total correlation reduced the number of satisfactory item-total correlations to 14 and negated the redundancy of *Post high school-total* correlation. Nunnally and Bernstein (1994), however, proposed that adding items which have item-total correlations of .20 can increase the reliability of an instrument. Therefore, an additional 10 items with .20 corrected item-total correlations can be added to the items with satisfactory corrected item-total correlations. Moreover, more than two thirds of the LEQ items had corrected item-total correlations between .10 to .30, thus, attainment of acceptable item-total correlations (Nunally & Bernstein, 1994). The non-specific items, *Socialization* and *Physical activities*, had corrected item-total correlations below .20 for all stages of life.

Items with unsatisfactory item-total correlations may have been ambiguous to the study participants (Nunnaly & Bernstein, 1994) or had a decrease in the number of response options (Soeken, 2005). Indeed, during data collection, study participants frequently asked questions on

the items of *Socialization* and *Physical activities.* The item on *Socialization* asked the frequency of seeing family members or friends during a particular stage (Appendix B). Although the choices for non-specific items contained specific frequencies, study participants verbalized that they had different answers for family members and friends particularly during the young adulthood stage. Similar to the item *Socialization*, study participants articulated that the item, *Physical activities*, in the young adulthood stage can have different answers especially before and after high school. Although the item *Physical activities* had examples that distinguished it to mild, moderate, to vigorous, study participants expressed that certain activities such as walking can belong to three categories. Therefore, the ambiguity of the questions or choices may have affected the item-total correlation of *Socialization* and *Physical activities* (Nunnally & Bernstein, 1994). The specific items, *High school* of young adulthood stage and *Companionship*, of late-life stage may have more than three choices, however, their scores only has width of three (*High school*) and two (*Companionship*) which may have resulted to unsatisfactory corrected item-total correlations (Nunnally & Bernstein, 1994). Two different rationale may have contributed to the unacceptable item-total correlations of the specific (*High school* and *Companionship*) and non-specific (*Socialization* and *Physical activities*) items of the LEQ.

Validity

The correlation between the MMSE and the LEQ and the exploratory factor analysis examined the concurrent and construct validity of the LEQ, respectively. The MMSE assesses global cognition (Folstein, Folstein, & McHugh, 1975; Tombaugh & McIntyre, 1992). It contains items that measure vocal response, orientation, attention, memory and abilities to follow both verbal and non-verbal commands, write a sentence, and copy a figure (Cockrell & Folstein, 1988; Folstein et al., 1975; Tombaugh & McIntyre, 1992). Numerous studies had included the MMSE for cognitive evaluations. The correlation between the MMSE and cognitive performance

such as the Wechsler Adult Intelligence Scale had been studied (Folstein et al., 1975). The LEQ measures mental activities, thus, it was anticipated that a positive association between the MMSE and the LEQ would be discovered. There was a positive association observed between the LEQ and MMSE, however, it was low and non-significant. An evaluation of the specific items of the MMSE showed a low but significant correlation between the *Orientation to place* and the LEQ. This finding is congruent to the result of the study of Wilson, Barnes, and Bennett (2003) that mentally stimulating activities affect semantic memory, item or factual knowledge, but not episodic and working memory. Although the anticipated significant positive correlation between the broad score of the MMSE and the LEQ was not attained, a correlation on specific items particularly for the construct of semantic memory was found.

Exploratory factor analysis (EFA) evaluated the construct validity of the LEQ. The LEQ was divided into three subscales which represent the young adulthood, midlife, and late-life stages. Each life stage is composed of multidimensional items. Studies have found association between education (Mortimer, Snowdon, & Markesbery 2003; Tucker-Drob, Johnson, & Jones, 2009; Valenzuela & Sachdev, 2006), occupation (Potter, Plassman, Helms, Foster, & Edwards, 2006), leisure (Wilson, Barnes, & Bennett, 2003), physical (Podewils et al., 2005), social activities (Zunzunegui, Alvarado, del Ser, & Otero, 2003) and cognition of older adults. Thus, it was contemplated that the EFA would yield several factors which may be related to each other. The possible existence of relationships among the dimensions of the LEQ was the impetus to use the methods of principal axis factoring with an oblique rotation (Polit, 1996). The results showed nine factors and the magnitude of the item loadings signified their relationship with the specific factor (Polit, 1996).

Cognitive reserve theory proposes that individual differences in cognitive functioning among older adults are due to brain resources which have been accumulated over the life-span

(Richards & Deary, 2005; Stern, Y., 2009). The first factor, *Artistic pastime*, gauged the frequency of learning or developing the use of art as a leisure activity. Artistic pastimes are thought to have a great impact on the cognitive functions of older adults (Noice & Noice, 2004, Vance & Crowe, 2006). The second factor, *Information about the surroundings*, centered on leisure activities in gathering facts about the environment. Gathering information about one's surroundings such as by traveling may enhance the neural networks resulting to greater cognitive reserve (Scarmeas & Stern, Y., 2003). The third factor, *Bilingualism*, measured the practice of a second language. Indeed, bilingualism may enhance executive functions particularly for older adults (Bialystok, Klein, Craik, & Viswanathan, 2004). The fourth factor, *Reading*, assessed the frequency of reading activity among older adults while the fifth factor, *Musical instruments*, considered how often older adults played or began playing musical instruments. Activities such as reading and playing musical instruments were considered cognitive activities which lower the risk of dementia among older adults (Verghese, et al., 2003). The sixth factor, *Physical activities*, determined the regularity of performing a mild to vigorous form of physical activities. Similar to the factor 1, physical activities enhance global cognitive functions of older adults (Lautenschlager, et al., 2008). The seventh factor, *social engagement*, estimated activities that may have a social component. In contrast to Factor 7, the eighth factor, *Social integration and Network*, extracted by EFA focused on how often older adults involve themselves with their family members or friends. Social integration, network, and engagement protect older adults from cognitive decline (Zunzunegui, Alvarado, del Ser, & Otero, 2003). Lastly, the ninth factor, *Economic*, centered on education and occupation. The effects of education and occupation are similar to the effects of the other eight factors, which enhance the cognitive functions of older adults may be due to their contribution to cognitive reserve (Staff, Murray, Deary, & Whalley, 2004).

Eight items which may be associated with cognitive reserve did not belong under any factors. The eight items did not meet the inclusion criteria for EFA (High school education, late-life (LL) volunteer, supervisory, and LL education bonus), cross loaded on two factors (LL job, LL companionship), or were not congruent to stay under a factor (LL reaching out and midlife education bonus). Besides the criteria established, several rationales were identified to support the inability of the eight items to be with any factors. First, the sample size may be a reason why the eight items did not satisfactorily load on any factors (Costello & Osborne, 2005; Henson & Roberts, 2006). A 2:1 sample to item ratio, similar to the current study, may only produce 10% accuracy in solution for EFA (Costello & Osborne, 2005). A rule of thumb to determine sample size is to use sample to item ratio of 5:1 (Polit, 1996). The determination of sample size, however, is relative. The assessment of communalities, which measures the correlation of an item with the factors and items, may determine the adequacy of sample size (Henson & Robert, 2006). Nearly half of the items on extracted factors have communalities greater than .60, two items had below .40, and two items had cross loading on two factors. The result of the communalities of extracted factors and the Kaiser-Meyer-Olkin test (.61) suggested adequacy of sample size (Costello & Osborne, 2005; Henson & Roberts, 2006; Polit, 1996). Theoretically, the items characterized the different mental activities in a lifespan perspective which may contribute to cognitive reserve and empirically, the EFA managed to delineate nine factors that exemplify various mental activities.

Even though the sample size is adequate, outliers may affect the result of EFA (Liu & Zumbo, 2012). Mahalanobis distance assessed the multivariate outliers. Two participants were identified that had extreme values on two items of the LEQ. Identical results for EFA were attained even though the two participants were removed from the analysis. Outliers may have not influenced the result that the eight items did not load on any factors. Lastly, the different

proficiency of study participants in answering the LEQ may have impacted the result of dimensions obtained (Ackerman, 1994). Although the study participants were older adults from the same region, they may not be a homogenous sample based on their proficiency in answering the LEQ. Therefore, sample size and the participants' characteristics may have played a role for eight items not belonging under any factors.

Implication to Theory

Satisfactory cognitive functions assist older adults in the maintenance of their health and the ability to accomplish daily activities. Knowledge on resources to healthy cognition may aide older adults, their caregivers, and healthcare providers in planning and coordinating activities to acquire such resources. Cognitive reserve theory (CRT) contributes to the knowledge about resources which may account for individual differences in cognitive functioning despite changes in aging or neuropathology (Richards & Deary, 2005; Stern, Y., 2009). According to CRT, one of the factors that influences cognition is the lifestyle factor. The LEQ measures various lifestyle factors in a lifespan perspective.

As a measuring instrument, the LEQ needs to be culturally appropriate, reliable, and valid. Minor changes had been made to the LEQ that hopefully conformed to the culture of older American adults. The study presented satisfactory construct validity, however, some item revisions may be needed to increase the internal consistency of the LEQ. Moreover, instruments that gauge specific cognitive functions such as memory and executive function are needed to demonstrate concurrent validity. Quantifying lifestyle factors in a lifespan perspective is an immense beginning to operationally defining the broad construct of cognitive reserve.

Implication to Practice

Cognitive changes often occur in older adults, 64 years and older. Normal changes in the brain such as atrophy (Raz, Dixon, Head, Dupuis, & Aker, 1998; Raz, Rodriguez, Kennedy,

Acker, 2007), ventricular hypertrophy (Jacoby, Levy, & Dawson, 1980), and a decrease in cerebral metabolism (Sophie, 2007) may explain the changes observed in normal cognition in aging (Ball, Edwards, & Ross, 2007; Finkel, McArdle, Reynolds, & Pedersen, 2007; Pichotz & Malamut, 2008) as well as the higher risk of cognitive dysfunction (Unverzagt, et al., 2007). Individual differences in the cognitive function of older adults as illuminated by CRT may partially be explained by estimating various mental activities in a lifetime perspective. Thus, the LEQ may be a promising tool in evaluating cognition of older adults.

Assessing the cognition of older adults not only entails appraising cognitive performances but also factors that contribute to the state of their cognition. Although the association of the LEQ and the MMSE was low and non-significant, the result showed that the group of older adults who haves a low LEQ score tend to have a low MMSE score. The results of the study also showed that specific and global aspects of cognition may be associated with lifestyle factors (Seeman, et al., 2011; Verhese, et al., 2003; Wilson, et al., 2002) that are present from young adulthood to the current stage of older adults.

The exploratory factor analysis showed that at least nine mental activities may be assessed and the three stages of life contributed differently for each mental activity. The LEQ may serve as a screening tool for healthcare providers in their evaluation of different mental activities of older adults. As a screening tool, it can be used by healthcare providers as a guide in individually planning their interventions for maintenance or enhancement of mental activities. Furthermore, healthcare providers may be able to identify older adults who are at high risk for cognitive dysfunction prior to or during their stay in a healthcare facility.

Older adults are at a higher risk of developing cognitive dysfunction than other populations when admitted to healthcare facilities (Anderson, Gustafson, & Hallber, 2001; Cole, 2004; Marcantonio, Flacker, Wright, & Resnick, 2001; Siddiqi, House, & Holmes, 2006). The

numerous surgical and non-surgical procedures contribute to the risk of changes in cognition of older adults during their stay in healthcare facilities. Changes in cognition may result in undue burden on family members and increase healthcare costs (Gao, et al., 2005). Identification of high risk populations and development of preventive measures may be the key factors in minimizing cognitive dysfunction. Therefore, the LEQ may identify older adults at risk of cognitive dysfunction and assist healthcare providers in individually planning interventions which may maintain or enhance their mental activities.

Implication to Research

The study found that the LEQ had a satisfactory temporal stability and interpretable construct validity for older American adults. Study participants had similar characteristics with the population of a Piedmont County in north-central North Carolina in the areas of education, workforce, and income. The deliberate decision to generate a higher proportion of African Americans compared to their percentage in the Piedmont County and the method of convenient sampling made it more challenging to generalize the result to the targeted population. Thus, it is recommended that future studies on cultural appropriateness of the LEQ be more congruent with the demographic characteristics of targeted population. Moreover, future studies can employ differential item functioning (DIF) analysis to examine how various groups of study participants in the same geographical location respond to the items of the LEQ.

Compared to temporal stability, revisions of a few items may strengthen its internal consistency. The non-specific item, *physical activities*, needs to have a clear definition of the different intensities. Meanwhile, the non-specific item, *socialization*, may need to have separate questions for friends and family members (Shaw, Krause, Liang, & Bennett, 2007). Furthermore, the specific items under the young adulthood stage, *high school years*, may need revision on its scale.

The study limited its concurrent validity with assessment of global cognition, however, further investigation showed that at least the item, *orientation to place,* had significant association with the LEQ. It is recommended future studies on concurrent validity examine the association of specific cognitive performance such as working memory and executive functions. Although the study found that the LEQ had temporal stability and interpretable construct validity, reexamination of the psychometric properties of the LEQ for older American adults is needed after revision of a few items, congruency of demographic characteristics with targeted population, and the use of specific cognitive function assessment.

Limitations

The methodological section of the study identified convenience sampling, recall bias, and limited test for concurrent validity. First, the representativeness of the study participants in the targeted population was sought, however, a decision was made to deliberately increase the participation of older African-Americans and convenience sampling resulted to greater presence of older American adults involved in senior centers. Second, recall bias may have been kept to a minimum since the temporal stability of each LEQ item did not reach a very high level. Lastly, the association of the MMSE and the LEQ did not have satisfactory result. Recommendations for further research on sampling and use of specific cognitive performance test were discussed in the "implication to research" section of this chapter.

Other than the limitations identified from the methodological section, the size of the sample for factor analysis may need to be increased. The study utilized 2:1 sample to item ratio. Although assessment of communalities of items from extracted factors directed to adequate sample size, a 5:1 ratio (Polit, 1996) may increase the accuracy of the result of EFA solution (Costello & Osborne, 2005).

Conclusion

Cognitive changes often occur in older adults, 64 years and older. Cognitive reserve theory may explain the variances in cognition of older adults. The lifestyle factors such as education, occupation, social, physical, and leisure activities contribute to the formation of cognitive reserve (Richards & Deary, 2005; Stern, Y., 2009). The LEQ is the only known instrument available to quantify the different lifestyle factors in a lifetime perspective. However, the psychometric properties of the LEQ were studied only once and limited to an Australian population. Therefore, the goal of the study was to evaluate the utilization of the LEQ among older American adults. The LEQ had satisfactory temporal stability and interpretable construct validity, however, revisions of items, *socialization*, *physical activities*, and *high school years* may be needed to increase its internal consistency. Moreover, the study limited its concurrent validity to the association of the MMSE and LEQ. Recommendations for future studies were identified in the areas of sampling, test construction, and concurrent validity.

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APPENDIX A

DEMOGRAPHIC SURVEY

ID#:_____

*Please **check or write** the answer on the space provided.*

1. What is your age? _____

2. What is your gender?

_____ Female

_____ Male

3. What is your race?

_____Asian/Pacific Islander

_____ Black/African American

_____ Caucasian/White

_____ Hispanic

_____ Others: Please specify: _____

4. What language can you speak?

_____ English

_____ Spanish

_____ Others: Please specify: _____

5. What is your current marital status?

_____ Divorced

_____ Married

_____ Separated

_____ Single

_____ Widowed

6. What is your total household income?

_____ Less than $15,000

_____ Less than $25,000

_____ Less than $50,000

_____ Less than $75,000

_____ Less than $100,000

_____ More than $100,000

7. Please list all your current health or medical problems.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

8. Please list all the current medications you are taking.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

This is the end of the demographic survey. Thank you very much.

APPENDIX B

LIFETIME EXPERIENCE QUESTIONNAIRE

ID #_____

Please answer the following questions as accurately as possible.
Choose the option by placing a check mark on the item that most closely fits with your experience.

LEQ – YOUNG ADULTHOOD

The following questions apply to the time in your life ***between 13 and 30 years of age.***

1. How many years of High School (i.e. grades *after* Year 8) did you complete?

_____ none
_____1
_____2
_____3
_____4
_____5
_____6

Please specify what type(s) of training or study you attempted *up until 30 years of age* and for how long you were enrolled. Some categories are given below. If your experience is not covered by this list please fill in the details under "Any other course."

Type of Course	Number of Years? Enrolled in Course	Full-time or Part-time	% of Course You Completed
Clerical, administrative or basic book-keeping training	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ___100%
Business Course	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Trade apprenticeship	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Other technical course or associate degree	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%

Type of Course	Number of Years? Enrolled in Course	Full-time or Part-time	% of Course You Completed
College diploma	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Bachelor's degree (3 or 4 year degree)	_____ 1 _____ 2 _____3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Bachelors degree (5 or 6 year degree)	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Masters degree	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
PhD degree	_____ 1 ____ 2 _____ 3 _____ 4 ____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Other graduate course	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Any other course?	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Name of other course:			
PLEASE PRINT			

General Questions: The following questions also apply to the time in your life between 13 and 30 years of age.

1. How often did you see a member of your family or friends during this time?
   _____ Never
   _____ Less than Monthly
   _____ Monthly
   _____ Every two weeks
   _____ Weekly
   _____ Daily

2. How often did you practice or play a musical instrument?
   _____ Never
   _____ Less than Monthly
   _____ Monthly
   _____ Every two weeks
   _____ Weekly
   _____ Daily

3. How often did you practice or develop an artistic pastime (e.g. drawing, painting, writing, acting)?
   _____ Never
   _____ Less than Monthly
   _____ Monthly
   _____ Every two weeks
   _____ Weekly
   _____ Daily

4. How often did you take part in sports or activities that were mildly energetic, moderately energetic or vigorous:

   4a. **Mildly energetic:** (e.g. walking, carpentry, gardening, housework**)**
   _____ Never
   _____ Less than Monthly
   _____ Monthly
   _____ Every two weeks
   _____ Weekly
   _____ Daily

   4b. **Moderately energetic**: (e.g. dancing, golf, lawn mowing, leisurely swim, easy bicycling)
   _____ Never
   _____ Less than Monthly
   _____ Monthly
   _____ Every two weeks
   _____ Weekly
   _____ Daily

   4c. **Vigorous**: (e.g. running, competitive tennis, squash, hard bicycling)
   _____ Never
   _____ Less than Monthly
   _____ Monthly
   _____ Every two weeks
   _____ Weekly
   _____ Daily

5. How often did you read (material of any sort) for more than five minutes?

_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

6. How often did you practice speaking a second language?

_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

7. Did you travel to any of the following continents ***between the ages of 13 and 30*** years?

_____Pacific Islands
_____Asia / Subcontinent
_____Latin / Central America
_____Australia
_____North America
_____Europe / former USSR
_____Africa
_____Middle East

8. Between the ages of 13 and 30 years did you have any other pastime, hobby or special interest ***NOT*** mentioned in this questionnaire?

_____No
_____Yes

If yes, please list :

_____
_____
_____
_____
_____
_____
_____
_____
_____

LEQ – MIDLIFE

We are now moving on to your experiences
during your middle-age years. This refers to the time from **30 years until 65 years** of age.

1. Please provide a history of the jobs or occupations that you have been involved in, from your early thirties to immediately prior to retirement. If you had multiple jobs during any one time period, please indicate **the main job or occupation** you were involved with.

Age Range	**JOB TITLE**
30 -34 years	_____
	_____
35- 39 years	_____
	_____
40- 44 years	_____
	_____
45- 49 years	_____
	_____
50- 54 years	_____
	_____
55- 64 years	_____
	_____
60- 65 years	_____
	_____

2. Did any of your jobs or occupations mean that you were in charge of, directing, or responsible for other people?
   _____ if no, please, continue to answer general question number 1.
   _____ if yes, please indicate below the approximate number of people you were in charge of.

Age Range	**Job Title**	**Number of People in Charge of?**
30-34	_____	_____None _____ 1-5 _____6-10 _____>10
35-39	_____	_____None _____ 1-5 _____6-10 _____>10
40-44	_____	_____None _____ 1-5 _____6-10 _____>10

Age Range	Job Title	Number of People in Charge of?
45-49	_____	_____None _____ 1-5 _____6-10 _____>10
50-54	_____	_____None _____ 1-5 _____6-10 _____>10
55-59	_____	_____None _____ 1-5 _____6-10 _____>10
60-65	_____	_____None _____ 1-5 _____6-10 _____>10

General Questions: The following questions also apply to the time in your life between ***30 and 65 years of age.***

1. How often did you see a member of your family or friends during this time?
   - _____ Never
   - _____ Less than Monthly
   - _____ Monthly
   - _____ Every two weeks
   - _____ Weekly
   - _____ Daily

2. How often did you practice or play a musical instrument?
   - _____ Never
   - _____ Less than Monthly
   - _____ Monthly
   - _____ Every two weeks
   - _____ Weekly
   - _____ Daily

3. How often did you practice or develop an artistic pastime (e.g. drawing, painting, writing, acting)?
   - _____ Never
   - _____ Less than Monthly
   - _____ Monthly
   - _____ Every two weeks
   - _____ Weekly
   - _____ Daily

4. How often did you take part in sports or activities that were mildly energetic, moderately energetic or vigorous:

4a. Mildly energetic: (e.g. walking, carpentry, gardening, housework)
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

4b. **Moderately energetic**: (e.g. dancing, golf, lawn mowing, leisurely swim, easy bicycling)
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

4c. **Vigorous**: (e.g. running, competitive tennis, squash, hard bicycling)
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

5. How often did you read (material of any sort) for more than five minutes?
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

6. How often did you practice speaking a second language?
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

7. Did you travel to any of the following continents between the ages of ***30 and 65 years?***

_____ Pacific Islands
_____ Asia / Subcontinent
_____ Latin / Central America
_____ North America
_____ Australia
_____ Europe / former USSR
_____ Africa
_____ Middle East

8. Between the ages of ***30 and 65 years*** did you have any other pastime, hobby or special interest ***NOT*** mentioned in this questionnaire?

_____No
_____Yes

If yes, please list :

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

9. ***Between the ages of 30 and 65*** did you undertake any type of formal study?

_____ No. Please go to LEQ-Late Life at next page.
_____ Yes. Please indicate the details on the list below.

Type of Course	Number of Years? Enrolled in Course	Full-time or Part-time	% of Course You Completed
Clerical, administrative or basic book-keeping training	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Business Course	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Trade apprenticeship	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Other technical course or associate degree	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%

Type of Course	Number of Years? Enrolled in Course	Full-time or Part-time	% of Course You Completed
College diploma	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Bachelor's degree (3 or 4 year degree)	_____ 1 _____ 2 _____3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Bachelor's degree (5 or 6 year degree)	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Masters degree	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
PhD degree	_____ 1 ____ 2 _____ 3 _____ 4 ____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Other graduate course	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Any other course?	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Name of other course:			
PLEASE PRINT			

LEQ- Late-Life

You will now be asked questions about the present phase of your life, ***beginning from 65 years of age.***

SPECIFIC

1. Have you retired?

1a. _____ Yes (=no ongoing paid work)

At what age did you retire? _____

1b. _____ Sort of (= part-time or casual ongoing paid work)

Number of hours of paid work per week? _____

What is the main occupational title? _____

1c. _____ No (= full time ongoing paid work)

Number of hours of paid work per week? _____

What is the main occupational title? _____

2. Do you currently reside:

_____ Alone
_____ With a partner
_____ With a friend
_____ With a family

3. Are you currently an active member of any social clubs or groups?

_____ No. Please go to question number 4
_____ Yes

Please indicate how many: _____ 1 _____ 3 _____ 5 _____ 7
_____ 2 _____ 4 _____ 6 _____ 8 or more

4. Do you do any charity or volunteer work?

_____ No. Please go to question number 5

_____ Yes

Please indicate how many charities or organizations you are doing volunteer work for:

_____ 1 _____ 3 _____ 5 _____ 7

_____ 2 _____ 4 _____ 6 _____ 8 or more

5. How often might you make an outing to see a family member, friend or group of friends?

_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

6. What types of events or entertainment have you undertaken in the last 2 months? (You may check more than one item)

_____ Movies
_____ Plays / Drama
_____ Pub / RSL Club
_____ Concert / Recital
_____ Special Performance
_____ Dancing
_____ Visiting friends
_____ Sporting event
_____ Restaurant
_____Other –Please describe: _____
_____
_____

7. How would you spend a typical day? (You may check more than one item)
_____ Sleep / Nothing
_____ House work
_____ TV
_____ Radio
_____ Listening to Music
_____ Walking
_____ Gardening
_____ Crosswords/Suduko
_____ Pet Care
_____ Socializing
_____ Reading
_____ Writing
_____ Studying
_____ Teaching
_____ Volunteer work
_____ Paid work
_____ Strategic games (e.g. Chess, Bridge, Cards)
_____ Helping friends / family
_____ Artistry (e.g. drawing, painting, sculpture, acting, etc)
_____ Prayer / Religious activity
_____ Playing Music
_____ Brain Training Games (e.g. on computer or Nintendo)
_____ Learning something new
_____ Hobby / Pastime
_____ Intellectual / Professional

8. How do you usually acquire your information about world and national events? (You may check more than one item).
_____ No particular way of getting information
_____ Friends
_____ TV
_____ Radio
_____ Newspapers
_____ Magazines
_____ Internet
_____ Other –Please describe: _____
_____

9. What kinds of materials are you reading on a regular basis? (You may check more than one item).

_____ Just what is needed to get by
_____ Newspaper articles
_____ Magazines articles
_____ Novels
_____ Fiction stories
_____ Journals or Monographs
_____ Non-Fiction Books
_____ All of above
_____ Other –Please describe:_____

General Questions: The following questions apply to current period in your life ***from 65 years of age.***

1. How often did you see a member of your family or friends during this time?

_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

2. How often did you practice or play a musical instrument?

_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

3. How often did you practice or develop an artistic pastime (e.g. drawing, painting, writing, acting)?

_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

4. How often did you take part in sports or activities that were mildly energetic, moderately energetic or vigorous:

4a. **Mildly energetic**: (e.g. walking, carpentry, gardening, housework)
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

4b. **Moderately energetic**: (e.g. dancing, golf, lawn mowing, leisurely swim, easy bicycling)
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

4c. **Vigorous**: (e.g. running, competitive tennis, squash, hard bicycling)
_____ Never
_____ Less than Monthly
_____ Monthly
_____Every two weeks
_____ Weekly
_____ Daily

5. How often did you read (material of any sort) for more than five minutes?
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

6. How often did you practice speaking a second language?
_____ Never
_____ Less than Monthly
_____ Monthly
_____ Every two weeks
_____ Weekly
_____ Daily

7. Have you traveled to any of the following continents since the age of 65 years?

_____Pacific Islands
_____Asia / Subcontinent
_____Latin / Central America
_____ North America
_____Australia
_____Europe / former USSR
_____Africa
_____Middle East

8. Have you had any other pastime, hobby or special Interest ***NOT*** mentioned in this questionnaire?

_____ No. Please go to question number 9.
_____ Yes. Please list: _____
_____

9. Since the age of 65 years, have you undertaken any form of formal study?

_____ No
_____ Yes. Please indicate the precise nature of the list below.

Type of Course	Number of Years ? Enrolled in Course	Full-time or Part-time	% of Course You Completed
Clerical, administrative or basic book-keeping training	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Business Course	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Trade apprenticeship	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Other technical course or associate degree	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
College diploma	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Bachelor's degree (3 or 4 year degree)	_____ 1 _____ 2 _____3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Bachelor's degree (5 or 6 year degree)	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%

Type of Course	Number of Years ? Enrolled in Course	Full-time or Part-time	% of Course You Completed
Masters degree	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
PhD degree	_____ 1 ____ 2 _____ 3 _____ 4 ____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Other graduate course	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Any other course?	_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6	_____ Full-time _____ Part-time	____ 25% ____50% ____75% ____100%
Name of other course:			
PLEASE PRINT			

Thank you for taking the time to complete this questionnaire.

APPENDIX C

SCORING OF THE AUSTRALIAN VERSION OF THE LEQ

Education scores in the Young Adulthood subsection were calculated in the following manner: clerical or short business courses were scored 4 points; 3 year trade or technical college courses 6 points, 4 year trade apprenticeships 8 points; 3 or 4 year college courses 8 points; undergraduate university courses 10 points; postgraduate Masters 8 points; postgraduate doctorate 10 points; other post graduate courses 4 points per year of study. A cumulative education score for the Young Adulthood section was summed and then normalized with the Young Adulthood non-specific subscores. As indicated above, together these two scores contributed a third of the overall LEQ score. If an individual completed a formal educational course outside his or her Young Adulthood period, an equivalent number of points were added to the LEQ total in the relevant life-stage section as an adjustment. Occupation scores were calculated for the 30–35, 35–40, 45–50, 50–55, 55–60 and 60–65 year age ranges. The main occupation pursued in each age bracket (in terms of years worked) was classified according the Australian Standard Classification of Occupations (ASCO [ABS Australian Bureau Of Statistics, 1997]) guidelines : professional occupations such as engineers, doctors, lawyers and so forth are classified 1.0; semi-professionals such as teachers and police as 2.0; skilled tradespersons 3.0; unskilled tradespersons 4.0 and so forth with unskilled clerical staff in the ultimate ASCO category (8.0). Each occupational category was first inverted, so that occupations with greater cognitive and managerial responsibilities scored higher, and then summed. A cumulative occupational score for the Mid Life section was summed and then normalized with the Mid Life nonspecific subscores (as a whole group). As indicated in the previous section, together these two scores contributed a third of the overall LEQ score. If an individual was continuing in paid employment beyond 65

years of age, then an equivalent number of points was added to the Late Life section as an adjustment.

Late life-specific questions focused on social, leisure and information-seeking behavior. The following questions formed the Specific Late Life score, with each affirmative response in the direction of greater complexity/frequency given an equivalent value out of five (unless indicated otherwise below):

(i) Reside alone or with partner (not coded)

(ii) Membership of social groups

(iii) Membership of charity groups

(iv) Frequency of seeing family members

(v) Frequency and diversity of participating in events and entertainment (frequency diversity recoded and scaled out of 5)

(vi) Behavioral analysis of typical day – these items were recoded into a 10-point scale based on the diversity of activities listed (25 items to choose from; 0–4=1, 5–7=2, 8–9=3, 10–11=4, 12=14=5, 15–16=6, 17–18=7, 19–20=8, 21–22=9, 23+=10

(vii) Diversity of information sources

(viii) Diversity of reading materials

A cumulative activity score for the Late Life specific section was summed and then normalized with the Late Life non-specific subscores (as a whole group). As indicated previously, together these two scores contributed a third of the overall LEQ score.

Note on normalization

As this was the first iteration of the LEQ, there was no a prior reason to weight scores from any one of the Young Adulthood, Mid Life or Late Life subsections more than another. Thus, scores from each Life stage was weighted 33.3% towards the overall LEQ total.

Furthermore, within each Life stage score, there were items from the Specific and Non-Specific domains. There was no compelling reason to weight scores from one domain over the other. Given scores from the Non-Specific domain in each Life stage had an absolute maximum of 35, and tended towards a mean of around 12. Scores from the Specific domain varied more widely. We applied a different normalization Factor to each individual's Life stage Specific score so that at the group level they approximated a mean of 12. Thus, for the Young Adulthood Specific score a normalization factor of 0.7 was applied, for the Mid Life Specific score 0.25, and for the Late Life 0.4. It is for this reason that the mean Life stage scores are about 24–25 and the overall LEQ mean approximately 75. Non-specific life stage questions: each life stage asked a standard set of eight questions relating to participation in a diverse number of leisure and mental activities and artistic and fitness pursuits (only the first 7 were used to derive the LEQ total). Each was scored out of 5 and summed to produce a theoretical maximum of 35.

*** Scoring the LEQ for the current study had two differences from the Australian version of LEQ.

a. The U.S. Standard Occupational Classification was used to give weights for jobs identified by participants. A score of 9 was given to managers and administrators, 8 for professionals, 7 for associate professionals, 6 for tradespersons and related workers, 5 for advanced clerical and service workers, 4 for intermediate clerical, sales, and service workers, 3 for intermediate production and transport workers, 2 for elementary clerical, sales, and service workers, and 9 for laborers and related workers.

b. Normalization factors of 1.45, 0.14, and 0.62, respectively, were applied based on the non-specific items mean for young adulthood, midlife, and late-life stages.

APPENDIX D

MINI-MENTAL STATE EXAM

Maximum Score	Score	
		ORIENTATION
5	( )	What is the (year) (season) (date) (day) (month)?
5	( )	Where are we: (state) (county) (town) (hospital) (floor).
		REGISTRATION
3	( )	Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them.

Give 1 point for each correct answer. Then repeat them until he learns all 3. Count trials and record.

		ATTENTION AND CALCULATION
5	( )	Serial 7's. 1 point for each correct. Stop after 5 answers. Alternatively - spell "world" backwards.
		RECALL
3	( )	Ask for the 3 objects repeated above. Give 1 point for each correct.
		LANGUAGE
9	( )	Name a pencil, and watch (2 points)

Repeat the following "No ifs, ands or buts." (1 point)

Follow a 3-stage command: (3 points)

"Take a paper in your right hand, fold it in half, and put it on the floor"

Read and obey the following:

CLOSE YOUR EYES (1 point)

Write a sentence (1 point)

Copy design (1 point)

Total score:_____

ASSESS level of consciousness along a continuum

Alert Drowsy Stupor Coma

INSTRUCTIONS FOR ADMINISTRATION OF

MINI-MENTAL STATE EXAMINATION

ORIENTATION

(1) Ask for the date. Then ask specifically for parts omitted, e.g., “Can you also tell me what season it is?” *One point for each correct.*

(2) Ask in turn “Can you tell me the name of this hospital?” (town, county, etc.). *One point for each correct.*

REGISTRATION

Ask the patient if you may test his memory. Then say the names of 3 unrelated objects, clearly and slowly, about one second for each. After you have said all 3, ask him to repeat them. This first repetition determines his score (O-3) but keep saying them until he can repeat all 3, up to 6 trials. If he does not eventually learn all 3, recall cannot be meaningfully tested.

ATTENTION AND CALCULATION

Ask the patient to begin with 100 and count backwards by 7. Stop after 5 subtractions (93, 86, 79, 72, 65).Score the total number of correct answers. If the patient cannot or will not perform this task, ask him to spell the word “world” backwards. The score is the number of letters in correct order. E.g. dlrow = 5, dlorw = 3.

RECALL

Ask the patient if he can recall the 3 words you previously asked him to remember. Score O-3.

LANGUAGE

Naming: Show the patient a wrist watch and ask him what it is. Repeat for pencil. Score O-2.

Repetition: Ask the patient to repeat the sentence after you. Allow only one trial. Score 0 or 1.

3-Stage command: Give the patient a piece of plain blank paper and repeat the command. Score 1 point for each part correctly executed.

Reading: On a blank piece of paper print the sentence “Close your eyes,” in letters large enough for the patient to see clearly. Ask him to read it and do what it says. Score 1 point only if he actually closes his eyes.

Writing: Give the patient a blank piece of paper and ask him to write a sentence for you. Do not dictate a sentence, it is to be written spontaneously. It must contain a subject and verb and be sensible. Correct grammar and punctuation are not necessary.

Copying: On a clean piece of paper, draw intersecting pentagons, each side about 1 in., and ask him to copy it exactly as it is. All 10 angles must be present and 2 must intersect to score 1 point. Tremor and rotation are ignored. Estimate the patient’s level of sensorium along a continuum, from alert on the left to coma on the right.

APPENDIX E

GERIATRIC DEPRESSION SCALE-SHORT FORM

Choose the best answer for how you have felt over the past week:

1. Are you basically satisfied with your life? YES / NO

2. Have you dropped many of your activities and interests? YES / NO

3. Do you feel that your life is empty? YES / NO

4. Do you often get bored? YES / NO

5. Are you in good spirits most of the time? YES / NO

6. Are you afraid that something bad is going to happen to you? YES / NO

7. Do you feel happy most of the time? YES / NO

8. Do you often feel helpless? YES / NO

9. Do you prefer to stay at home, rather than going out and doing new things? YES / NO

10. Do you feel you have more problems with memory than most? YES / NO

11. Do you think it is wonderful to be alive now? YES / NO

12. Do you feel pretty worthless the way you are now? YES / NO

13. Do you feel full of energy? YES / NO

14. Do you feel that your situation is hopeless? YES / NO

15. Do you think that most people are better off than you are? YES / NO

APPENDIX F

TEST-RETEST RELIABILITY OF LEQ ITEMS

Table 10. Test-retest Pearson's r Correlation of Specific Items for Young Adulthood Stage, N = 30

Items	Correlation
Years in high school	.91**
Post high school education	.81**

**$p < .01$

Table 11. Test-retest Pearson's r Correlations of Non-specific Items for Young Adulthood Stage, N = 30

Non- specific items	Correlation
Socialization	.68**
Instrument	.65**
Artistic pastime	.29
Physical activity	.64**
Reading	.06
Language	.60**
Travel	.61**

**$p < .01$

Table 12. Test-retest Pearson's r Correlation of Specific Items for Midlife Stage, N = 30

Items	Correlation
Occupation	.94**
Supervisory Role	.88**

**$p < .01$

Table 13. Test-retest Pearson's r Correlation of Non-specific Items for Midlife Stage, N = 30

Items	Correlation
Socialization	.67**
Instrument	.71**
Artistic Pastime	.81**
Physical Activity	.76**
Reading	.27
Language	.50**
Travel	.82**

**$p < .01$

Table 14. Test-retest Pearson's r Correlation of Specific Items for Late-Life Stage, N = 30

Items	Correlation
Occupation	.89**
Social Club	.71**
Volunteer	.61**
Reaching Out	.61**
Entertainment	.64**
Typical ADL	.41*
Information	.68*
Source of Information	.69**

*$p < .05$; **$p < .01$

Table 15. Test-retest Pearson's r Correlation of Non-specific Items for Midlife Stage, N = 30

Items	Correlation
Socialization	.41*
Instrument	.96**
Artistic Pastime	.63**
Physical Activity	.61**
Reading	--
Language	.81**
Travel	.48**

Note: -- = no variance; **$p < .01$

APPENDIX G

INTERNAL CONSISTENCY OF LEQ ITEMS

Table 16. Inter-item, Item to Subscale, and Item to Total Score Spearman Rho Correlation of Specific Items of Young Adulthood Stage, N = 90

Specific items	1	2	3	4
1. Years in high school	1	.26*	.35**	.29**
2. Post high school education		1	.92**	.71**
3. Subscale (Stage)			1	.86**
4. Total score				1

*$p < .05$; **$p < .01$

Table 17. Inter-item, Item to Subscale, and Item to Total Score Spearman Rho Correlation of Non-specific Items of Young Adulthood Stage, N = 90

Nonspecific items	1	2	3	4	5	6	7	8	9
1. Socialization	1	.13	-.03	.33**	.22*	.14	.08	.10	.19
2. Instrument		1	.13	-.07	0.24*	.20	.27*	.47**	.50**
3. Artistic pastime			1	.13	0.32**	.19	.22*	.24*	.40**
4. Physical activities				1	.19*	-.01	.18	-.04	.02
5. Reading					1	.25*	.30*	.39**	.474**
6. Language						1	.16	.46**	.54**
7.Travel							1	.32**	.36**
8. Subscale								1	.87**
9. Total score									1

*$p < .05$; **$p < .01$

Table 18. Inter-item, Item to Subscale, and Item to Total Score Spearman Rho Correlation of Specific Items of Midlife stage, N = 90

Specific items	1	2	3	4
1. Job title	1	.40**	.65**	.59**
2. Supervisory		1	.58**	.48**
3. Subscale score			1	.91**
4. Total score				1

*$p < .05$; **$p < .01$

Table 19. Inter-item Spearman, Item to Subscale, and Item to Total Score Rho Correlation of Non-specific Items of Midlife Stage, N = 90

Non-specific items	1	2	3	4	5	6	7	8	9
1. Socialization	1	.20	.15	.18	.17	.21	.25*	.32**	.33**
2. Instrument		1	.14	-.10	.05	.08	-.05	.39**	.36**
3. Artistic pastime			1	.12	.34**	.03	.03	.39**	.30**
4. Physical activities				1	.21*	.17	.22*	.26*	.18
5. Reading					1	.18	.23*	.47**	.39**
6. Language						1	.31**	.51**	.52**
7. Travel							1	.42**	.46**
8. Subscale score								1	.91**
9. Total score									1

*$p < .05$; **$p < .01$

Table 20. Inter-item, Item to Subscale, and Item to Total Score Spearman Rho Correlation of Specific Items of Late-Life Stage, N = 90

Specific items	1	2	3	4	5	6	7	8	9	10	11
1. Job	1	.04	.24	.01	.09	.07	.12	-.32	.11	.30**	.31**
2. Companionship		1	-.09	-.07	-.11	.02	.04	.01	-.09	.28**	.13
3 Social club			1	.17	.13	.32**	.29**	.15	.13	.26*	.26*
4. Volunteer				1	.20	.26*	.18	.18	.17	.32**	.33**
5. Reaching out					1	.17	.17	.03	.19	.40**	.36**
6.Entertainment						1	.47**	.37**	.44**	.54**	.51**
7. Typical day activities							1	.48**	.52**	.69**	.47**
8. Information								1	.42**	.39**	.31**
9. Information sources									1	.47**	.44**
10. Subscale score										1	.71**
11. Total score											1

*$p < .05$; **$p < .01$

Table 21. Inter-item, Item to Subscale, and Item to Total Score Spearman Rho Correlation of Non-specific Items of Late-Life Stage, N = 90

Non-specific items	1	2	3	4	5	6	7	8	9
1. Socialization	1	.03	.03	.16	.43**	.13	.20	.42**	.22*
2. Instrument		1	.13	-.07	.09	.07	.00	.36**	.32**
3. Artistic pastime			1	.19	.13	.09	.02	.41**	.21*
4. Physical activities				1	.17	.07	.08	.42**	.20
5. Reading					1	.08	.33**	.41**	.38**
6. Language						1	.17	.43**	.47**
7. Travel							1	.42**	.36**
8. Subscale score								1	.70*
9. Total score									1

**$p < .01$

APPENDIX H

CORRELATION OF MMSE ITEMS AND THE LEQ

Table 22. Pearson's r Correlation Coefficients of MMSE Items and the LEQ, N = 90

MMSE Items	LEQ
Orientation to time	-.08
Orientation to place	.25*
Registration	a
Attention	.20
Recall	-0.01
Naming	a
Repetition	-.01
Comprehension	.11
Reading	a
Writing	a
Drawing	.07
MMSE (total)	.19

Note: MMSE = Mini-Mental State Examination
LEQ = Lifetime Experience Questionnaire
a= SPSS did not compute correlation because at least one variable is constant; *$p < .05$.