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Memory self-efficacy in cognitively normal older adults and older adults with mild cognitive impairment

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MEMORY SELF-EFFICACY IN COGNITIVELY NORMAL OLDER ADULTS AND OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT

by

Mary Ellen Stolder

An Abstract

Of a thesis submitted in partial fulfillment
of the requirements for the Doctor of
Philosophy degree in Nursing
in the Graduate College of
The University of Iowa

December 2012

Thesis Supervisors: Professor Emeritus Kathleen Buckwalter
Professor Janet P. Specht

ABSTRACT

Although there are ample studies confirming that memory self-efficacy (MSE) declines with age, less is known about what factors account for the variation in MSE among older adults. The purpose of this study was to examine the relationship between MSE, diagnostic and clinical characteristics, and subsequent episodic memory performance in older adults. A nonprobability sample of 200 cognitively normal and older adults with mild cognitive impairment (MCI) participating in a longitudinal population-based study investigating the incidence, prevalence and risk factors for MCI completed a questionnaire about self-referent beliefs of MSE. Bandura's (1989) self-efficacy theory and the Integration Model (Whittemore, 2005) informed the descriptive study. Pearson product-moment correlations, a general linear model and a multiple linear regression analysis were conducted. The difference in MSE ratings between the cognitively normal group and the MCI group tested as a whole was significant when adjusting for age, gender and educational attainment ($p < .001$; ES= 0.585). The overall regression model explained 17 % of the variance of MSE ($p < .001$) and included age, gender, educational attainment, APOE 4 genotype, family history of dementia, cognitive diagnosis and depressive symptoms. After controlling for age and the other variables of interest, cognitive classification and depression were significant predictors of MSE. Higher MSE ratings were correlated with better episodic memory performance for both groups ($r = .273$, $p < .001$). Memory training that capitalizes on the benefits accruing from higher MSE is needed for cognitively normal older adults and older adults with MCI.

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CERTIFICATE OF APPROVAL

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PH. D. THESIS

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Memory is the treasury and guardian of all things.

Cicero

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INTRODUCTION

Background

Memory loss is an important concern among older adults who fear that memory lapses may mar their enjoyment of life. Further, they worry that with the passage of years their memory incapacity will impose a burden of care on their loved ones. This widespread concern also has grave public health implications as health care costs swell with the functional loss and dependency in this cohort and with the scarcity of therapies with any proven benefits. As the subject of intense research focus, memory loss in later life can be examined from multiple angles; one construct that requires further scrutiny is the role of memory self-efficacy (MSE). Conceptualized as a component of metamemory, MSE measures an individual's level of confidence and self-assessment of ability to perform successfully on a domain of memory tasks. Additionally, MSE may also represent a self-evaluation of memory capabilities in general.

Aging literature has reported that older adults with poorer memory self-efficacy (MSE) are less willing to engage in memory-challenging situations, put forth less effort in the face of demanding memory tasks, and perform more poorly on memory tasks than those with a stronger sense of self-efficacy (Cavanaugh, 2000; Chasteen, Park, & Schwarz, 2001; Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005; Dixon, Rust, Feltmate, & See, 2007; Gould, Mcdonald-Miszezak, & King, 1997; McDougall & Kang, 2003; Souchay, Moulin, Clarys, Taconnat, & Isingrini, 2007; Valentijn et al., 2006; Wells & Esopenko, 2008). Given that age-targeted cognitive training has been shown to improve memory performance among cognitively normal adults in randomized controlled

trials, boosting MSE can positively influence training outcomes and improve the capacity of older adults to maintain independent function into older age. Although the efficacy of delivering cognitive training interventions to individuals with mild cognitive impairment (MCI) is not as well established (Jean, Bergeron, Thivierge, & Simard, 2010), there is the theoretical implication of slowing or reducing the incident rate of dementia as the result of the use of successful compensatory strategies that are augmented by sufficient MSE.

Statement of the Problem

Memory loss is not an irrevocable part of aging; rather it is highly influenced by personal and contextual factors. Research findings suggest that age-related differences in memory performance are heightened both by activated negative aging stereotypes and a poorer sense of memory self-efficacy that is prevalent in older adults (Desrichard & Köpetz, 2005). Frequently individuals with poorer MSE are likely to attribute their expected memory failures to reasons beyond their control (e.g., "normal" aging). Adult and aging literature has established that older individuals have consistently lower levels of MSE than younger individuals and that the age-related decline in MSE is not closely tied to actual memory changes (Wells & Esopenko, 2008). Hence, beliefs in memory competency (i.e., MSE) may account for some of the large variance in older adults' memory performance relative to younger adults (Cavanaugh, 2000).

As the memory processing system becomes less reliable with aging, a reduction in MSE may undermine optimal memory function, which is vital to handling cognitively demanding tasks that are part of everyday functioning (Berry, West, & Dennehey, 1989). Of concern, older adults with reduced MSE are less apt to seek out and attempt cognitive interventions to remediate any losses in their memory. However, memory training

interventions that have been found to elevate self-efficacy and/or promote active transfer of strategies to real-world activities are instrumental to maintaining independence and improving health-related quality of life among older adults (Jobe et al., 2001; Wolinsky et al., 2006).

Since few longitudinal studies have examined changes in MSE in older adults, examining the relationship between these perceptions of memory abilities and subsequent cognitive decline in cognitively healthy older subjects and those individuals with established mild cognitive impairment (MCI) is crucial to the study of memory aging. Little is known about memory self-efficacy in cognitively impaired older individuals and whether a reduction in MSE may be a useful clinical predictor of cognitive decline. Given the absence of a "gold standard" neurobiological marker in the foreseeable future, the availability of simple, non-invasive and cost-effective indicators of disease progression may lead to earlier recognition of the progression from normal aging to MCI to dementia, with the added benefit of being able to offer cognitive rehabilitation interventions to those in the earliest stages of cognitive decline.

The Parent Study

The ongoing parent study, a National Institute of Aging (NIA) and National Institute of Mental Health (NIMH)-funded research effort, referred to as the Mayo Clinic Olmsted Study of Aging (MCSA), is based in Rochester, MN. The intent of the study is to establish the population-based incidence and prevalence and risk factors for cognitive impairment and to refine the diagnostic criteria for cognitive impairment. Using an ongoing population-based prospective cohort of 2,300 non-demented participants drawn from a target population of older individuals residing in Olmsted County on the

prevalence date of October 1, 2004, this study represents one of the first nationwide efforts to combine clinical, neuroimaging and biomarker information as predictors of cognitive impairment. In-person clinical measures are obtained at baseline and at each 12- to 18-month follow-up assessment for active participants of the study. At baseline and at each follow-up assessment, a cognitive classification of normal cognitive aging, MCI or dementia is adjudicated by an expert consensus panel of physicians, psychologists and nurses. Per study design, the consensus diagnosis and other study findings are not shared with study participants. Subjects who decline further participation in the study as active participants are followed up passively through a medical records linkage system. The principle investigator (PI) of the MCSA is Ronald Petersen, M.D., Ph.D.

Specific aims of the parent study are to establish stable estimates of incidence rates for transition rates from normal cognition to MCI subtypes; MCI to dementia; and MCI to other outcomes such as death, stable MCI, or reversion to normal cognition. Additionally, this study aims to investigate potential risk factors or predictors for transitions from normal cognition to MCI and MCI to dementia; to explore multivariate models of risk factors or predictors resulting from findings for transitions from normal cognition to MCI and from MCI to dementia; and to provide subjects and biological materials for related research projects.

Purpose of the Study

The following paragraph explains the purpose of the study and describes its difference from the larger study. This investigator was added as an external collaborator on the MCSA for analyzing the data collected from the one time only memory

questionnaire added to the neuropsychological battery at a single follow up visit. A secondary data analysis examined differences in MSE ratings in a nonprobability sample of 200 active participants, undergoing the 15-month follow-up assessment during a four month period in 2012, who completed the study instrument. Based on classifications determined by an expert consensus panel, a group classified as having normal cognition, a group with classified amnestic MCI (A-MCI) and a group with classified non-amnestic MCI (NA-MCI) was compared. The research questions and hypotheses guiding the study include:

Research question #1

Question: What is the relationship between MSE scores and cognitive classification group for active participants of the Mayo Clinic Olmsted Study of Aging? Hypothesis associated with research question # 1: Subjects in the A-MCI group will demonstrate lower MSE scores on average compared to those in the cognitively normal group or those in the group diagnosed with NA-MCI.

Research question #2

Question: What is the relationship between MSE rating and the variables of age, gender, level of education, depressive symptoms, cognitive classification, the use of psychoactive medications, APOE 4 carrier status and family history of dementia? Hypothesis associated with research question #2: Based on known risk factors for decreased memory performance among older adults, higher MSE scores will be related to younger age, the absence of depressive symptoms, higher level of education and female gender. Conversely, lower MSE scores will be associated with family history of dementia, the use of psychoactive medications, and APOE 4 carrier status.

Research question # 3

Question: What is the relationship between MSE rating and episodic memory performance in the cognitively normal group? Hypothesis associated with research question #3: Given prior research findings, i.e., that MSE beliefs are based in part on actual ability but not necessarily accurate, the direct relationship between the measure of MSE and memory performance scores is expected to correlate positively yet modestly with an episodic memory performance score on a standardized screening instrument.

Summary

This study examined the relationship between MSE scores and group classification in a convenience sample of active participants enrolled in the MCSA. The relationships between MSE rating and key demographic variables, the use of psychoactive medications, depressive symptoms, positive family history of dementia and APOE 4 carrier status were also examined. Finally, the relationship between cognitive performance and MSE ratings in the group with normal cognition was analyzed. Chapter two describes key conceptual definitions followed by the theoretical frameworks that guided the study, with a discussion of the literature related to memory changes associated with aging; memory self-efficacy in community-dwelling older adults; stereotype threat; and the efficacy of memory training interventions.

CHAPTER II

LITERATURE REVIEW

Definitions

The following definitions encompass the main concepts in the study.

APOE 4

Of the three apolipoprotein isoforms (E2, E3, E4) of the polymorphic APOE gene mapped on chromosome 19, the APOE 4 allele confers the greatest risk of developing Alzheimer's disease (AD). The APOE 3 allele is the most common isoform (80-90%), whereas the APOE 2 and APOE 4 account for 5-10% and 10-15%, respectively (Mahley, Weisgraber, & Huang, 2006). The detrimental mechanism of APOE 4 is thought to be related to its cholesterol-carrying function, determining how the brain responds to other adversities and how likely the person is to form the neurofibrillary tangles in the brain which are a hallmark of Alzheimer's disease (AD). Individuals homozygous for APOE 4 have an 8- to 18-fold increase in the incidence of AD, with a lifetime risk of 50 to 60%. An estimated 58% of the population is heterozygous for APOE 4, which increases the incidence by 3- to 5-fold. There is also fairly convincing evidence that the APOE 2 allele may serve a protective role in AD (Mahley et al., 2006).

Cognition

Cognition refers to mental processes (thoughts) of knowing, encompassing awareness, perception, reasoning and judgment. In psychological terms, it most commonly refers to individual processing of information and the application of knowledge. Cognition may be viewed also as a social process whereby the individual receives input from the social world. With advancing age, a decline in cognitive function

is not a uniform occurrence and there are pronounced individual differences in the rate and timing of changes in cognition (Schaie, 1994). Cognitive impairment associated with normal aging includes loss of memory for words and names, slowed processing speed and difficulty sustaining attention when faced with competing environmental stimuli. These changes occur in normal aging without evident functional impairment and are distinctively different from the memory loss associated with dementia. For some older adults, observed cognitive decline may be attributed to disease and may be reversible (Gauthier et al., 2006). For study purposes, MCI and its subtypes and normal cognitive diagnostic classification established by well-defined MCSA criteria were operationalized

Depression

Depression refers to a group of symptoms that represent a change from previous functioning. Characteristically these symptoms include depressed mood or loss of interest or pleasure in addition to changes in appetite, weight, and sleep patterns. Other hallmark symptoms include feelings of guilt and worthlessness, loss of concentration, psychomotor agitation or retardation, and suicidal ideation. These symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning (American Psychiatric Association, 2000). Subjective complaints of cognitive loss may be more related to depressive affect than to actual memory impairment (Zimprich, Martin, & Kliegel, 2003) and may persist despite remission of depression (Lee, Potter, Wagner, Welsh-Bohmer, & Steffens, 2007). Depressive symptoms were operationalized by the participants' most recent Beck Depression Inventory-II (BDI) score.

Memory

Memory is the ability to store, retain and recall information and experiences. To best understand divergent patterns in memory performance in later years, a memory systems perspective has influenced research on memory and aging organization and relationships among systems. Memory is not a single function but may be best described in terms of several memory systems that show differential aspects of aging (Craik & Salthouse, 2000; Salthouse, 2003). Craik (2008) offered a model whereby overall memory performance is viewed as a complex set of interactions between variables associated with the individual, with tasks, and with the degree of environmental support. For study purposes, episodic memory was operationalized by normative age and education-adjusted standard scores for immediate and delayed verbal memory on the most recently administered Neuropsychology Screening Battery (NSB).

Memory Self-efficacy

Even though memory self-efficacy is related to general self-efficacy, it is still distinct. Specifically, memory self-efficacy (MSE) is one's sense of mastery or capability to use memory effectively in situations that demand it. MSE is regarded by theorists as a construct that can be measured reliably and validly (Hertzog, Hultsch, & Dixon, 1989). Memory complaint questionnaires, other self-efficacy measures, single-task prediction performance and "feeling-of-knowing" confidence ratings have yielded widely divergent findings about subjects' self-ratings and objectively measured memory parameters, both in individuals with normal age-related changes in memory and those with MCI (Cavanaugh & Murphy, 1986; Cipolli et al., 1996; Lin et al., 2010; Perrig-

Chiello, Perrig, & Stahelin, 2000; Perrotin, Belleville, & Isingrini, 2007; Reese & Cherry, 2006; Serra, Dunlosky, & Hertzog, 2008; Valentijn et al., 2006; Zimprich et al., 2003). In addition to its cognitive influences, self-efficacy also affects the extent to which a person experiences stress and depressive symptoms when faced with challenging situations (Bandura, 1989). Memory self-efficacy was operationalized by two subscales of the Metamemory in Adulthood (MIA) questionnaire (Hertzog et al., 1989).

Metamemory

Metamemory, i.e., thinking about remembering, involves a highly complex, dynamic process that mediates and is mediated by a host of other constructs such as personality, cognitive level, and social context (Cavanaugh, & Green, 1990). The term "metamemory" broadly refers to thoughts about memory and includes general knowledge of memory functioning, insight into whether individual memory changes or impairment exists, an awareness of one's current abilities, beliefs about memory skills and demands, and memory-related emotions (Cherry, Brigman, Hawley, & Reese, 2003; Dixon et al., 2007; Reese & Cherry, 2006). Departing from the original concept of metamemory with its exclusive emphasis on knowledge base, a conceptual framework provided by Hultsch, Hertzog, Dixon and Davidson (1987) distinguished four dimensions of metamemory: *memory knowledge,* reflecting factual knowledge about memory function; *memory monitoring*, entailing self-awareness of one's memory performance; *memory-related affec*t, reflecting the emotions relative to memory situations; and *memory self-efficacy*, which involves one's sense of competency in the memory sphere.

Self-evaluation of memory is regarded as one of the most important aspects of memory in older adults. In aging, metamemory knowledge of effective strategies

remains relatively preserved though it may not be applied in memory situations as warranted (Hertzog & Hultsch, 2000). One's metamemory beliefs about age-related decline may influence the extent that one is willing to engage in memory-challenging social situations; one's degree of motivation and effort in the face of a demanding memory task; one's expectation relative to performance; and one's actual performance (Cavanaugh, 2000; Chasteen et al., 2001; Chasteen et al., 2005; Dixon et al., 2007; Gould et al., 1997; Gould et al., 1997; McDougall & Kang, 2003; Souchay et al., 2007; Wells & Esopenko, 2008).

In a longitudinal study examining whether perceptions of memory change arise from application of an implicit theory about aging and memory or from accurate monitoring of actual changes in performance in two samples of adults, the authors reported that overall the findings were consistent with predictions derived from an implicit theory of aging hypothesis. Moreover, individual differences in metamemory were highly stable over time (McDonald-Miszczak, Hertzog, & Hultsch, 1995). One domain of metamemory, memory self-efficacy, will be operationalized by two subscales of the Metamemory in Adulthood (MIA) questionnaire.

Mild Cognitive Impairment (MCI)

By definition MCI refers to a syndrome that is considered to be a transitional stage of cognitive impairment between normal aging and dementia that does not meet criteria for a formal diagnosis of dementia (Petersen et al., 2001). Individuals with MCI present with subjective complaints of progressive memory changes (preferably corroborated by an informant) that is supported by objective cognitive impairment on psychometric testing that is 1.5 SD below that expected for their age and education.

However, functional ability is mainly preserved, particularly on complex instrumental activities of daily living. Although no validated neurobiological marker exists for MCI, known risk factors for A-MCI include older age, fewer years of educational attainment, the presence of an APOE 4 genotype and a lifetime history of depression (Kryscio, Schmitt, Salazar, Mendiondo, & Markesbery, 2006; Roberts et al., 2012). Cognitively normal individuals recruited by the Mayo Alzheimer Disease Patient Registry for longitudinal studies of cognitive aging who developed depression were found to be at increased risk of subsequent MCI, with a synergistic interaction between apolipoprotein E genotype and depression (Geda et al., 2006). Depression more than doubled the risk of transition to MCI after controlling for age, education and gender. One important finding was that persons with depression who subsequently developed MCI or dementia complained of memory problems more frequently than those who remained cognitively normal.

The clinical criteria for MCI have been revised in recent years with the recognition that MCI is a more heterogenous entity than originally thought (Petersen, 2007a; Petersen, 2007b; Petersen, 2011). When memory loss is the most predominant symptom it is referred to as amnestic MCI (A-MCI), a subclassification of MCI that is more empirically validated than the subtype of nonamnestic MCI. If impairment in other cognitive domains (e.g., language) in addition to memory loss is evident, the diagnosis of A-MCI multi-domain is specified. When an individual presents with non-memory-impaired deficits in other cognitive domains, it is classified as single non-memory MCI or multi-domain non-memory MCI depending on how many cognitive domains are impaired (Feldman & Jacova, 2005; Rosenberg, Johnston, & Lyketsos, 2006). In this

subtype, that is likely less prevalent than the amnestic type, there are barely perceptible declines in functions not directly related to memory that affect attention, use of language or visuospatial skills (Petersen, 2011).

Diagnosing MCI requires a comprehensive clinical assessment in addition to detailed neuropsychological testing. Blood tests and neuroimaging techniques are often undertaken to rule out an alternative diagnosis. There are varying estimates of the prevalence, incidence and outcomes for MCI, with a general agreement that the incidence rates of dementia for individuals with MCI and each of its subtypes are uniformly higher than those found for cognitively normal individuals over 65 (Feldman & Jacova, 2005). Depending on the classification and exclusion criteria being used in population-based epidemiological studies, the prevalence of MCI ranges from 3% to 19% of adults older than 65 years, with more than half progressing to some form of dementia within 5 years (Gauthier et al., 2006). In particular, research findings implicate the subtype A-MCI as a frequent precursor of Alzheimer's disease (Feldman & Jacova, 2005). Relative to MCI conversion to dementia, Petersen and colleagues (2001) reported a progression rate from MCI to dementia of 80% over six years. Predicting who will progress to dementia remains unrefined although the prognostic role of neuropsychological test performance is promising (Duff et al., 2008). In addition, research on subjective memory complaints is contradictory in terms of accuracy and its predictive roles in MCI (Roberts, Clare, & Woods, 2009). Another consideration is that many cases of MCI are reversible, with up to 44% of individuals in some population- based studies estimated to return to normal cognition a year later (Unverzagt et al., 2001). However, more recent prospective studies indicate lower rates (Manly et al., 2008). Additionally Peterson (2011) cautioned that

reversal to normal cognition at the time of a relatively short follow-up does not preclude later progression. For the purposes of the study, MCI and its subtypes and normal cognitive diagnostic classification will be determined by the MCSA criteria delineated by Petersen (2004) and operationalized according to these parameters.

From the existing literature addressing age-related memory changes, there are several areas that need systematic examination in order to better apply the research base to address the challenges confronting older adults. There is an emerging body of important translational research which examines the benefits of memory training and memory compensation mechanisms for everyday activities of older adults. Examining aspects of social, experiential and personal characteristics that contribute to the conceptual integration of changes that accompany aging may also prove beneficial (Bandura & Locke, 2003; Blazer, 2002; Kim & Mueller, 1997).

There has been considerable interest in recent years, too, in the concept of memory self-efficacy and how it influences cognitive aging. Defined as a self-evaluative system of one's beliefs in one's capacity to use memory effectively in a variety of situations, a lower sense of memory self-efficacy (MSE) is prevalent among older adults compared to younger adults (Lineweaver & Hertzog, 1998). Significantly, a strong association between MSE and actual performance on everyday tasks among older adults has been reported (Berry et al., 1989; Seeman, McAvay, Merrill, Albert, & Rodin, 1996). Taken together, these findings suggest that further investigation of the role of memory self-efficacy offers the possibility of establishing interventions that optimize memory adaptation in later life, improve quality of life and reduce the costly public health burden of dementia care.

Theoretical Framework

With respect to the theoretical foundation of the study, there are several conceptual models that are relevant to the concept of memory self-efficacy and aging. Three models are of particular interest in terms of application of constructs to everyday functioning. Both the Self- Efficacy Model (Bandura, 1989) and the Successful Aging Model (Baltes & Baltes, 1990) have been adapted for use in health-related behavior and provide a useful explanation for ways in which self-beliefs may enhance or compromise a person's behavior. However, the self-efficacy model, in particular, may be limited in its ability to encompass many of the dynamics in play, necessitating a more comprehensive framework to explicate these relationships. Components from these two models have utility for a third preferred model, the Integration Model (Whittemore, 2005), which is a nursing model that identifies the antecedents and consequences of events that are associated with life transitions such as aging.

The Integration Model was selected and adapted for use for this dissertation because of its potential for nursing theory development, further research and the development of interventions that preserve everyday memory function, compensate for deficits, and enhance quality of life. With age-related memory changes, a restoration of prior level of functioning may not be a reasonable expectation, necessitating that the individual integrate the reality of their current circumstances while taking on a merged identity. Supportive attitudes and beliefs such as strong memory self-efficacy may contribute to awareness for the need to change and promote the process of self-management, resulting in acceptance, reconciliation and a positive self-concept.

Self-Efficacy Model

An influential theory for examining the role of self-beliefs and its relationship to memory abilities is Bandura's Self-Efficacy Model (Bandura, 1989). The concept of self-efficacy is central to social learning theory which proposes that people who regarded themselves as highly capable act, think, and behave differently from those who do not (Bandura, 1989). Closely related to self-confidence, self-efficacy is the positive judgment of one's own capacity to perform. Self-efficacy is not the same as actual skills one has, but rather the belief about what one can do with one's skills.

Self-efficacy beliefs underlie human motivation, well-being, and personal accomplishment. Four elements affect self-efficacy: mastery experience, modeling, social persuasions and physiological factors. Perceived self-efficacy positively influences level of goal setting as well as the degree of effort and persistence when encountering difficulties (Bandura & Locke, 2003). Conceivably, one's judgment about self-effectiveness can better predict performance than actual ability, whereby these beliefs determine what one does with the knowledge and skills at hand.

Albert Bandura (1989), a Stanford University psychologist, proposed diverse ways that perceived self-efficacy contributes to cognitive functioning. According to Bandura, one's beliefs about self-effectiveness may better predict performance than actual ability. Significantly, older adults consistently report less memory capacity, perceive that they have less direct control over their memory, and hold negative stereotypes about memory changes associated with aging (Corner & Bond, 2004; Hawley, Cherry, Su, Chiu, & Jazwinski, 2006; Hultsch et al., 1987; Jin, Ryan, & Anas,

2001; Troyer & Rich, 2002; Turner & Pinkston, 1993; Zeintl, Kliegel, Rast, & Zimprich, 2006).

Bandura's model (1989) elucidates diverse ways that perceived self-efficacy contributes to cognitive functioning. For example, lower memory self-efficacy is associated with attribution of memory failure to causes beyond one's control, increasing vulnerability to failure in memory-demanding situations, not only in laboratory tests but in everyday types of activities (West & Berry, 1994). Bandura also argued that any judgment of competence is a social construction. Hence, if a society holds fast to a belief in age-related memory decline, older adults may allow this belief to influence their memory performance. Attributing expected failure to a reason beyond one's control (e.g., aging) may in turn lead to dampened desire to persevere and self-monitor performance. Thus the dynamic reciprocal nature of competency (or self-efficacy) beliefs and one's own evaluation of performance may reduce cognitive motivation and subsequent memory performance and further lessen self-efficacy (Cavanaugh & Green, 1990).

The construct of self-efficacy acts primarily as a moderator, mediator or predictor in social-cognitive models of health behavior change (McDougall, 2009; Strecher, DeVellis, Becker, & Rosenstock, 1986). Having confidence in one's capabilities influences not only the amount of effort to exert in a specific situation but the degree of perseverance when faced with roadblocks. Bandura's conceptual model that shows how perceived self-efficacy enhances memory performance directly and by increasing cognitive processing of information is displayed as Figure 1.

A second model shows the mediating role of perceived self-efficacy in the mastery of specific competencies (Figure 2). Those with high self-efficacy exhibit a greater efficiency in analytical thinking in the mastery in complex decision-making tasks whereas those with low self-efficacy are likely to be more inconsistent in analytical thinking. In turn, the quality of analytical thinking influences the degree of performance success (Cavanaugh & Green, 1990). However, due to the number of complex and mediated relationships between content knowledge and beliefs and that of performance, a strong association between MSE and objective performance is rarely a reported finding.

Close Successful Aging Model

Baltes and Baltes (1990) conceptualized a metamodel of successful aging that rests on the premise that successful individual mastery relies on the processes of selection, optimization, and compensation. Successful aging is a socially and culturally defined construction, with interactions among inner biology, individuality and social constructs that exert a profound influence on cognitive function (Hess, 2005). The well-known Selective Optimization with Compensation (SOC) Model takes into account how individuals accommodate age-related losses and views mastery of goals in the context of these three processes. Prioritizing goals (selection) according to their importance for promoting gain in the process (optimization) and avoiding losses (compensation) are key strategies to promote adaptive behavior and ensure successful aging. For older adults, an awareness of age-related memory changes may in turn be the antecedent to engaging in selective optimization with compensation strategies (Baltes & Carstensen, 1996; de Frias & Dixon, 2005).

Integration Model

A final explanatory framework to apply to successful compensation for age-related memory losses is a model that draws from the fields of psychology, sociology and medicine. Westra and Rodgers (1991) analyzed the concept of integration for its adaptation to nursing. Coping, adaptation and accommodation were not found to capture the interactive nature of persons in their relationship with their personal, social and physical environment. Whittemore (2005) returned to the concept of integration to examine its utility as a theoretical framework to examine how individuals adjust to living with a chronic condition.

Though quantitative measurements of integration were lacking, Whittemore suggested that integration could be used as an outcome measure that is sensitive to change. Nursing interventions that promote self-management and symptom management could be developed to facilitate successful transitions and to promote integration. If self-care behaviors could be integrated into self-identity, better health outcomes might result. Whittemore identified a number of facilitators such as personal knowledge and understanding, sufficient guidance, connections with family and friends, as well as personal characteristics such as optimism that foster acceptance of change and the development of a positive sense of coherence. As an overarching framework, integration could provide a better understanding of the factors that help or hinder self-acceptance. Applicability to the integration of age-related changes (e.g., age related deficits in sensory processing) was suggested by Whittemore as a potential avenue of investigation and guides this research (see Figure 3).

Memory Changes Associated with Aging

Numerous studies of memory and aging have examined the extent and the domains of memory decline in older adulthood (Dixon et al., 2007). One influential theory is that much of late-life decline in memory performance is explained by slower processing and response speed, with a modest age decline from young adulthood until late adulthood (Salthouse, 2000). There is broad general agreement that memory aging begins in early adulthood and overlaps with other aspects of cognitive aging. Notably, memory aging in early and middle adulthood is associated with a shift of the entire distribution of the curve and is not attributable to the small number of individuals experiencing a steep decline, with the remainder maintaining the same level of performance (Salthouse, 2003). Notwithstanding the rare "successful agers" that go through life with virtually no cognitive decline, advancing age itself is associated with greater interindividual (diversity) and intra-individual differences, leading to a greater variance in cognitive scores at older ages (Christensen, 2001; Petersen, 2011).

Episodic memory refers in part to storage and recollection of autobiographical information and specific events and generally shows a continuous linear decline from early adulthood. However, task performance that involves episodic memory varies depending on the testing method and the nature of the material. Further acceleration in late old age may signal further cognitive decline (Cook & Marsiske, 2006; Jessen et al., 2007; Rosen et al., 2002). Aspects of memory function that hold up relatively well in older adults include prospective memory (remembering to carry out an intention at some future time), procedural memory (memory for cognitive and sensorimotor procedures), implicit learning (learning without conscious effort), and semantic memory (retrieval of

well-learned and often-used facts). Some studies have established that working memory (manipulating information held in mind) is particularly vulnerable to the effects of aging and that uncued prospective memory is not as spared as originally thought (Backman, 2008; Kliegel & Jager, 2006; Light, 1991; Luo & Craik, 2008; Macdonald, Stigsdotter-Neely, Derwinger, & Backman, 2006; Neupert & McDonald-Miszczak, 2004; Thornton & Dumke, 2005).

Research has been directed at identifying which memory processes are bolstered by the external environment or by well-learned schematic knowledge and which are more reliant on self-initiation and encoding. These latter operations are considered to be the domain of frontal lobe functioning, in addition to other cognitive functional abilities such as attention, executive control, learning and problem solving. The difficulty with self-initiated processing may stem from the declining efficiency of frontal lobe function, in particular a decrease in the dopaminergic system projections to the frontal cortex (Braver & Barch, 2002; Cabeza, 2002; F. Craik & Grady, 2002; Stebbins et al., 2002). These functional abilities are likely to show a drop in both normal and pathological aging (Backman, 2008; Burton, Strauss, Hultsch, Moll, & Hunter, 2006; Thornton & Dumke, 2005; Thornton, Deria, Gelb, Shapiro, & Hill, 2007). Thus if older adults are less able to self-initiate memory processes and need to rely on the environmental context to perform successfully, they are accordingly more likely to benefit when such environmental support is provided (Bissig & Lustig, 2007).

In a longitudinal study, Christensen (2001) examined cognitive decline among community-dwelling older adults and found that cognitive speed and memory performance declined with age. Variability of scores also increased with aging. Poor

health, lower activity, fewer years of education, elevated blood pressure, and the presence of the APOE e4 allele predicted cognitive decline. The author concluded that cognitive decline is not unitary and that some cognitive abilities decline more rapidly.

In a seminal study of adult intellectual development, Schaie (1994) identified the antecedents of individual differences in age-related changes in cognitive performance: the absence of cardiovascular disease and other chronic diseases; favorable environmental circumstances characterized by high social economic status; a substantial involvement in complex and stimulating activities; a flexible personality style (per self-report); being married to a spouse with high cognitive status; the maintenance of a high level of processing speed within old age; and rating oneself as being satisfied with one's life accomplishments. Along these lines, Stern (2002) proposed that engagement in intellectual, social, and physical activities of a stimulating nature may confer a protective benefit against the effects of cognitive aging.

Recent studies have examined the protective role of continued engagement in social activities as a means to preserve memory function and compensation for age-related losses. Ertel, Glymour and Berkman (2008) found that high levels of social integration delayed memory loss in a nationally representative sample of older Americans (n=16,638) followed prospectively for six years. The study authors theorized how social integration may buffer cognitive decline: through improved physical health by means of social pressures to take care of oneself; through cognitive aspects of social interaction resulting from mastery of complex cognitive and memory challenges; and through contacts with loved ones which may provide a sense of purpose and worthiness that confers direct neurohormonal benefits.

Memory Self-Efficacy in Community-Dwelling Older Adults

An noted earlier, older adults consistently report less memory capacity, perceive that they have less control, and hold negative stereotypes about memory changes associated with aging (Corner & Bond, 2004; Desrichard & Köpetz, 2005; Hawley et al., 2006; Hultsch et al., 1987; Jin et al., 2001; McDougall, 2004; Troyer & Rich, 2002; Turner & Pinkston, 1993; Zeintl et al., 2006). Memory self-efficacy in older adults can vary considerably depending on the task and whether it takes place within an everyday or laboratory setting. Although older adults may feel that they are unable to perform at the level of younger individuals, their confidence level is not substantially lower than that of the young for specific memory tasks they feel that they can carry out (Lachman & Jelalian, 1984). Accordingly, it may be necessary for researchers to address multiple measures of self-efficacy (West & Berry, 1994).

Neupert and McDonald-Miszczak (2004) investigated cognitive and metacognitive variables as predictors of younger and older adults' (mean age of older adults, 74 years) delayed recall of cued medication instructions. This study entailed subjects completing cognitive testing and reporting their everyday and task-specific memory self-efficacy. Hierarchical regression analysis indicated that both cognitive abilities and metacognitive beliefs played a role in both young and older adults' delayed recall of medication instructions. Significantly, working memory ability was especially important for older adults' recall.

In a study of 307 community-dwelling adults ranging from 18 to 93 years of age, adults of all ages (young, middle-aged and older) were predisposed to associate memory failure with aging rather than to contextual or temporary causes (Lineweaver & Hertzog,

1998). Two specifically developed questionnaires, the General Beliefs about Memory (GBMI) and the Personal Beliefs about Memory Instruments (PBMI) were used to compare and contrast beliefs about memory for the general population from one's own memory beliefs. On average, all age groups perceived the average adult as experiencing a curvilinear decline over the adult lifespan for multiple aspects of memory, with the greatest change after age 40. Respondents also endorsed beliefs about specific memory types that were consistent with empirical results regarding aging and memory. On most items, both middle-aged adults and older adults believed that memory decline did not occur as early in adulthood as did younger adults. The authors suggested that this finding might be attributed either to a self-enhancement bias, personal experiences with aging, or to denial of the magnitude of memory decline.

The research hypothesis that personal beliefs are merely extrapolations of implicit theories was not completely supported in the above study. Though implicit theories about memory were strongly related to personal beliefs about memory efficacy, some of the age differences for the two instruments were inconsistent with the hypothesis that they measure the same construct. Further research is needed to better understand how personal and general beliefs about memory are related to each other and to personal characteristics. Finally, the authors suggested that lay persons and psychologists alike may share a belief that age-related declines are both normative and inevitable and that age changes of cognition in everyday life may be altered through effort.

McDougall (2004), a nurse researcher, examined demographic variables, depressive symptoms, health, memory self-efficacy and metamemory in relation to memory performance of black and white American older adults with Mini-Mental State

Examination (MMSE) scores in the non-impaired range. Memory self-efficacy scores of the entire sample indicated low self-efficacy, with the black elders scoring lowest on both memory self-efficacy and memory performance. Memory self-efficacy predicted memory performance in the White group, but the correlation for the Black group was statistically insignificant. Age, educational attainment, and MSE accounted for 13% of the variance in memory performance. McDougall concluded that the research participants demonstrated low confidence in their memory ability and that this lack of confidence negatively influenced their everyday memory performance.

In another cross-sectional study, McDougall (1995) examined MSE and strategy use in a sample of community-dwelling elders (n=169) and reported a statistically significant decrease in MSE with age. McDougall also examined the relationship between memory self-efficacy, anxiety, depressive symptoms and health status. The Strategy subscale of the Metamemory in Adulthood (MIA) instrument indicated that external memory strategies were used significantly more often than internal mnemonics, though the correlation between memory strategies and MSE was insignificant. The investigator suggested that among older adults without any measurable depressive symptoms and with a high perceived health status, beliefs about memory may be influenced by age. Additionally McDougall concluded that remedial memory training would benefit from the assessment of memory self-efficacy and anxiety because these variables may hold prescriptive possibilities.

Bielak, Hultsch, Levy-Arzenkopf, MacDonald, Hunter and Strauss (2007) compared short-term changes in younger and older adults' memory-specific control beliefs. Exposure to a series of cognitively demanding tasks led to decline in older

adults' ratings of either general or memory-specific competence, compared to little change or improvement in younger adults. Older adults were also more inconsistent in self-ratings.

In the MacArthur Studies of Successful Aging (Seeman et al., 1996), positive instrumental efficacy beliefs predicted better verbal memory performance in men at a 2.5 year follow up. No association was found for women after controlling for baseline verbal memory score and sociodemographic and other health status characteristics. However, self-efficacy beliefs did not predict performance in any of the other cognitive domains for either gender.

Memory complaints in the absence of objective memory impairment are a common finding among older adults though relatively few seek medical attention. Ramakers and colleagues (2009) investigated what factors determine whether individuals with subjective memory complaints seek attention at a memory clinic. Adults with memory complaints were compared to control subjects who did not seek help for their complaints. Those who sought help scored lower on memory self-efficacy and lower on quality of life indicators.

Despite normal memory functioning according to standard memory testing, these individuals reported less memory capacity and more decline in memory functioning than did controls. They were also more likely to report a family history of dementia. However, similar levels of depressive and anxiety symptoms as well as levels of extraversion and neuroticism were found between the two groups. As expected, these findings suggest that one's personal (subjective) evaluation of memory function may be instrumental in help-seeking behavior. In conclusion, the authors recommended a

consideration of cognitive behavioral therapy to improve subjective memory functioning and coping skills for those persons with memory complaints who lack objective impairments. However, the authors also acknowledged that lower scores in memory self-efficacy might reflect neurodegeneration that is too subtle to be detected by standard psychometric testing.

In a six year longitudinal study of normal aging in a sample of relatively healthy older adults (Valentijn et al., 2006), researchers investigated the relationship between baseline memory self-efficacy (MSE) and objective indicators of episodic memory functioning in a sample of Dutch older adults (n=557). The total score on the abridged Dutch version of the Metamemory in Adulthood (MIA) questionnaire predicted memory performance as measured by a verbal memory performance task (Ponds & Jolles, 1996). Three domain-specific factors measured in the questionnaire were used: beliefs about one's current level (Capacity), beliefs about changes in memory from early adulthood (Change), and perceived anxiety in relation to memory (Anxiety). The authors concluded that a perceived sense of change in memory performance may indeed be an accurate reflection of objective performance and that lower MSE scores may underlie avoidance of cognitively demanding situations or reflect a use of ineffective strategies to maintain memory proficiency. These findings extend the understanding of the longitudinal relationship between MSE, subjective feelings of memory dysfunction and actual performance.

Stereotype Threat

Though memory beliefs have been an extensive focus of research investigations, another body of literature has extended the understanding of the impact of culturally

shared stereotypes that older adults hold regarding memory performance. All in all, there is an inclination for adults of all ages to associate memory failure with aging (Lineweaver & Hertzog, 1998). Placing older adults in a testing situation in which widely held stereotypes about aging are triggered play a role in subsequent memory performance (Desrichard & Köpetz, 2005). Strong stereotypes and actual deficits may combine to reduce self-efficacy, leading to further deterioration of memory skills, with the consequence that older persons become victims of their own low expectations (Berry et al., 1989).

In a study examining feelings of stereotype threat and its influence on older adults' memory performance, researchers found overall better memory performance for younger than older adults under different instruction sets (Chasteen et al., 2005). Younger and older adults were asked to complete a memory task that either emphasized or de-emphasized memory. Age differences in memory performance were mediated by individuals' feelings of stereotype threat, with age positively related to stereotype threat and stereotype threat undermining memory performance. The authors concluded that concerns about being negatively stereotyped influenced apparent age differences in memory performance that proved resistant to varying task instructions to reduce these feelings.

The degree to which older research participants value memory ability and the differential effect of stereotype threat on memory performance was examined by Hess and Hinson (2006). Adults (24-86 years of age) were randomly assigned to read either negative or positive information related to aging and memory prior to completing a memory task. Performance among the youngest and oldest research participants was

insignificantly influenced by stereotype manipulation. However, adults in their 60s demonstrated effects consistent with activation of stereotype threat, possibly related to increasing identification with older adults. Conversely, middle-aged adults showed performance benefit, presumably based on stereotype lift, a phenomenon that emphasized the dissimilarity between them (out-group) and older participants (target in-group). The authors found the higher the value placed on one's memory and the greater the concern about one's memory increased vulnerability to stereotyped-based cues.

The specificity of stereotype threats in later adulthood and its effects on older adults' memory performance was recently studied by Hess, Hinson and Hodges (2009). In a study examining whether stereotype-based influences were moderated by age, education, and concerns about being stigmatized, adults aged 60-70 years and 71-82 years (n=103) were tested under conditions designed to activate or reduce stereotype threat. Threat influenced the performance in the young-old more than in the old-old group. The reverse was shown for the effects of stigma consciousness. Additional analysis indicated that there was little supporting evidence of a mediating role of anxiety (as measured by state anxiety and skin conductance responses) or working memory as suggested by earlier studies. Concerns about being stereotyped negatively altered performance with the effect most pronounced at higher levels of education. The authors concluded that age, education and stigma consciousness all moderated memory performance.

In reviewing cross-sectional and longitudinal research related to stereotype threats and aging effects, McDaniel, Einstein and Jacoby (2008) posited that aging stereotypes can exert a profound effect in memory studies to the degree that stereotype activation

may completely mediate the relationship between age and memory performance. Of equal interest, age differences in memory performance are more evident in cultures that hold negative aging stereotypes; deemphasizing the memory nature of a task improves memory performance in older adults; and implicitly priming negative stereotypes reduces memory performance in older adults (McDaniel et al., 2008). Though it has proven difficult to remove stereotype threat under testing conditions, boosting self-efficacy in training procedures is one mechanism by which memory performance is less likely to be compromised (Floyd & Scogin, 1997).

The Efficacy of Memory Training Interventions

Persons with the greatest need, i.e., those of more advanced age and those with lower baseline cognitive ability, often show the least improvement on memory training interventions (Bissig & Lustig, 2007; McDougall, 2001). Effective interventions to improve memory need to have broad consequences or include multiple strategies to target different types of memory (Salthouse, 2003). Recent findings indicate that baseline memory and speed of processing abilities, age, and education are predictive of older adults' response to memory training (Langbaum, Rebok, Bandeen-Roche, & Carlson, 2009). Additionally, some evidence exists that both healthy, cognitively intact adults and older adults with MCI can improve and sustain memory skills through training programs, though traditional approaches have not been consistent in demonstrating transfer of training (Ball et al., 2002; Bayen, McCormack, & Bann, 2005; Belleville, 2008; Cavallini, Dunlosky, Bottiroli, Hertzog, & Vecchi, 2010; Jean et al., 2010; Rapp, Brenes, & Marsh, 2002). Novel approaches such as online and CD-ROM-based training offer some promise, enhancing the accessibility, affordability and applicability of memory

learning (Bailey, Dunlosky, & Hertzog, 2010; Rebok, Carlson, & Langbaum, 2007; Smith et al., 2009; Winningham et al., 2003). Improving cognitive performance may enhance an individual's perceived personal control over remembering abilities and improve cognitive motivation, subsequent memory performance, and lead to a greater sense of well-being (Aben, Busschbach, Ponds, & Ribbers, 2008; Hoogenhout, de Groot, van der Elst, & Jolles, 2012; Kurz, Pohl, Ramsenthaler, & Sorg, 2009; McDougall, 2009; McDougall, 1998; McDougall, Becker, Acee et al., 2010; McDougall, Becker, Pituch et al., 2010; Schafer & Shippee, 2010; Smith et al., 2009; Valentijn et al., 2005).

A memory training program that targeted self-efficacy theory in a diverse age sample yielded a significant performance increase for trainees compared to a wait list control group on measures of memory self-efficacy, locus of control, and name recall and story recall performance (West, Bagwell, & Dark-Freudeman, 2008). In regression analysis, the final level of performance achieved after training was predicted by memory self-efficacy, training condition, or interactions between training conditions, with baseline ability serving as an additional predictor. In this innovative memory training intervention that specifically targeted self-efficacy, with emphasis on mastery, verbal persuasion, reduction of anxiety and modeling of skills, participants were able to demonstrate new memory strategies and elevated test scores.

Summary

Findings from literature review do not support that MSE is the single or even the most significant contributor to cognitive performance in older adults who face cognitive decline. However, the degree of memory self-efficacy beliefs may hold significance for memory performance, both in the laboratory setting and everyday life because it is

"uniquely modifiable" (Wells & Esopenko, 2008). Memory self-efficacy may mediate or moderate performance and may prove predictive in the amount of strategic effort devoted to a memory performance task and the degree of persistence in the face of difficulty. One approach to improve older adults' metamemory beliefs to enhance perceived well-being and actual performance is to advance the development and effectiveness of memory training interventions that conserve and optimize memory functions.

Memory performance in older adults is best understood not only in the context of situational factors, but also in terms of individual characteristics that affect perception and response to a situation. Research that examines whether individual differences (particular affective status) modify efficacy judgments may also prove beneficial. Further, whether subjective feelings of memory dysfunction can serve as a key criterion to identify older adults with a high risk of developing dementia is currently under reevaluation and may lead to changes in diagnostic concepts (Cook & Marsiske, 2006; Kliegel, Zimprich, & Eschen, 2005).

Stereotype threats and stereotype manipulations in older adults have also demonstrated a striking impact on beliefs and concerns about memory. The pervasive stereotype existing in Western culture that portrays aging as a time of inevitable cognitive decline has been shown also to compromise the testing performance of older adults on explicit memory tasks, particularly among older individuals who highly value memory. Whether actual performance decline precedes the development of negative self-perception, and whether stereotype threats might influence outcomes in cognitive training programs is still in question.

CHAPTER III

METHODOLOGY

This chapter describes the methodology and the study design; participant inclusion; measures utilized within the study and study procedures; and statistical considerations.

Study Design

The study capitalized on data collection from the parent study and consisted of a secondary analysis using data gathered from the Mayo Clinic Olmsted Study of Aging (MCSA) investigation of the incidence, prevalence and risk factors for cognitive impairment and dementia and refinement of the diagnostic criteria for cognitive impairment. Participants who were scheduled for a regular in-person follow-up from February to early June 2012 were mailed a packet one month prior to their scheduled visit. Included in this mailing was a one-time pencil and paper memory self-efficacy questionnaire, along with a battery of standardized instruments and required intake forms per MCSA protocol. Participants were requested to bring all the completed forms to their scheduled follow-up appointment. Those who did not bring the memory questionnaire to the return appointment were not asked by MCSA staff to complete the questionnaire.

A prospective, population-based cohort of 2300 normal and cognitively impaired individuals comprises the parent study. Beginning in 2004, potential subjects were recruited by stratified random sampling (with equal allocation of men and women in two age strata i.e., 70 to 79 and 80 to 89 years old) from a target population of nearly 10,000 elderly individuals living in Olmsted County, MN. Participants enrolled in the study are evaluated at baseline and contacted every 15 months on average for a reevaluation which

includes a clinical evaluation and the administration of an abbreviated neuro-psychological battery. For those subjects that decline further in-person evaluation or have incomplete follow-up, their outcome is followed passively through Mayo Clinic medical records.

For the 2009-2014 renewal period of the MCSA, the intent is to further refine incidence rates of dementia and MCI and to evaluate the utility of a number of traditional and innovative factors, including medical comorbidities, biomarkers and imaging procedures. A subset of randomly selected participants from the continually replenished active cohort of 2,000 undergo quantitative MRI scans, lumbar punctures and Compound B PET scans, which are combined with plasma measures and genotype information to develop multivariate prediction models. Additional information about the MCSA purpose, design, methods and selected outcomes are described elsewhere in the literature (Roberts et al., 2008). The strengths of the MCSA research design include the random selection of subjects from a defined population, the in-person evaluation for the majority of the sample, and the application of published criteria for the definition of MCI (Petersen, 2004; Winblad et al., 2004). The participation rate of 62% is slightly lower but comparable to other population-based aging studies, with nonparticipants showing a slightly higher prevalence of comorbid conditions (Roberts et al., 2008).

Sample

Participants for the secondary analysis consisted of a nonprobability sample from the current active cohort of 2000 persons (approximately 1650 cognitively normal and 350 MCI individuals) undergoing a scheduled reevaluation visit. As noted earlier, the sampling frame for the parent study comprised all Olmsted County residents in contact

with the Rochester Epidemiology Project (REP) records systems within the three years preceding the survey onset date of October 1, 2004. Sampling was at random within each designated age (70-79, 80-89) and gender stratum. The study was approved by the Institutional Review Boards (IRB) of the Mayo Clinic and Olmsted Medical Center. Each potential subject identified by the sampling procedure was contacted first through an IRB-approved letter and brochure explaining the purpose of the study. The letter included a form for written refusal and a pre-stamped return envelope. Telephone contacts were then made to confirm willingness or to obtain approval from nonresponders using a contact schedule that had been previously approved by the Mayo IRB for other contacts. Willing subjects were then invited to an outpatient clinic for a direct evaluation. Those unable to come to the clinic were offered a home visit. Participants in the parent study received $50 remuneration for their participation, as approved by the Mayo IRB. All subjects provided written informed consent in accordance with the Mayo Clinic IRB procedure.

Measures

Study variables and operational measures to answer the research questions are summarized in Table 3.1. The psychometric properties of the three selected instruments, The Metamemory in Adulthood Questionnaire, the Beck Depression Inventory-II and the WMS-R-Logical Memory Story IIA Version used for data analysis suggest reliability and validity. Additional instruments that were used to collect other information for the parent study will not be addressed here but are outlined in Appendix B.

Table 3.1. Study Variables with Operational Measures

Variables	Measures	Completed by/Time
Demographic information	Mayo Clinic Medical Record Linkage System electronic retrieval	Abstracting done by Mayo Clinic nurses with extensive experience in medical record review/baseline
Depression	Beck Depression Inventory -II Scale (BDI-II) - 21 items	Mayo Nurse clinician administers at the time of initial in-person evaluation or follow-up evaluation
Cognitive Classification	Based on evaluation outlined in Appendix B	Mayo Clinic neurologist/ diagnostic classification at time of proposed study
Memory Self-Efficacy	MIA Questionnaire: Change and Capacity Scores – 35 items, see Appendix A	Self-administered/at time of proposed study
Family history of dementia	Mayo Clinic Medical Record Linkage System electronic retrieval	Abstracting done by Mayo Clinic nurses with extensive experience in medical record review/baseline
APOE 4 genotype	Blood sample	Mayo Clinic/baseline
Psychoactive Medications	Mayo Clinic Medical Record Linkage System electronic retrieval	Abstracting done by Mayo Clinic nurses with extensive experience in medical record review/most recent evaluation
Memory performance score	Neuropsychology Screening Battery (NSB) – Story recall scores (immediate and delayed)	Administered by in-person evaluation or psychometrist/initial follow-up evaluation

The variables of interest for the secondary data analysis were selected for their known or plausible association with self-efficacy and/or memory performance in cross-sectional studies. Socio-demographic characteristics (age, gender and education attainment) were obtained from the study database. Ethnicity was not obtained as over 98% of those enrolled in the MCSA are identified as Caucasian (Roberts et al., 2008). Age, gender, educational attainment, family history of dementia, the concurrent use of psychoactive medications, the presence of the APOE 4 genotype and the adjudicated consensus cognitive diagnosis were selected as predictor variables.

The concept of metamemory has proven useful in normal and clinical aging research. In particular, the role that metamemory may play in compensating for memory changes and how metamemory and episodic memory changes relate to each other in aging shows promise. MSE (a dimension of metamemory) was measured with the self-administered, clinician-scored Metamemory in Adulthood (MIA) omnibus questionnaire which consists of 108 statements. Responses are rated on a 5-point Likert scale (strongly agree, agree, undecided, disagree, strongly disagree) (see Appendix A).

The MIA is a well-established multidimensional self-evaluation questionnaire with solid psychometric properties that is used frequently in studies of cognitive aging. Independent subscales measure achievement, anxiety, capacity, change, locus, strategy, and task (Dixon et al., 1988). Internal consistency in large studies using Cronbach's alpha for Capacity and Change reported 0.84 and 0.91 respectively. Two year test-retest reliability estimates were moderate to high (McDonald-Miszczak et al., 1995).

The MIA Questionnaire offers an assessment of attitudes, beliefs, and use of strategies to facilitate remembering in everyday situations. It is a measure of a construct

that appears to differ from general self-efficacy, personality dimensions (neuroticism, extraversion and energy), and psychological distress measures (well-being, depression and anxiety). There are 4 broad subdomains of metamemory that are measured: memory knowledge, memory monitoring, memory self-efficacy and memory-related affect (Hertzog et al., 1989). The MIA requires ratings of specific and general statements and uses both positive and negative wording. This instrument may be self-administered.

For the present study, it was conditioned that the instrument be as parsimonious as possible to minimize subject burden. The considerable amount of time required to complete the 108 item questionnaire could adversely affect compliance, especially in cognitively impaired individuals. Given the findings in the literature specific to factor analysis of the MIA questionnaire and the recommendation of one of the authors of the instrument (Hertzog, personal communication, February 24, 2011), the 35 MIA Capacity and MIA Change items were determined to be appropriate for a reduced set of questions to measure MSE. The Capacity scale consists of 17 items and higher scores indicate more perceived memory capacity. The Change scale has 18 items and a higher score indicates less perceived decline or greater stability in memory function. Taken together, Change and Capacity are also indicators of a higher order dimension of MSE, with higher scores reflecting higher MSE.

In the interest of brevity, a pilot test of an abridged version of the instrument was carried out. An older adult familiar with psychometric instruments reported a time frame of two minutes to read and comprehend the directions and 12 minutes to answer 45 items initially selected to represent MSE. Most individuals would be able to complete the 35

item abridged instrument in 15-20 minutes. A larger font was used to improve readability and to accommodate age-related visual changes.

With respect to timing, metamemory scales are often administered before memory testing to predict performance. As noted earlier, memory questionnaires typically show a low correlation with subsequent objective memory performance. In response to that finding, researchers propose that memory performance is mediated by a number of other variables such as age, gender and level of education; that people use compensatory strategies when taking memory tests; that memory questionnaires may elicit implicit theories or stereotypes about aging that influence performance; and that responses on these instruments are driven by general beliefs about memory and aging rather than specific incidents of faulty memory (Troyer & Rich, 2002). With that consideration in mind, the timing of the MIA questionnaire relative to the reevaluation of subjects for diagnostic classification in the MCSA needs to be considered in the interpretation of the findings.

In the MCSA study, the Beck Depression Inventory-II (BDI-II) is one of the screening tools used at each time point to identify the presence and severity of depressive symptoms (Beck, Steer, & Brown, 1996). A 21-item multiple choice self-report inventory, the 1996 BDI-II is the substantially revised version of the original BDI. Widely used to measure the severity of depression, each item is rated on a 4-point Likert-type scale ranging from 0 to 3, with higher scores indicating higher levels of depression. The measures ask respondents to endorse statements characterizing how they have been feeling throughout the past 2 weeks. The cut-off scores are 0–13: minimal depression; 14–19: mild depression; 20–28: moderate depression; and 29–63: severe depression

(Beck, Steer, & Brown, 1996). Higher total scores indicate more severe depressive symptoms. Designed for individuals 13 and older, it consists of cognitive, affective and somatic items such as fatigue, weight loss (or gain), and changes in appetite. In sample of community-dwelling older adults, the BDI-II demonstrated strong psychometric properties, with the internal reliability reported as 0.86 (Segal, Coolidge, Cahill, & O'Riley, 2008). The BDI-II is considered to be stronger in its factor structure than the original instrument (Dozois, Dobson, & Ahnberg, 1998). The most recently administered (BDI-II), part of the MCSA 15-month follow-up test battery, was used for data analysis (for those identified as having depressive symptoms based on the BDI-II or any of the other study questionnaires used to ascertain depressive symptoms, the MCSA has an IRB-approved protocol in place.)

Episodic memory deficit have been shown to be predictive of later progression of dementia regardless of setting and type of sample (Feldman & Jacova, 2005). A measure of cognition for normal controls that taps the cognitive domain related to verbal episodic memory as measured by an age-adjusted score from a neuropsychological battery were used for analysis. The neuropsychological test battery from the Uniform Data Set (UDS) of the Alzheimer's Disease Centers (ADC) program of the National Institute on Aging (NIA) is administered in the MCSA (Weintraub et al., 2009). It consists of abbreviated, widely-used, validated measures of attention, processing speed, executive function, episodic memory and language adapted for use in ADCs.

The WMS-R-Logical Memory Story IIA Version-immediate and delayed test requires that subjects recall two paragraphs read aloud by the examiner, both immediately and after a 20 minute delay and with cueing with one detail from the story (Wechsler,

1987). There is a maximum score of 50 points for total items recalled. Summary statistics for each neuropsychological test including the mean, standard deviation, median, 25th and 75th quartiles, and range (minimum and maximum) are available in the UDS testing manual. For reporting purposes, raw scores are transformed on each test into age- and education-adjusted scores using Mayo's Older American Normative Studies normative data (Ivnik et al., 1992). These adjusted scores are scaled to have a mean of 10 and a standard deviation of 3.

Procedures

The investigator received approval to conduct this study from the University of Iowa IRB-02.

Recruitment

All MCSA participants scheduled for a follow-up in-person evaluation from February 2012 to early June 2012 comprised the potential sample for this secondary data analysis. The necessary sample size of 202 was calculated based on 80% power, a two-sided alpha level of 0.05, an effect size of 0.50 based on the reported effect of memory training interventions on memory performance and an allowance for 5% attrition. As mentioned earlier, one month prior to their scheduled follow-up on-site evaluation visit, participants were sent a mailed packet from the MCSA staff that included the MIA questionnaire in addition to intake forms and other instruments. The enclosed cover letter asked the participants to complete the forms and instruments. Additionally, the letter emphasized that participation was voluntary and that care at Mayo Clinic would not be altered by the decision to participate or not to participate.

Informed Consent

The MCSA involves already enrolled subjects whose capacity to give consent may change over the course of this longitudinal study. At the time of initial enrollment in the parent study, the letter of informed consent was read and reviewed and questions answered. All participants received a personal copy of the Mayo IRB-approved consent document. At each follow-up evaluation visit conducted on-site the same procedures are followed.

Taking part in the parent MCSA study is the subject's decision. They may stop at any time. In addition, the researchers or Mayo may stop any research participant from taking part in the study at any time if it is deemed in the person's best interest, if the subject does not follow the study rules, or if the study is stopped.

Data Management

With the exception of the MIA questionnaire, all data were stored in a password-protected computer file at a Mayo Clinic Study site in accordance with Mayo Clinic policies. Information is coded with a unique identifying number assigned by the MCSA research team. Patient identification information is restricted to MCSA staff and other affiliated investigators. This investigator was provided the hard copies of the memory questionnaire for coding and data entry and the requested de-identified information to complete the data analysis. The MIA questionnaires were retrieved by the investigator from the MCSA on three separate occasions and stored at the College of Nursing in a locked file cabinet inside a locked office. Data files were stored on the College of Nursing server, which is password protected and met the guidelines of the University of Iowa Human Subjects office.

Data were analyzed using SAS statistical analysis software version 9.2 (SAS Institute, Cary, NC) and parametric tests were used whenever tests assumptions were met. All statistical tests were two-tailed and significance was set at $p \leq 0.05$. Table 3.2 summarizes the basic methodology by research questions.

Table 3.2. Research Questions with the Analysis Methods

Research Questions	How Measured	Analysis
#1 What is the relationship between memory self-efficacy scores and cognitive classification group for in-person participants of the Mayo Clinic Olmstead Study of Aging?	Metamemory in Adulthood (MIA) Questionnaire-Appendix A Mayo Clinic in-person evaluation for Diagnostic Classification (Appendix B)	General Linear Modeling
#2 What is the relationship between MSE scores and the variables of age, gender, level of education, depressive symptoms, psychoactive medications, cognitive classification, APOE 4 and family history of dementia?	Beck Inventory II Medical record review Mayo Clinic in-person evaluation for diagnostic Classification (Appendix B) Metamemory in Adulthood (MIA) Questionnaire-Appendix A	Multiple Linear Regression
#3 What is the relationship between MSE scores and memory performance in cognitively normal participants?	Neuropsychology Screening Battery; immediate and delayed memory scores Metamemory in Adulthood (MIA) Questionnaire-Appendix A	Pearson Product Correlation

For the first question of interest a general linear model (GLM), with adjustments for age (continuous variable), sex, and education (years of education as a continuous variable), was selected for its flexible generalization of ordinary linear regression that allows for response variables that have other than a normal distribution. For the second question, univariate linear regression was conducted first for each predictor variable, including age (continuous variable), sex, and education (years of education as a continuous variable). Using findings from prior reports as well as clinical judgment, the following variables were selected for the forward step-wise linear regression to predict MSE score: age, gender, educational attainment, APOE 4 genotype, depressive symptoms, family history of dementia, depressive symptoms cognitive classification, and psychoactive drugs. For the final question the primary test of association used was Pearson's Product Correlation.

Descriptive Analysis

A descriptive analysis using one or more descriptive statistics was conducted for all variables. Univariate analysis was completed for ranges of values, as well as measures of central tendency and variability for continuous variables.

Data preparation

All data from the MIA questionnaires were double entered; the two databases were compared and inconsistencies were resolved before proceeding with data analysis. Collected instruments were reviewed to identify MSE items prone to missing responses. If missing responses on a questionnaire were $\leq$10%, the missing variables were imputed using an indicator variable (mean score on subscale) to account for the missing data. If more than 10% of the items were unanswered, the questionnaire was judged unusable.

Additionally, questionnaires with duplicate IDs were not used. If two responses to an item on the MIA questionnaire were circled, the numerical value of the two responses was averaged and used.

A total of 214 questionnaires were collected: 9 were eliminated for the above reasons, and 5 questionnaires were returned from individuals who had converted to dementia and were set aside for separate analysis. A total of 163 completed questionnaires from individuals with normal cognitive classification, 31 questionnaires from individuals with A-MCI and 6 questionnaires from individuals with NA-MCI were used for statistical analysis

The data provided from the MCSA were checked for missing data prior to conducting statistical analysis. Additionally, consistency and outlier checks were conducted to reduce error. A codebook with the listing of each variable and possible response was prepared prior to conducting the statistical analysis.

CHAPTER IV

RESULTS

This chapter presents the demographic and clinical characteristics of the study participants and results of the study by research questions and hypotheses. Data from the MCSA were provided in an Excel file format and exported into SAS software. Statistical testing was conducted at the two-tailed alpha level of 0.05. All analyses were performed by using SAS, version 9.2.

Characteristics of the Study Participants

Preliminary review of the data indicated that missing data were minimal. No data from the MCSA files for gender, level of education (years completed), age (per last visit), and cognitive classification were missing. Two BDI-II values were missing, family history for dementia was not available for three participants out of 200, and APOE genotype was missing for three participants. Cohort designation was not entered for eight participants. Communication with the MCSA statistician clarified that blank cells for cohort meant that the subject was a "volunteer" and was not a population-based participant (the MCSA started replenishing with new cohorts in an effort to keep the total sample comprising 2,000 active non-demented subjects). Given the cross-sectional nature of the descriptive study and the number of missing items for this variable, the plan to include cohort designation in the linear regression model was dropped.

Characteristics of the study sample for the secondary data analysis included age, gender, and level of education. Age (continuous variable) was calculated from the date of the most recent follow-up evaluation visit which took place in 2012. Gender was categorized as a binary variable. Level of education (continuous variable) was coded per

years and also dichotomized at 12 years of education. Residence, marital status and ethnicity were not requested for analysis. In terms of demographic composition, the study sample reasonably approximates the characteristics of the MCSA participants obtained by stratified random sampling for the parent study.

Clinical and Demographic Characteristics of the Study Participants

Table 4.1 summarizes the demographic and clinical characteristics of the participants. Frequencies/percentages for categorical demographic variables and means, median and standard deviations for continuous variables are provided in the table. The median age for all participants was 81.29 years, with 54% of the sample between 80-89 years of age. Median years of completed education was 13.0, with a range from 8 to 20 years. There were 109 male participants (54.5%) and 91 female participants (45.5%) in the sample. Approximately 25% of the participants endorsed a family history of dementia. The percentage of the 200 participants with depressive symptoms (BDI-II > 13) was 11% overall. Relative to diagnostic classification there were 163 subjects with normal cognition, 31 with A-MCI and 6 with NA-MCI.

Research question #1: What is the relationship between memory self-efficacy MSE scores and cognitive classification group for in-person participants of the Mayo Clinic Olmsted Study of Aging?

As emphasized earlier, cognitive diagnoses are established by the interdisciplinary team using a standardized protocol. At each evaluation visit MCSA participants undergo a nurse evaluation, a risk factor assessment, a neurological evaluation and a neuropsychological evaluation. Information is also collected from an informant and from the record linkage system. Each study evaluator (nurse, physician or psychometrist) is

asked to independently arrive at a preliminary impression of the participant's cognitive status. Subsequently a diagnosis of normal cognition, amnestic or nonamnestic MCI (single- or multiple domain), dementia or AD is reached by a consensus panel after reviewing the findings of all available data. For purposes of analysis, numeric codes were used for normal cognition, A-MCI and NA-MCI. However, to address the first study question and to provide sufficient power to determine whether a relationship existed between cognitive classification and MSE scores, all participants with MCI were combined into one diagnostic group for testing purposes.

To operationalize MSE the numeric scores from the 35-item Capacity and Change subscales of the self-administered Metamemory in Adulthood (MIA) questionnaire (Dixon, Hultsch & Hertzog, 1988) were used to measure memory self-efficacy. The two subscales were combined, with a higher scores indicating higher MSE. A coefficient of reliability, Cronbach's alpha was used as a measure of the internal consistency of a psychometric score. This measure will generally increase as the intercorrelations among the test items increase, with higher values more desirable. The Cronbach's alpha for the MIA questionnaire based on the total 34 items (one duplicate item was dropped) was 0.914. The final Capacity subset consisted of 15 items with a reliability of 0.805 (two items on the 16-item Capacity subset were perfectly correlated, thus one item was omitted for reasons of redundancy for determining reliability and for data analysis). The 18-item Change subscale showed a reliability of 0.890. MIA scores are displayed in Table 4.2. Based on the 33 items used for analysis, the possible minimum total score is 33 and a maximum score is 165.

Table 4.1. Demographic and Clinical Characteristics of Study Participants N=200

Variable		n	(%)
Gender			
	Male	109	(54.50)
	Female	91	(45.50)
Age, year*		81.80	(72-97)
	70-79	82	(41.00)
	80-97	118	(59.00)
Education,*		14.35	(8-20)
	>12 y	102	(51.00)
BDI-II (Beck Depression Inventory) depression,			
	Total score >13	22	(11.11)
	Normal cognition	16	(9.88)
	MCI	6	(16.67)
	Missing scores	2	
Family History of Dementia		48	(24.37)
	Missing scores	3	
Consensus Cognitive Classification			
	Normal cognition	163	(68.00)
	Amnestic MCI	31	(15.50)
	Nonamnestic MCI	6	(3.00)
APOE (apolipoprotein E) genotype			
	ε4/ε4	2	(1.00)
	ε3/ε4	44	(22.33)
	ε3/ε3	120	(60.00)
	Other	31	(15.50)
	Missing scores	3	

*Median (range)

A preliminary examination of a histogram of the MIA scores supported the use of parametric tests. Given the size imbalance between the cognitively normal group (n=163) and the combined MCI group (37), a general linear model was chosen to analyze the first question. An extension of the linear modeling process, the general linear model

(not to be confused with the generalized linear model) forms the foundation of most of the statistical analysis used in applied research. Incorporating a number of statistical models (ANOVA, ANCOVA, MANOVA, MANCOVA,, *t*-test), this model allows for the consideration of more than one independent variable and the summarization of a wide variety of outcomes Errors are assumed to follow a multivariate normal distribution. To answer the first question group membership (categorical) was used as the independent variable and MSE score (continuous) as the dependent variable. The Levene's test was used to test for homogeneity of variance between the two groups and was not significant (p= 0.52)

Table 4.2. MIA scores descriptors

	Scales		
	Capacity Scale	**Change Scale**	**Total**
Number of items	16	18	34
Mean score by item	3.023	3.354	3.198
Mean score of total	48.37	60.37	108.73
Standard deviation	7..927	9.897	16.269
Cronbach's alpha	0.805	0.890	0.914

A univariate analysis of variance was conducted first for age, education, gender, age x education, age x gender, education x sex, and age x education x sex. As hypothesized, after controlling for the corresponding noncognitive covariates of age, gender and education, the relationship between cognitive classification (combined MCI versus normal) and MSE rating was statistically significant (p=<0 001; E.S.= 0.585) (see Table 4.3).

Table 4.3. General Linear Model of Univariate Analysis of Variance of Memory Self-Efficacy Ratings and Diagnostic Classification Normal and Mild Cognitive Impairment

Source	Type III Sum of Squares	df	Mean Square	F	Significance	Partial Eta Squared
Model	1731309.246[a]	5	346261.849	1543.409	.000*	.975
Sex	918.809	1	918.809	4.095	.044	.021
Education	1183.369	1	1183.369	5.275	.023	.026
Age	58.677	1	58.677	.262	.610	.001
Cognitive Diagnosis	9198.971	2	4599.486	20.501	.000*	.174
Error	43748.004	195	224.349			
Total	1775057.250	200				

* p-value < 0.001; [a] R^2= .975 (Adjusted R^2= .975)

The small number of participants with NA-MCI precluded a determination of the relationship between the diagnostic classification of NA-MCI and MSE. However examining the mean scores of the three groups is informative, with the lowest scores for the A-MCI group (see Table 4.4).

Table 4.4. MIA scores for Cognitively Normal Subjects and Subjects with Mild Cognitive Impairment N=200

Subjects	Number	Mean Score	SD	Range
A-MCI	31	83.871	15.094	45-123
NA-MCI	6	89.583	13.872	68-109
Normal	163	94.755	15.226	50-141

Research question #2: What is the relationship between MSE rating and the variables of age, gender, level of education, APOE 4 carrier status, family history of

dementia, depressive symptoms, cognitive classification and the use of psychoactive medications?

Depression: The clinician-administered Beck Depression Inventory-II (Beck, Steer, & Brown, 1996) was used to measure depressive symptoms. The BDI-II consists of 21 questions; each answer is scored on a scale value of 0 to 3. The cutoffs for the BDI-II are 0–13: minimal depression; 14–19: mild depression; 20–28: moderate depression; and 29–63: severe depression. Scores were dichotomized with a cut-off score of > 13 to indicate the presence of depressive symptoms.

Psychoactive drugs: Information about the participants' self-reported use of psychoactive drugs was coded as being either absent or present for tetracyclic antidepressants, tricyclic antidepressants, selective serotonin reuptake inhibitor (SSRI) or selective norepinephrine reuptake inhibitor (SNRI) antidepressants, and cognitive enhancers for dementia or MCI treatment (memantine, galantamine, donepezil or rivastigmine). There were no participants reporting antipsychotic drug use. All categories were grouped together in the linear regression analysis (see Table 4.5).

Table 4.5. Psychoactive Drug Treatment by Diagnosis

	Normal N=163		**MCI N=37**	
Medication	**n**	**(%)**	**n**	**(%)**
SSRI (Selective serotonin reuptake inhibitor) and SNRI (Selective serotonin reuptake inhibitor)	18	(11.04)	9	(24.0)
Tetracyclic (tetracyclic antidepressant)	1	(0.61)	1	(2.70)
Tricyclic (tricyclic antidepressant)	0		3	(8.10)
Cognitive enhancers	3	(1.84)	1	(2.70)

APOE genotype: Blood was drawn from MCSA participants after receiving informed consent. DNA amplification and APOE genotyping is determined by well-established laboratory methods. Per study design, study participants are not informed of the results of the genotyping. For purposes of data analysis, the APOE genotypes were coded $\varepsilon 4/\varepsilon 4$, $\varepsilon 3/\varepsilon 4$, $\varepsilon 3/\varepsilon 3$, or other and then dichotomized for the absence or presence of an APOE 4 allele (see Table 4.1).

Family history of dementia: At each evaluation visit participants are asked to specify all first-degree relatives (parent, full siblings, and children) and questioned about diagnoses of MCI, dementia, AD, Parkinson's disease, frontotemporal dementia and amyotrophic lateral sclerosis in these individuals. A binary coding of absent or present was used for data analysis (see Table 4.1).

Multiple linear regression was used to analyze the second question. This technique extends the simple linear regression model to incorporate more than one predictor variable. The regression weights in multiple regression reflect how changes in each predictor variable affect the dependent variables. Assumptions for the use of multiple linear regression are that the relationship, if any, is linear and that errors are an independent random sample from a normal distribution.

For purposes of analysis a forward selection step-wise procedure was conducted. The first step consisted of the covariates of age, gender and educational attainment as a group; the second step was APOE genotype; the third step was family history of dementia; the fourth step was depressive symptoms; the fifth step was diagnostic classification; and a final step was psychoactive medications. The presence of an APOE 4 genotype and family history of dementia did not explain enough variance in MSE

beyond that explained by the covariates of education, gender, and age. The BDI-II depression score was significant after removing the effects of education, age, gender, APOE genotype and family history of dementia. Cognitive diagnosis (MCI versus normal) was also significant after removing the effects of education, age, gender, APOE genotype, family history of dementia and BDI-II depression scores. Psychoactive medications did not explain variance in MSE scores beyond that accounted for by the other variables of interest and was dropped from the final model. The overall regression model explained 17 % of the variance with depressive symptoms, and cognitive classification emerging as the significant predictors of MSE. Contrary to the hypothesized relationships, age, gender, education attainment, APOE 4 genotype, family history of dementia and the use of psychoactive medications were not significant predictors of MSE (see Table 4.6).

Table 4.6. Estimated Effect of Variables Based on Multiple Linear Regression Modeling N=195

					95% CI*	
Parameter	**Estimate**	**SE**	***t***	***p-value***	***Lower***	***Upper***
Age*	-.120	2.119	-0.583	0.561	-0.524	0.285
Gender	-3.170	0.205	-1.496	0.136	-7.351	1.011
Education	0.544	0.401	1.358	0.176	-0.246	1.335
APOE 4 genotype	-2.340	2.427	-0.964	0.336	-7.128	2.447
Family hx of Dementia	-0.614	1.366	-0.449	0.654	-3.309	2.081
Depressive Symptoms	-12.638	3.301	-3.828	0.000	-19.151	-6.125
Diagnostic Classification*	-8.226	2.726	-3.018	0.003	-13.604	-2.849

*Reference group is female for gender and normal for diagnostic classification

**confidence interval; Overall model F= 5.489; *p*-value <0. 001; $R^2 = 0.148$

Research question #3: What is the relationship between MSE rating and episodic memory performance in the cognitively normal group?

A Pearson product-moment correlation was carried out to determine the relationship between MSE scores and episodic memory performance in the cognitively normal group (n=161). Bivariate correlation measures the degree to which one variable measure predicts the other measure. In correlation a measure goes from -1 to 1 and measures the degree of the linear relationship between two variables. Assumptions for correlation are that the two variables are from an independent sample, are normally distributed, and that the relationship, if any, is linear.

The scores from the Wechsler Memory Scale-Revised (WMS-R) Logical Memory immediate and delayed (Wechsler, 1987) were used to evaluate episodic memory. The raw scores on each test (0-25) were transformed into age- and education-adjusted scores using Mayo's Older American Normative Studies normative data (Ivnik et al, 1992). These adjusted scores were subsequently scaled to have a mean of 10 and a standard deviation of 3.

As hypothesized, for cognitively normal individuals MSE was modestly positively correlated with age- and education-adjusted performance on the WMS-R Logical Memory Story I A immediate recall ($r = 0.182$, $p = 0.021$) and WMS-R Logical Memory Story II A delayed recall ($r = 0.197$, $p = 0.012$) (Table 4.7). Higher MSE beliefs were also significantly correlated with better episodic memory performance when the cognitively normal and MCI group were combined for analysis ($r = 0.273$, $p < 0.001$).

On the basis of these findings, depression scores and age-adjusted memory performance scores for cognitively normal adults were entered into a regression equation

as independent variables, with MSE scores as the dependent variable. Both depression and memory performance scores emerged as significant predictors of MSE for cognitively normal adults (see Table 4.8).

Table 4.7. Age Adjusted Memory Performance Scores and Correlations with Memory Self-Efficacy for Cognitively Normal Subjects

Memory Test	Mean of Scores	Standard Deviation	Pearson Correlation	Significance (2-tailed)
*LM1-AASS	12.010	3.005	0.182	0.021
**LM2-AASS	11.881	3.178	0.197	0.012

*Logical Memory I age-adjusted scaled score

**Logical Memory II age-adjusted scaled score

Table 4.8. Estimated Effect of Depression Scores and Memory Performance Scores on Memory Self-Efficacy in Cognitively Normal Subjects N=161

Parameter	Estimate	SE	*t*	*p-value*
Depressive Symptoms	-16.037	3.748	-4.279	.000
Memory Performance	.474	.189	2.502	.013

Overall model: F= 12.484; *p*-value < .001; Adjusted $R^2 = 0.126$

CHAPTER V

DISCUSSION

The previous chapter provided the results of the study research questions and hypotheses. This final chapter explains and discusses the results, the application of the two distinct nursing models to the findings, limitations of the study, and implications for nursing research and practice and public policy.

Overview of Study and Findings

The purpose of the current study was to examine the relationship between MSE scores and group classification in a convenience sample of active participants enrolled in the MCSA. Cognitive classification was significantly associated with MSE, with the MCI group as a whole demonstrating significantly lower MSE than the cognitively normal group. Of clinical importance, the magnitude of the mean-adjusted effect size (d = 0.585) argues for the clinical utility of MSE when designing interventions. These findings, however, do not support some recent reports that individuals with MCI are prone to less accurate estimation or awareness of their memory capabilities compared to cognitively normal individuals (Lin et al., 2010; Perrotin et al., 2007). Arguably there could be significant heterogeneity between subtypes of MCI relative to memory awareness that could be captured by a sufficiently powered study sample that relies on the published criteria for A-MCI and NA-MCI. Given that cross-sectional studies have provided contradictory findings about impaired metamemory awareness in individuals with MCI, a longitudinal study design is better equipped to determine if individuals have different views of their memory performance depending on their progression of MCI (Kalbe et al., 2005)

The relationships between MSE rating and key demographic variables, the use of psychoactive medications, depressive symptoms, positive family history of dementia and APOE 4 carrier status were also examined. The overall multiple linear regression model, accounting for 17 % of the variance of MSE, found that depressive symptoms; and diagnostic classification were the only significant predictors of MSE. Most interesting, the covariates of age, gender and education were no longer significant in the final model when the depressive symptom predictor was entered into the step-wise progression.

A multivariate regression model can be problematic as many predictive variables can't be reasonably measured or are not measured well. Additionally, many predictor variables are highly correlated and confounding occurs, which complicates interpretation of the regression model. Other variables not addressed in the study, such as living arrangements, multiple medical comorbidities, personality traits, and prior memory task performance are likely to be predictive of MSE.

There are other statistical methods, too, that might be better suited to testing the relationship between MSE and other variables. In particular, structural equation modeling (SEM) enables the structural relationship between latent variables such as MSE and depression to be accurately estimated. In this technique both statistical data and qualitative causal assumptions are used to model explain causal effects and examine bidirectionality (Bandura & Locke, 2003).

Depressive symptoms emerged as the most significant predictor of MSE in this model. This finding is consistent with a previous report that depressive symptoms are a predictor of MSE (Zelinski & Gilewski, 2004). One relevant MCSA finding related to depression and cognition is that cognitively normal individuals who newly developed

depression were at increased risk for subsequent MCI. In fact depression more than doubled the risk of transitioning to incident MCI after controlling for age, gender and education, with the association stronger in males (Geda et al., 2006). The authors were unable to test the hypothesized protective effect of antidepressant medication used by participants with a positive history of depression prior to subject recruitment due to methodological limitations. Another outcome of this investigation was a reported synergistic interaction between APOE genotype (a risk factor for Alzheimer's disease) and depression (Geda et al., 2006). Although APOE genotype did not contribute significantly to the overall regression model, there is the intriguing possibility that it mediates the relationship between MSE and memory performance. Possible mechanisms linking depressive symptoms, cognitive performance and MSE have yet to be explored.

This study supports previous findings of a modest and positive relationship between memory self-efficacy and memory performance in cognitively normal older adults ($p = 0.029$). Given the correlational nature of this research, however, it is plausible that poorer memory leads to lower self-efficacy ratings rather than positive memory self-efficacy improving performance. Findings are consistent with most studies that have demonstrated a modest amount of performance variance that is attributable to MSE (3-15%), although a few studies have demonstrated a stronger relationship (Berry et al., 1989; Cavanaugh & Poon, 1989). Such a finding justifies more experimental designs that test the effects of memory training interventions that incorporate memory self-efficacy strategies on buffering age-related memory decline and absolute levels of memory functioning. Admittedly memory training will not eliminate age differences or necessarily transfer to unrelated memory tasks. Even if memory training that employs

self-efficacy strategies is not shown to slow the slope of cognitive decline, arguably the benefit gained from delaying the drop in performance to later in life reduces the immediate public health burden (McDaniel et al., 2008).

Limitations

There are a number of limitations to this secondary analysis and as such the findings need to be critically evaluated. First, the 62% participation rate in the parent study, though comparable with reported estimates for other large-scale aging studies, calls into question how closely the MCSA sample represents the entire population. The study sample consisted primarily of Caucasian and well educated individuals. In particular, the low percentage of non-Caucasian participants in the MCSA lessens external validity. A less homogenous population that crosses more diverse socioeconomic, educational, racial and geographical distributions would yield valuable findings. However, the use of stratified random sampling and a comparison of participants and nonparticipants using the medical-records linkage system and active follow-up of MCSA participants do allow for reasonable generalizations to the entire population.

Second, the non-probability sampling used for the secondary data analysis is a limitation in generalization and inference making about the population as a whole. In a study of this nature, too, there is the plausible reluctance of older adults to complete a questionnaire about their cognition, thus limiting study participation and incurring response bias. It is possible, also, that some respondents may have been hesitant or unable to respond truthfully about their memory abilities. For some individuals the questionnaire may have activated stereotype threat and depressed their later performance

on memory testing. Moreover, any study that uses a self-administered questionnaire is subject to low completion and response rates, partially due to some of the ambiguities within the questions themselves. Nonetheless, methodological problems exist with any questionnaire administration, and absent an experimental design, a questionnaire is sometimes the most feasible way to examine some aspects of human behavior. Caution is indicated, too, when making conclusions based on one indicator of MSE.

A third limitation of the study was the lack of qualitative data to provide richer insight into the influence of memory self-efficacy in individuals with either normal cognition or MCI. Such evidence would lend support to a contextual perspective on aging that emphasizes the centrality of specific life circumstances, culture, and effective coping strategies to sustaining memory performance (Hess, 2005).

In addition, the unequal sample size across groups, while approximating the percentage within the parent sample, impaired the statistical power to determine differences among the three groups. Thus inferences can't be justified about the small group of individuals with NA-MCI. Conversely, the investigator was able to capitalize on the impending follow-up visit that adjudicated the cognitive classification (normal, A-MCI, NA-MCI) based on published criteria, expert clinical judgment and a consensus panel, relative to the completion of the memory questionnaire. Although many individuals may manifest cognitive impairment on one testing occasion and may not when given the same battery of tests on repeat occasions, in general the serial administration of testing used in the MCSA is likely to achieve high diagnostic accuracy (Feldman & Jacova, 2005). The temporal order of events (memory questionnaire mailed to participants one month prior to scheduled follow-up assessment) reduced the

likelihood that the individual had transitioned from one cognitive state to another and that the cognitively normal participants were indeed in an intrinsically fluctuating stage of MCI.

Finally, although this cross-sectional descriptive study does explore the relationship between several explanatory variables of interest and memory self-efficacy, causal inference cannot be implied. Additional research that employs a longitudinal design would allow for investigators to observe memory-self efficacy changes over time and to discover temporally based causal connections. Such a design would reduce the probability of sample selection effects and rectify some of the weakness of this study. Notwithstanding the limitations enumerated, the current study represents a relevant contribution to the cognitive aging literature insofar as it supports previous findings and examines memory self-efficacy among individuals with criterion–based mild cognitive impairment.

Implications and Future Research

The National Institute for Nursing Research (NINR) has issued a strategic plan that emphasizes building a scientific foundation for managing and eliminating symptoms caused by illness and for preventing disease and disability. In particular interdisciplinary and innovative interventions that encompass multiple health determinants, including psychological factors, have been the subject of intense focus. Relative to cognitive aging, interventions that lower societal costs by delaying the need for institutionalization are sorely needed. Empirical support is accumulating that inter-individual variation in aging memory cannot be attributed exclusively to cognitive slowing, changes in attention or working memory capacity, and specific deficits in brain structure and function. Hence

multifaceted interventions that promote cognitive engagement, perseverance and self-efficacy and consider the influence of differential goal attainment attributable to aging are needed. This changing nature of goal attainment has been hypothesized as age-related resource conservation whereby an older person is more selective in task engagement when it is less relevant or meaningful to the individual (Hess, 2000). Additionally, lifestyle factors that are more distally related to memory performance and recognition of the influence of cultural stereotypes need to be addressed when designing interventions that capitalize on a contextual perspective rather than a single-minded focus on memory processes per se.

Graham McDougall (2009), a NINR-funded nurse researcher, has proposed a nonpharmacologic cognitive intervention model to enhance memory self-efficacy and everyday memory performance (Figure 4). McDougall asserts that multifactorial interventions that bolster participants' awareness and knowledge (metamemory) reduce negative beliefs (self-efficacy) and negative memory-related affect (anxiety) have not been integrated into earlier models. Regarding the modification of negative attitudes toward aging as the determinant of successful intervention, McDougall derived his unique framework from Bandura's self-efficacy theory. Interrelated theoretical components include antecedent factors which reside within the individual (including age, cognition, gender education and health). The second component of the cognitive behavioral model of everyday memory (CBMEM) is the intervention itself, which is a psychosocial intervention emphasizing stress inoculation, strategy use, exposure, modeling and practice. The third component of McDougall's model is deemed the mediators of memory performance which are identified as anxiety, depression,

metamemory and memory self-efficacy. A final component consists of proximal and distal outcomes i.e., everyday memory performance and instrumental activities of daily living. Whereas this framework builds on the model used in the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) by its inclusion of implicit and self-referent memory beliefs, it remains key to consider that a developmental perspective model has much to offer.

A strong case can be made that Whittemore's multidimensional model (Figure 3) is relevant to examining memory changes and memory training in an aging population. Within the integration process the emphasis is placed on an individual's ability to reconcile past and present identities. This perspective builds on the findings of Adams and colleagues (1990) who proposed that changes in social-cognitive goals that accompany aging lead to a shift from knowledge acquisition in younger life to dissemination in later life. Thus older adults are more attuned to integrating existing knowledge and passing on this information to others. One implication of Adam's perspective is that this developmental transformation in goal orientation makes one less inclined toward verbatim reproduction, which is often the core of memory assessment in laboratory studies. Another implication is that performance is enhanced when the testing context reflects the hypothesized goals of later life (Hess, 2005).

Other evidence indicates that older adults exhibit an age-related positivity bias, which is congruent with the desire to optimize emotional experiences (Mather & Carstensen, 2003). Significantly, this age-related difference in processing style may not necessarily be a manifestation of impairment in the encoding processes. Without disregarding normative memory loss with aging, these developmental changes, like

memory self-efficacy, may account for some of the age-related variation in memory performance that is most often regarded as evident decline (Hess, 2005).

In summary, there is mounting evidence that both environmental and individual characteristics are thought to underlie age-related decrements. Theoretical models, such as the Baltes Model of Successful Aging with its multidimensional and multidirectional nature, offer a more experiential view than that implied by the prevailing biological-based perspective. Models that reflect the adaptive nature of memory compensation are more likely to inform the identification of the determinants of intra-individual variation in memory performance (Hess, 2005).

There is a pressing need for research that explicitly examines non-normative influences such as personality characteristics and lifestyle choices and the role of collaboration in adapting to and compensating for memory loss, both of which offer possibilities for designing effective interventions that promote integration of age-related memory changes. For example, Saczynski, Margrett and Willis (2004) examined changes in strategic behavior in older married couples completing a cognitive training intervention offered in the home setting. Couples were assigned to work individually or as a couple. Both collaborative and individual training groups showed a similar degree of strategy use in terms of individual performance. However, the collaborative groups were more likely than the individual training group to maintain strategy use on a collaborative task. Future studies that examine mediating and moderating influences and the contribution of more distal factors will also help account for the variability in the rate and course of memory functioning and the role of MSE.

Nurses in clinical practice are in a good position to support health promotion practices that enhance brain fitness. There is impressive evidence from the MCSA, for example, that exercise may mitigate age-related decline in cognitive functioning. Using a population based case-control study design, Geda and Mayo Clinic colleagues (2010) found that any frequency of moderate-intensity exercise carried out in either midlife or later was associated with a reduced risk of MCI.

As part of their advocacy role, nurses in clinical practice need to respond to ageism the same way they would when a person is marginalized because of race or disability and to support any efforts to counteract ageism in their practice setting. Understanding that negative stereotypes are hurtful to older adults and that older adults exposed to more positive attitudes about aging have demonstrated better memory skills is evidence that holds implications for nursing practice (Levy & Langer, 1994). Moreover, the growing recognition that depression in cognitively impaired and cognitively normal older adults all too frequently goes unrecognized and untreated and is mistakenly attributed to an aging mindset is further evidence that has bearing on clinical practice and advocacy. Most important, the need for sufficient assessment skills related to depression recognition and effective treatment is paramount for nurses whose practice involves working with older adults.

Educating older adults about lifestyle changes may improve global self-efficacy beliefs. In addition, interventions that focus on improving metamemory knowledge (for example, a relationship exists between self-efficacy beliefs and memory performance which accounts for some of the age differences in memory performance) and restructuring negative beliefs may improve individual motivation, effort and persistence

when carrying out instrumental activities of daily living. At present, however, there is limited evidence that negative beliefs are easily modifiable and that any gains in MSE persist over time. Informing the community at large about differences between normal memory aging and impairment in cognitive functioning is an educational intervention that is appropriately delivered by nurses.

Nursing education programs from the entry level and beyond need to expand the didactic content on significance of intraindividual variation in memory changes observed in older adults; neurogenesis, cognitive reserve and brain plasticity; the fluidity of classifications relative to cognition; and observed age-related normative changes in cognitive goals and motivation. Additionally nursing programs need to raise consciousness about the individuality of aging. It is vital that nursing curricula address the issue that older adults often encounter negative and demeaning age stereotypes from providers in the health care setting that may ultimately lead to poorer symptom management, reduced longevity, and impaired quality of life. Not only do students and faculty alike need to recognize the relevance of the insidious nature of ageism, there is a need for all nurses to examine their own personal attitudes and biases relative to aging. Moreover, experiential learning exercises that explore the existential threat of one's own fallibility and the self-denial of the young relative to aging may sensitize students to the value of the developmental task of generativity that is vital to successful aging.

In the public policy arena there is an imperative for additional research funding to examine prevention and intervention practices that generalize to every day memory tasks, compensate for age-related decrements in memory performance, and promote greater probability of the preservation of memory abilities. The National Institutes of Health

recently gathered together 500 researchers and advocates to announce a new national plan to address Alzheimer's disease, with funding priority given to the development of effective prevention and treatment approaches for Alzheimer's disease and related dementias by 2025. Of particular relevance to memory self-efficacy is testing the effects of nonpharmacological interventions that are informed by behavior change theory. Public awareness campaigns that address stereotyped treatment of older adults and their memory abilities and how such treatment can influence memory performance need to be sufficiently funded and disseminated to the public at large. Indeed, transcultural studies have found a mediating effect on memory performance for older individuals from societies when a more positive view of cognitive aging exists (Levy & Langer, 1994; Yoon, Hasher, Feinberg, Rahhal & Winocaur, 2000).

This study provided a perspective on several determinants of memory self-efficacy in cognitively normal older adults and older adults with MCI. Despite the limitations acknowledged earlier, the current study contributes to the body of cognitive aging literature. Given the absence of research on memory self-efficacy in older adults with MCI, this study offers some insight into the variation of memory self-efficacy among these individuals. There are implications, too, for designing training programs that do not rely exclusively on memory-based training efforts but also address implicit and self-referent beliefs about memory changes. Finally, these findings are useful in terms of building an explanatory model that addresses the role of contextual factors in maintaining memory abilities and integrating memory changes in later life. Ultimately this may lead to better understanding and characterization of memory changes that are associated with aging.

FIGURE 1

Self-Efficacy in Memory Performance

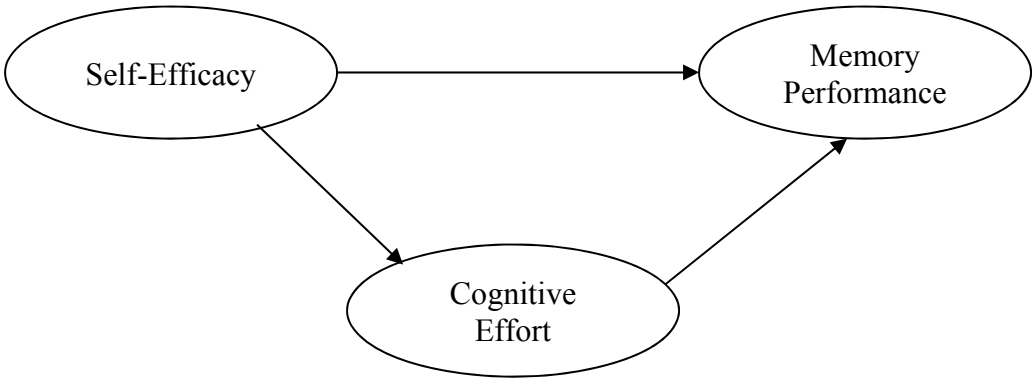


FIGURE 2

Self-Efficacy in Cognitive Development

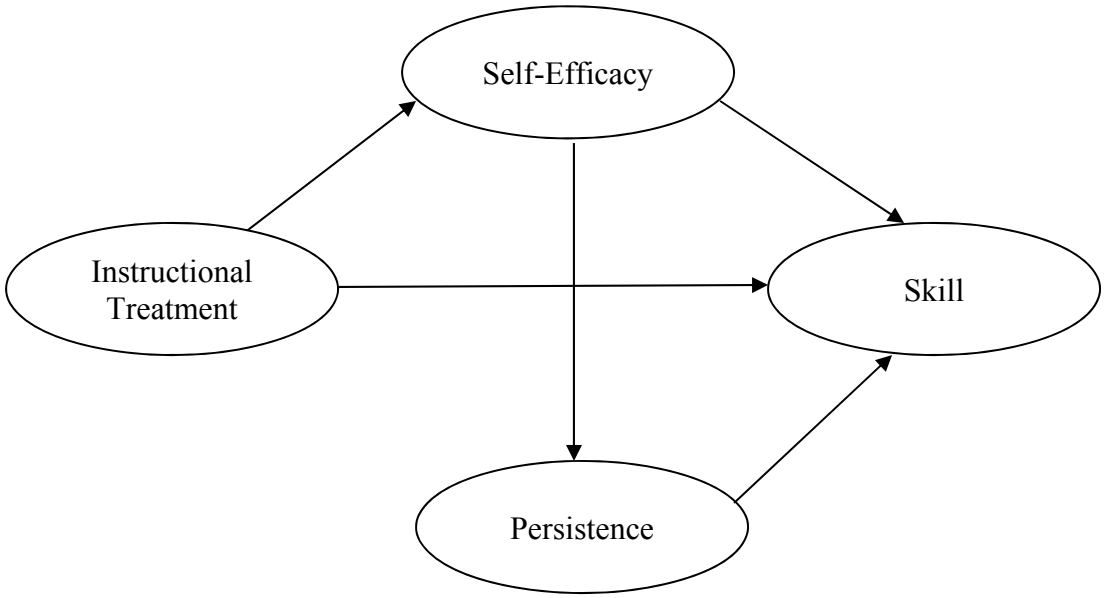
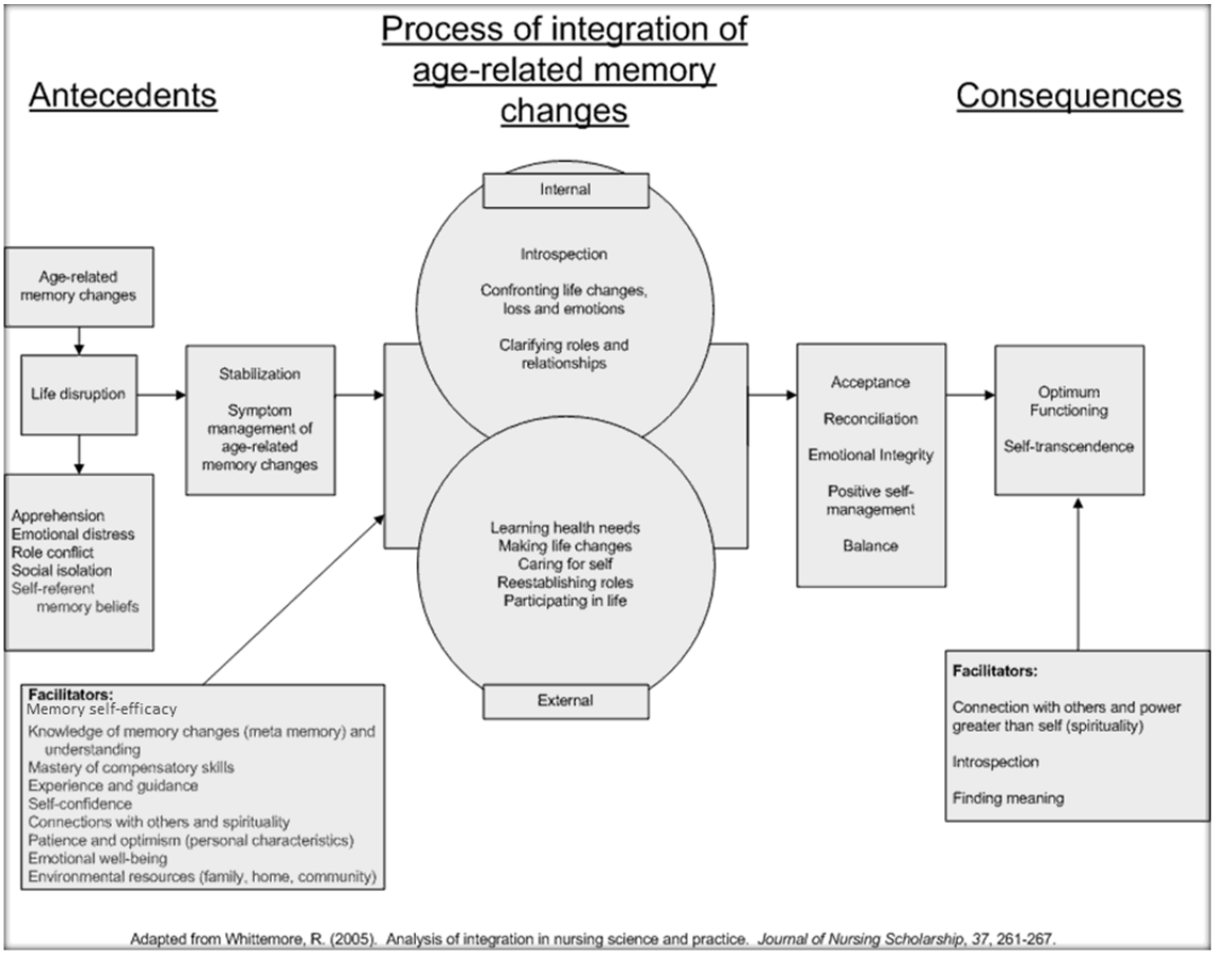


FIGURE 3

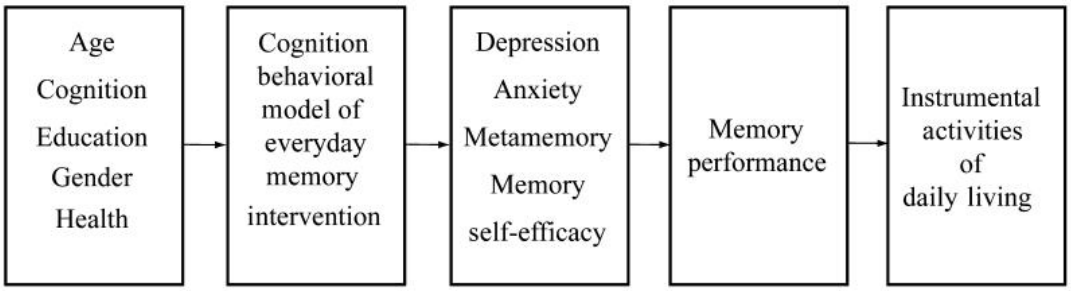
Integration of Age-Related Changes Model



Adapted from Whittemore, R. (2005). Analysis of integration in nursing science and practice. *Journal of Nursing Scholarship*, 37, 261-267.

FIGURE 4

The Cognitive Behavioral Model of Everyday Memory



APPENDIX A

MEMORY QUESTIONNAIRE

DIRECTIONS:

Different people use their memory in different ways in their everyday lives. For example, some people make shopping lists, whereas others do not. Some people are good at remembering names, whereas others are not.

In this questionnaire, we would like you to tell us how you use your memory and how you feel about it. There are no right or wrong answers to these questions because people are different. Please take your time and answer *each* of these questions to the best of your ability and without any assistance from others.

Each question is followed by five choices. Draw a circle around the letter corresponding to your choice. Mark *only* one letter for each statement.

Some of the questions ask your opinion about memory-related statements; for example:

My memory will get worse as I get older.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

In this example you could, of course, choose any *one* of the answers. If you agree strongly with the statement you could circle a. If you disagree strongly you would circle letter e. The b and d answers indicate less strong agreement or disagreement. The letter c answer gives you a middle choice, but don't use the c unless you really can't decide on any of the other responses.

Some of the questions ask how often you do certain things that may be related to your memory. For example:

Do you make a list of things to be accomplished during the day?	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Again, you could choose any one of the answers. Choose the one that comes closest to what you usually do. Don't worry if the time estimate is not exact, or if there are some exceptions.

Keep these points in mind:

a) Answer *every* question, even if it doesn't seem to apply to you very well.

b) Answer as honestly as you can what is true for you. Please do not mark something because it seems like the "right thing to say."

1.	I am good at remembering names.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
2.	I am good at remembering birthdates.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
3.	I can remember things as well as always.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
4.	I'm less efficient at remembering things now than I used to be	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
5.	The older I get the harder it isto remember clearly.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
6.	I am just as good at remembering as I ever was.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

7.	I have no trouble keeping track of my appointments.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
8.	I am poor at remembering trivia.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
9.	I am much worse now at remembering the content of news articles and broadcasts than I was 10 years ago.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
10.	Compared to 10 years ago, I am much worse at remembering titles of books, films or play.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
11.	I remember my dreams much less now than 10 years ago.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
12.	I misplace things more frequently now than when I was younger.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

13.	As people get older they tend to forget where they put things more frequently.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
14.	Compared to 10 years ago, I now forget many more appointments.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
15.	My memory for important events has improved over the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
16.	I am good at remembering the order that events occurred.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
17.	I am good at remembering conversations I have had.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
18.	My memory for phone numbers will decline as I get older.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

19.	My memory for dates has greatly declined in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
20.	My memory for names has declined greatly in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
21.	I often forget who was with me at events I have attended.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
22.	I am good at remembering the places I have been.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
23.	I have no trouble remembering where I have put things.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
24.	I know of someone in my family whose memory improved significantly in old age.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

25.	I am good at remembering things like recipes.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
26.	My memory has improved greatly in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
27.	I am good at remembering titles of books, films or plays.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
28.	My memory has declined greatly in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
29.	I often forget who was with me at events I have attended.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
30.	I have no trouble remembering lyrics of songs.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

31.	My memory will get better as I get older.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
32.	I am good at remembering names of musical selections.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
33.	I am good at remembering the content of news articles and broadcasts.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
34.	Remembering the plots of stories and novels is easy for me.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
35.	I am usually able to remember exactly where I read or heard a specific thing.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

APPENDIX B

MAYO CLINIC OLMSTED STUDY OF AGING

IN-PERSON EVALUATION

Consent subject to study, review family history and medications forms and administer the following questionnaires:

- Global staging – Clinical Dementia Rating (CDR) (study partner)
- Activities of Daily Living (ADL) Inventory (study partner)
- Behavioral assessment – Geriatric Depression Scale (GDS)
- Neuropsychiatric Inventory Questionnaire (NPI-Q) (study partner)
- Blessed Dementia Rating Scale (BDRS) (participant)
- N Proneness Scale (participant)
- Prime MD Patient Questionnaire (participant)
- ADRP Medical History/Risk Factor Assessment Form (participant)
- Mayo Sleep Questionnaire (MSQ) and the Everyday Cognition (ECog) (study partner and participant)

Physician will perform the ADRP and administer:

- Hachinski Ischemic Scale
- Unified Parkinson's Disease Rating Scale (UPDRS)
- Short Test of Mental Status (STMS)
- Montreal Cognitive Assessment (MoCA)

Psychometrist will administer the Neuropsychology Screening Battery (NSB) which consists of two measures in each of the following domains:

- Memory Story and Design Recall (immediate and delayed)
- Executive Functioning (Trail Making Test A & B and Digit Symbol Substitution)
- Language (Boston Naming Test and Auditory Verbal Learning Test (AVLT))
- Visuospatial skills (Block Design and Picture Completion)

Subjects will complete:

- Financial Capacity Instrument Short Form (FCI-SF)
- Beck Depression Inventory-II
- Beck Anxiety Inventory

Other measures:

- Brief Smell Identification Test – Version A
- Ankle-brachial BP index (ABI)

Follow-up Evaluation:

Participants who are initially enrolled in the study will be contacted every 15 months for re-evaluation at the Mayo Clinic or in the place of residence.

- Clinical Dementia Rating (CDR)
- Updating family history information
- Updated medication list

- ADL inventory
- ADRP Medical History/Risk Factor Assessment Form
- Blessed Dementia Rating Scale (BDRS)
- Neuropsychiatric Inventory Questionnaire (NPI-Q)
- Hachinski Ischemic Scale
- Unified Parkinson's Disease Rating Scale (UPDRS)
- Short Test of Mental Status (STMS)
- Neuropsychology Screening Battery (NSB)
- Financial Capacity Instrument Short Form (FCI-SF)
- Cognitive and Physical Activities Questionnaire
- Food Frequency Questionnaire

Quantitative MRI scans, lumbar puncture for the collection of cerebrospinal fluid and Pittsburgh Compound B PET scans are performed on a subset of randomly selected participants from the cohort. These measures will be combined with annual plasma Aβ measures.

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