University of Alberta

Use of Autobiographical Memory Cues as Cognitive Support for Episodic Memory: Comparison of Individuals With Mild-Stage Alzheimer's Disease and Healthy Older Adults

by

Karen Michelle Cochrane

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Counselling Psychology

Department of Educational Psychology

Fall, 2009
Edmonton, Alberta

DEDICATION

This research project is dedicated to God, who has shown me throughout this journey that He is faithful in keeping his promises.

I would also like to dedicate this to my 101-year-old grandmother Hortense Cochrane, and my 96-year-old grandfather Edgar McDormand. My relationships with you fostered my strong interest in working with older adults.

ABSTRACT

The purpose of the study was to examine the effectiveness of autobiographical memories to support the improvement of episodic memory (i.e., word recall) in patients with mild-stage Alzheimer's Disease (AD) and healthy older adults. Participants included 20 healthy young-old adults (*M* Age = 70.90; *M* MMSE = 28.70), 20 healthy old-old adults (*M* Age = 79.75; *M* MMSE = 28.05), and 15 patients with mild-stage AD or mixed dementia (*M* Age = 74.73; *M* MMSE = 22.47). Participants were presented with three lists of 30 words, each administered under a different support condition: (1) no cognitive support, (2) autobiographical memory support, and (3) semantic support. In the autobiographical memory support condition, participants associated each to-be-remembered word with a personal memory that was then shortened to a word cue for use in subsequent memory testing. In the semantic support condition, participants associated each to-be-remembered word with a one-word descriptor. Memory was assessed with three recall conditions: immediate free recall, cued recall, and recognition. It was expected that autobiographical memory cues would be more effective than general semantic cues in improving number of words recalled in patients with mild-stage AD and healthy older adults. The results indicated that healthy older adults and patients with mild-stage AD benefited from both forms of cognitive support. Although the young-old group recalled more words in the autobiographical than in the semantic support condition across the three recall conditions, the differences were not significant. The old-old group recalled more words in the autobiographical than in the

semantic support condition on tests of immediate free recall. In contrast, the mild AD group recalled more words in the autobiographical than in the semantic support condition on tests of cued recall and recognition. A limitation was the ceiling effect for recognition performance in the young-old and old-old group. Consistent with previous studies, the results indicate that patients with mild-stage AD can benefit from cognitive support to improve episodic memory if support is provided at encoding and retrieval. The results suggest that autobiographical memory cues may be effective for improving everyday memory performance in healthy older adults and patients with mild-stage AD.

ACKNOWLEDGEMENTS

I would like to thank the members of my supervisory committee for their commitment to helping me carry out my research, and for their willingness to provide feedback long distance. Thank you to my departmental supervisor Dr. Bob Frender for his attention to detail, and for helping me to continually refine my writing of this document. Thank you to my co-supervisor Dr. Roger Dixon for providing a supportive lab environment in which to carry out my research, and for helping me with the details of my design and analyses. Thank you to Dr. Brent Small from the University of South Florida, for lending his expertise to the project, and for his words of encouragement along the way.

I would like to acknowledge financial and laboratory support from the Victoria Longitudinal Study (VLS), which is supported by a grant from the National Institutes of Health (National Institute on Aging) to Roger A. Dixon (R37AG008235).

I would like to thank my colleagues at the Edmonton VLS lab. Thanks to Jill (Jenkins) Friesen for her substantial help with the many details involved in testing my participants, as well as her help in formatting this document. I would also like to acknowledge Sarah Tippe and Sarah Feltmate for taking phone messages and greeting participants in the lab.

I would like to acknowledge the following for their assistance recruiting participants:

- The staff at the Edmonton Alzheimer Society, including Arlene Huhn and Jackie Gendre, for allowing me to attend their caregiver support groups.

- The staff at the Glenrose Rehabilitation Hospital Geriatric Clinic and the University of Alberta Hospital Seniors Clinic. A sincere thank you to Dr. Peter McCracken from the Glenrose Hospital for his help recruiting participants, and for his ongoing support of my research.

I would also like to thank the older adults from the community who enthusiastically volunteered to participate in this study. Thank you for sharing your interesting stories, and for providing feedback to help me refine my testing procedures. Special thanks to my initial research participant Dave F. You are an inspiration to so many, including those living with Alzheimer's.

There are many people I would like to acknowledge who supported me on my journey throughout grad school. My parents, who transported me and my belongings to McGill in a u-haul trailer, only to get it stuck for hours in a parking garage. The Parker family, who took me into their home when I first moved to Edmonton. My friends Marina Tan, Jackie Parnell, and Faye Grant, for their ongoing prayer support and encouragement. My fellow U of A student Danielle Fullerton-Straub, for her friendship and support during our Ph.D. program, and for helping me to not take grad school too seriously. My co-worker Edie Crytzer from the Center for Aging Resources (Pasadena, California), who encouraged me to continue writing my thesis during my internship.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 – INTRODUCTION

Alzheimer's disease (AD) is a neurodegenerative disease that is characterized by a gradual onset and a progressive course. AD is the most common form of dementia in older adults, representing 64% of all dementia disorders in Canada (Alzheimer Society of Canada, 2008). The risk of AD increases with age, doubling every five years after age 65, and represents a significant health concern among older adults (Canadian Study of Health and Aging, 1994). In terms of its prevalence, 1 in 13 Canadians over age 65 and 1 in 3 over age 85 has Alzheimer's disease or a related dementia (Alzheimer Society of Canada, 2008). The prevalence of AD is continuing to rise with increased longevity, resulting in increased economic costs associated with health care and institutionalization. Although several theories exist surrounding the etiology of AD, a specific cause is not presently known. Intervention efforts have focused on ameliorating symptoms through pharmacological treatments, and improving the quality of life for persons with AD through design of appropriate cognitive and behavioural interventions (Bayles & Kim, 2003; Mimura & Komatsu, 2007; Sitzer, Twamley, & Jeste, 2007).

AD is marked by a progressive decline in cognitive functioning, including impaired short-term and long-term memory, impaired abstract thinking and judgment, impaired attention and executive functions, aphasia, apraxia, and agnosia (Storandt, 2008). This neuropathology eventually results in personality changes, psychiatric and behavioural disturbances, and loss of functional ability, which leads to complete dependence in activities of daily living.

The earliest cognitive symptom and defining feature of AD is a profound deficit in episodic memory that progresses gradually throughout the course of the illness (Bäckman, Jones, Berger, Jonsson Laukka, & Small, 2005). As defined by Tulving (1972), episodic memory involves memory for personal experiences or episodes (events), encoded and maintained in relation to a particular temporal and spatial context, which require temporal or spatial cues for retrieval. Episodic memory could involve a memory for a personally experienced past event, or memory for information acquired in an experimental setting (i.e., a list of words or pictures of faces). In the literature, episodic memory has been contrasted with semantic memory, which involves memory for general knowledge about the world that is culturally shared and that is not time-or place-specific. Semantic memory includes knowledge of the meaning of words and concepts, names of objects, facts, and people (Tulving, 1972). Although they represent functionally distinct memory systems, semantic and episodic memory are highly interdependent and interactive in the context of everyday memory encoding and retrieval (Piolino, Lamidey, Desgranges, & Eustache, 2007; Rajah & McIntosh, 2005; Small & Sandhu, 2008; Westmacott, Black, Freedman, & Moscovitch, 2003). For example, knowledge in semantic memory guides the encoding and retrieval of new information, and provides a basis for integrating new information with existing knowledge in long-term memory (Hertzog, Dixon, Hultsch, & MacDonald, 2003).

Decline in episodic memory performance is considered a prominent characteristic of normal aging. Older adults may experience varying degrees of

forgetfulness or memory loss that is observable to family and friends, but that is not significant enough to interfere with daily functioning. Some older adults report difficulty remembering names and faces, dates, appointments, and other events in daily life (Nilsson, 2003). Although normal age-related memory changes are gradual (Dixon, Wahlin, Maitland, Hultsch, Hertzog, & Bäckman, 2004), they can be a source of concern for individuals who may wonder if their memory loss is symptomatic of a dementing illness. Research has demonstrated that healthy older adults are able to benefit from a variety of self-initiated strategies to enhance their everyday memory performance. These include external memory aids (i.e., notes, calendars), internal mnemonic techniques (i.e., organization, rehearsal), investing extra time in remembering, and increased effort in recall (Dixon, de Frias, & Bäckman, 2001).

In contrast to the memory deficits that occur with normal aging, the episodic memory deficit in AD is characterized by a profound difficulty acquiring and retaining new information (Bäckman et al., 2005). The episodic memory deficit interferes with activities of daily living, with increased functional impairment occurring as the disease progresses. Social interactions are affected by a reduced capacity for face and name recognition and an inability to recall daily events (Moore, Sandman, McGrady, & Kesslak, 2001). In the early stages of AD, individuals may frequently ask the same questions, or repeat identical statements or stories (Terry, 2006; Vandenberghe & Tournoy, 2005). Individuals with AD may frequently misplace familiar objects, forget their reasons for going into a room, or leave tasks unfinished after forgetting to return to them after an

interruption. The episodic memory deficit in AD is further characterized by a gradual loss of long-term memory for both public and personal (autobiographical) events, with recent memories becoming impaired first and remote memories being relatively spared (Starkstein, Boller, & Garau, 2005).

The early memory deficits associated with AD can result in frustration, anxiety, depression, and social withdrawal for affected individuals (Moore et al., 2001). As the memory impairment progresses, individuals with AD become increasingly reliant on others to assist them with their everyday memory performance (Dixon, Hopp, Cohen, de Frias, & Bäckman, 2003). Many caregivers of persons with AD report increased stress when the patient's memory loss reaches a stage where assistance is needed (Burns & Rabins, 2000; Razani et al., 2007). Because episodic memory plays an essential role in daily functioning and is related to emotional well-being, it is important to develop methods to help individuals with AD facilitate their memory performance for as long as possible. Previous studies have examined the effectiveness of interventions to improve memory in mild to moderate AD, including memory training and technical procedures or materials (Clare & Woods, 2003). Although patients with AD have failed to demonstrate long-term treatment gains from memory training programs, cognitive support interventions that aid the learning of new information may be helpful in improving memory performance during the early stages (Cahn-Weiner, Malloy, Rebok, & Ott, 2003; Moore et al., 2001). Previous research suggests that some patients with AD are capable of learning new information when a sufficiently supportive learning context is provided (for a review see

Grandmaison & Simard, 2003).

Purpose of the Study

The purpose of the present study was to (a) compare the effects of three cognitive support conditions (no support, semantic, and autobiographical) on number of words recalled in patients with mild-stage AD and healthy older adults, and (b) to examine whether patients with mild-stage AD and healthy older adults demonstrate differential improvement in number of words recalled as a function of support condition and recall condition (free recall, cued recall, and recognition). Healthy older adults and patients with mild-stage AD were presented with lists of random words under different support conditions. In the autobiographical memory support condition, they were instructed to associate each word on the list with an autobiographical memory, and in the semantic support condition they were instructed to associate each word with a one-word descriptor. Both support conditions were compared to a control condition in which no cognitive support was provided. The general expectation was that autobiographical memory support would be more effective than semantic support in improving number of words recalled for patients with mild-stage AD and healthy older adults.

CHAPTER 2 – LITERATURE REVIEW

In this literature review, I will first review the neurobiological changes that lead to the episodic memory deficit in AD. To provide a context for the memory changes that occur in normal aging and AD, I will next provide an overview of the research on episodic memory performance in healthy older adults and adults with mild-stage AD. I will then provide an overview of cognitive support interventions and review the research on cognitive support for both groups. In addition, research studies on autobiographical memory functioning in normal aging and AD will be reviewed. This will be followed by a summary and integration of the literature in these areas, and a rationale for the present study.

Neurobiology of AD

The episodic memory deficit in AD is due to disease-related damage to the neural network of brain structures critical to episodic memory formation, including the hippocampus and surrounding areas in the medial temporal lobe (Albert & Moss, 2002). Research has demonstrated that the hippocampus serves as a temporary storage for new incoming information, before it is consolidated permanently in neocortical areas of the brain (Eustache et al., 2004).

The progression of AD is marked by the development of neuritic plaques and neurofibrillary tangles, which accumulate in the brain causing synaptic death and neuronal degeneration (Coleman & Yao, 2003; Scheff & Price, 2003). Neuropathological studies of the brains of patients with AD have revealed a high density of plaques and tangles in the medial temporal lobe areas (Albert & Moss, 2002). The spread of neuropathology during the course of AD was divided into

six stages by Braak and Braak (1991). The plaques and tangles are first evident in the neurons of the transentorhinal region (entorhinal cortex and subiculum), affecting the pathways that send information to and from the hippocampal formations (stages I and II). This results in gradual functional disconnection of the hippocampal complex from the neocortex and other brain regions (Allen et al., 2007; Delbeuck, Van der Linden, & Collette, 2003). The gradual disconnection of the hippocampal complex and neocortex results in increased difficulty transferring new information from short-term to long-term memory. Early-stage neuronal loss is further evident in the superior temporal sulcus and the anterior cingulate (Killiany et al., 2000). The superior temporal sulcus is a multimodal association area responsible for holding information during a delay, whereas the anterior cingulate has reciprocal connections with the entorhinal cortex and prefrontal cortex (Killiany et al., 2000). Plaque deposition is further evident in the anterior frontal lobe areas in early-stage AD, leading to impaired attention and executive functions (Bullock & Lane, 2007). In stages III and IV, the plaques and tangles progress to the limbic structures including the hippocampus proper and amygdala. In the final stages of the disease (stages V and VI), the damage spreads to the temporal neocortex and cortical association areas (Delbeuck et al., 2003). The damage to these areas results in a gradual loss of semantic memory and memory for autobiographical experiences (Lambon Ralph, Patterson, Graham, Dawson, & Hodges, 2003; Westmacott, Freedman, Black, Stokes, & Moscovitch, 2004).

Neurochemical changes in AD include severe neuronal loss in the basal

nucleus of Meynart, resulting in reduction of the neurotransmitter acetylcholine in the hippocampus and cortex (Terry, 2006). According to the cholinergic theory, this cholinergic depletion contributes to episodic memory and attentional deficits in persons with AD (Schaeffer & Gattaz, 2008). In addition to cholinergic deficits, the neurotransmission of glutamate, an important process in learning and memory, is severely disrupted in AD (Schaeffer & Gattaz, 2008).

Episodic Memory in Healthy Aging and Mild-Stage AD

As mentioned previously, episodic memory involves the conscious recollection of past personal experiences or episodes (Tulving, 2002). In an experimental setting, episodic memory is tested with free recall, cued recall, or recognition of verbal or visual stimuli (i.e., lists of words or pictures). Both healthy older adults and adults with mild-stage AD demonstrate deficits on tests of episodic memory. Understanding the nature of age-related and AD-related changes in episodic memory can provide information to aid the development of memory interventions for older adults.

Episodic Memory in Healthy Aging

Previous research has confirmed that episodic memory changes occur with normal aging. Cross-sectional studies comparing younger and older adults have revealed age-related differences in performance on episodic memory tasks. Older adults typically recall less information than younger adults on tests of immediate and delayed word recall, story recall, paired associate learning, and pictorial recognition of faces (for a review see Bäckman, Small, Wahlin, & Larsson, 2000; Head, Rodrigue, Kennedy, & Raz, 2008). The performance deficit seen in

healthy older adults has largely been attributed to age-related decline in frontal lobe functions (Bunce, 2003; Tacconat, Clarys, Vanneste, Bouzzaoui, & Isingrini, 2007). Evidence from both neuroimaging and neuropsychological studies indicates that age-related differences in memory are mediated by a variety of neural and cognitive factors (Head et al., 2008). Neuroimaging studies have produced evidence of age-related structural and functional differences in the brains of older adults. These include modest volumetric reduction of selected brain regions (i.e., prefrontal cortex and hippocampus), reductions in synaptic density and number of dendrites, as well as reduced metabolism and cerebral blood flow (for reviews see Head et al., 2008; Persson et al., 2005; Reuter-Lorenz, 2000; Terry, 2006; Vandenberghe & Tournoy, 2005; West, 1996). Cerebral changes associated with normal aging include shrinkage of large cortical neurons, but not a significant loss of neuronal number (Terry, 2006). Neurochemical differences in the brains of older adults include region-specific reduction in the concentration of neurotransmitters and number of receptors (Vandenberghe & Tournoy, 2005). Head et al. (2008) obtained measures of regional brain volume in a sample of younger and older adults using Magnetic Resonance Imaging (MRI), as well as cognitive measures of executive functioning, processing speed, and episodic memory. The study found that age-related reduction in hippocampal volume directly affected episodic memory performance. Reduction in prefrontal cortex volume was found to impact processes related to episodic memory, including processing speed and executive functions (i.e., working memory and inhibitory control). Hertzog et al. (2003) found that 6-year changes in episodic

memory in older adults were significantly related to changes in processing speed and working memory.

The most direct evidence for age-related changes in episodic memory comes from longitudinal studies. Dixon et al. (2004) compared data from two longitudinal studies, the Victoria Longitudinal Study and the Kungsholmen Project, in order to examine memory changes in healthy older adults over a 3-year period. Although similar patterns of memory decline were observed for word list and story recall, the degree of change was not significant after 3 years. The old-old group (aged 75-84) recalled less information from word lists and stories than both the mid-old (aged 65-74) and young-old (aged 54-64) groups. For story recall, all three age groups recalled a high number of main ideas, but the old-old group recalled fewer story details at the second time of measurement. McArdle, Fisher, and Kadlec (2007) found significant episodic memory decline on tests of immediate and delayed free recall of words over a 12-year period. MacDonald, Dixon, Cohen, and Hazlitt (2004) found significant age-related changes and differences in word and story recall for older adults over a 12-year period. The very-old group (aged 81-95) recalled fewer words and story details across waves of measurement than the old-old group (aged 67-80). The results suggest that average memory decline in healthy older adults is modest and gradual, making changes difficult to detect in longitudinal studies using short follow-up intervals (Bäckman et al., 2004).

The degree of age-related episodic memory deficit is not uniform among individuals, and may be influenced by factors such as level of education, health,

lifestyle, verbal ability, prior knowledge, and specific memory-related skills (Bäckman et al., 2004; Hill & Bäckman, 2000; Lee, Buring, Cook, & Grodstein, 2006). In contrast to the age-related deficits associated with episodic memory, semantic memory is generally well preserved in healthy older adults (Nilsson, 2003; Nyberg et al., 2003; Peraita, Diaz, & Anllo-Vento, 2008).

Episodic Memory in Mild-Stage AD

It has been well documented that patients with AD demonstrate greater deficits on episodic memory tasks than older adults without dementia (for a review see Spaan, Raaijmakers, & Jonker, 2003). Neuropsychological studies reveal that patients with AD perform more poorly than healthy older adults on free recall of word lists and visual stimuli (Stopford, Snowden, Thompson, & Neary, 2007). The episodic memory deficit in mild-stage AD is most evident on tests of delayed verbal recall. Research has demonstrated that patients with mild-stage AD recall less information over short-delay intervals than healthy older adults and those with other forms of dementia including Huntington's disease, Pick's disease, or progressive supranucleur palsy (for reviews, see Albert & Moss, 2002). This rapid rate of forgetting has been demonstrated to be evident primarily during the initial 10 minutes of exposure to new material. As mentioned previously, the memory deficit in AD is due to disease-related damage to brain areas serving episodic memory formation, including the hippocampal complex, resulting in difficulty transferring new information from short-term to long-term memory. This results in a rapid decay of memory traces, which affects recall of verbal and visual material (Graham, Emery, & Hodges, 2004).

Summary

Episodic memory decline is evident in both healthy older adults and adults with mild-stage AD. Healthy older adults typically recall less information than younger adults on tests of episodic memory. Previous research suggests that the episodic memory deficit in healthy older adults is due to age-related structural and functional changes in the brain, including volumetric reduction of selected brain areas, as well as changes in executive functions and processing speed. Longitudinal studies suggest that the average memory decline in healthy older adults is modest and gradual. The degree of episodic memory deficit in older adults may be influenced by factors such as level of education, health, and existing memory-related skills.

Patients with mild-stage AD demonstrate greater deficits on episodic memory tasks than older adults without dementia. The episodic memory deficit in mild AD is due to disease-related damage to brain areas responsible for new memory formation, including the hippocampus and surrounding areas in the medial temporal lobe. The damage results in severe difficulty learning new information and a rapid forgetting of information over short-delay intervals.

Cognitive Support for Healthy Older Adults and Patients With Mild-Stage AD

The theoretical goal of memory training programs in aging and AD is to support or improve declining memory functions in order to facilitate new learning (Grandmaison & Simard, 2003; Mimura & Komatsu, 2007). In the context of episodic memory, the term *cognitive support* refers to the learning or task conditions that aid the *encoding* and/or *retrieval* of new episodic information. Encoding refers to the hippocampal-dependent process of transferring new information from short-term memory to long-term memory (Hou, Miller, & Kramer, 2005). Retrieval refers to the recall of stored information from long-term memory.

Episodic memory tasks can vary considerably in terms of the degree of cognitive support provided at encoding and retrieval. Cognitive support at encoding involves measures to facilitate the encoding process, such as enhancing the saliency or organization of the to-be-remembered information (Mimura & Komatsu, 2007). Encoding support could include additional study time, provision of learning material that can be structured or organized by semantic category, or instructions to associate the to-be-remembered material with something else. Cognitive support at retrieval could include provision of cues during recall, or recognition of the learned material (Nyberg et al., 2003). The testing materials used in experimental studies can also provide varying levels of cognitive support. For example, pictures and objects may provide a higher degree of cognitive support than words due to the richness of their visual detail (Larsson, Nyberg, Bäckman, & Nilsson, 2003).

Cognitive Support for Healthy Older Adults

Research suggests that healthy older adults possess a cognitive reserve capacity that may enable them to improve their performance on tests of fluid intelligence (Baltes, Kliegl, & Dittmann-Kohli, 1988; Baltes, Sowarka, & Kliegl, 1989; Corral, Rodriguez, Amenedo, Sanchez, & Diaz, 2006). Fluid intelligence refers to a cluster of cognitive abilities, including episodic memory, that decline with age. Cognitive reserve refers to the brain's capacity to compensate for brain pathology or aging-related changes through use of pre-existing cognitive skills or compensatory strategies (Stern, 2006). According to Stern, individual variations in cognitive reserve may be attributed to structural differences in the brain (i.e., number of neurons, synaptic complexity), as well as factors such as education, occupation, or general intellectual ability.

Derwinger, Stigsdotter Neely, Persson, Hill, and Bäckman (2003) developed a memory training program designed to improve four-digit number recall in healthy older adults. One group received instructions and training in a number-consonant mnemonic, whereas another group was instructed to adopt their own encoding and retrieval strategies to enhance number recall. Older adults with self-generated strategy training demonstrated performance improvement similar to those with mnemonic training. Furthermore, when the participants were reassessed eight months after completion of training, number recall for the mnemonic group dropped slightly, whereas performance for the self-generated strategy group improved (Derwinger, Stigsdotter Neely, & Bäckman, 2005). The study illustrates the benefit of self-generated memory strategies for older adults.

The fact that older adults are capable of producing cognitive training gains by themselves supports the theory of cognitive reserve capacity. This memory improvement may result from the activation or recruitment of other cognitive skills existing in a person's repertoire (Baltes et al., 1988). The cognitive reserve in healthy older adults enables them to benefit from supportive conditions in episodic memory tasks and improve their memory performance.

In previous studies, healthy older adults have demonstrated improved performance on episodic memory tasks following provision of various forms of cognitive support at encoding or retrieval (Dixon et al., 2004). Larsson et al., (2003) found that older adults benefited to the same extent as younger adults from a rich stimulus input (i.e., pictures of faces), intentional encoding instructions, and extra-study repetition when learning names. In a study by Dijkstra and Kaschak (2006), younger and older adults were asked to remember actions printed on 12 cards under three different encoding conditions. Participants were asked to (a) read the card out loud (verbal condition), (b) act out a command printed on the card (enactment condition), or (c) retrieve memories associated with the action printed on the card (autobiographical memory encoding condition). Participants were then asked to verbally free recall items from the cards. Both younger and older adults recalled more information from the enactment and autobiographical memory encoding conditions than from the verbal condition.

Using data from the Kungsholmen Project, Dixon et al. (2004) examined longitudinal performance of older adults on episodic memory tasks that varied in terms of the level of cognitive support. The tasks, ranging from least to most

support included (a) free recall of random words with 2-second presentation rate, (b) free recall of random words with 5-second presentation rate, (c) free recall of organizable words (5-second rate), and (d) cued recall. Recognition tests were also given for the random word lists. Both old-old (aged 67-80) and very old (aged 81-95) adults demonstrated improved word recall with increasing levels of cognitive support. In addition, both age groups demonstrated episodic memory decline across all levels of support after a 3-year period. Although both age groups recalled more words in the cued recall and recognition condition than in the free recall conditions, the degree of decline after three years was greatest for cued recall and recognition. The results suggest that the ability to benefit from cognitive support may gradually decrease in late life due to a possible reduction in cognitive reserve capacity (Bäckman et al., 2004). Using data from the Victoria Longitudinal Study, Dixon et al. examined free recall of organizable word lists for older adults. Although no significant decline in word recall was found over a 3-year period, old-old adults (aged 75-84) recalled a lower percentage of words than both mid-old adults (aged 65-74), and young-old adults (aged 54-64). The results suggest that old-old adults may have difficulty utilizing encoding support alone (i.e., organizable word lists) to improve their memory performance.

Cognitive Support for Patients With Mild-Stage AD

In contrast to healthy older adults, patients with AD demonstrate deficits in the ability to use cognitive support to improve memory due to disease-related damage to areas of the brain responsible for new memory formation (for a review see Bäckman & Small, 1998). However, there is increasing evidence that patients with mild-stage AD are able to benefit from cognitive support during episodic

memory tasks if support is provided at encoding and retrieval (for a review see Bäckman, Small, & Fratiglioni, 2002; Bayles & Kim, 2003). It should be noted that studies examining cognitive support for AD patients are lacking in the literature. A few earlier studies are noted here due to the paucity of more recent studies.

Almkvist et al. (1999) assessed 46 healthy older adults, 32 patients with AD, and 14 patients with vascular dementia (VaD) on word recall tasks using various forms of cognitive support. The design compared different levels of cognitive support at encoding (semantically organizable vs. random word lists; slow vs. rapid presentation rate), and different levels of support at retrieval (free recall vs. cued recall vs. recognition). On tests of free recall, healthy controls performed better with organizable than with random word lists, whereas patients with AD and VaD demonstrated no benefit from organizable word lists. All three groups (AD, VaD, and controls) demonstrated benefit from organizable word lists when semantic (category) cues were provided at retrieval. On tests of free recall, healthy older adults benefited from a slow presentation rate (5 seconds), as opposed to a fast rate (2 seconds), whereas both dementia groups demonstrated no benefit from slow presentation rate. The dementia groups demonstrated benefit from slow presentation rate only when memory was assessed with recognition. In summary, patients with dementia were able to benefit from cognitive support on episodic memory tasks only when support at encoding was combined with support at retrieval (i.e., organized word lists and category cues, or more study time and recognition cues). This finding suggests that patients with dementia

encoded more information with slowly compared to rapidly presented word lists, however, the effect did not show up on tests of free recall because of poor retrieval conditions. With the provision of recognition cues, the memory traces could be activated more easily and the benefit of more study time was seen in both AD and VaD groups. Although patients with AD and VaD demonstrated improved memory performance with provision of encoding and retrieval support, both dementia groups were still significantly impaired in relation to healthy older adults.

Bäckman and Small (1998) compared three groups of older adults (healthy, preclinical AD, and mild-stage AD) on word recall tasks that varied along a continuum in terms of the degree of cognitive support provided. The four tasks included (a) free recall of rapidly presented random words, (b) free recall of slowly presented random words, (c) free recall of slowly presented organizable words, and (d) cued recall of organizable words. Participants were tested at baseline and after a three-year interval. Although the healthy older adults declined slightly over the three year period, they demonstrated successful utilization of all three forms of cognitive support at both times of measurement, with word recall gradually increasing with the addition of more study time, organizability, and retrieval cues. Although the preclinical AD cases were impaired at baseline assessment, they demonstrated the same qualitative pattern as the controls, with recall performance increasing with increased levels of cognitive support. When these participants were diagnosed with AD at follow-up, they failed to demonstrate benefit from increased study time and organized word lists

on tests of free recall, but demonstrated benefit from organized word lists with provision of retrieval cues. The same pattern of results were demonstrated for the AD group at both times of measurement: they demonstrated improved performance only in the most supportive condition (organized word lists plus retrieval cues). The important finding of the study is that when support is provided at both encoding and retrieval, individuals with mild AD benefit to the same extent as healthy older adults on episodic memory tasks. This was evidenced by parallel line slopes for the AD and control groups when cues were provided at retrieval.

Some research has explored the use of relatively spared cognitive abilities to improve episodic memory in mild-stage AD (for reviews see Bayles & Kim, 2003; Neri, Iaconi, Renzetti, & DeVreese, 2001). There is evidence that some abilities such as motor skill learning, procedural memory, and the articulatory loop of working memory are relatively well preserved in mild-stage AD (for a review see Grandmaison & Simard, 2005). The presence of preserved cognitive abilities suggests a potential for memory compensation, as preserved abilities may be recruited to support declining episodic memory.

Patients with mild AD have demonstrated benefit from self-performed motor actions at the time of encoding (for a review see Grandmaison & Simard, 2005). Herlitz, Adolfsson, Bäckman, and Nilsson (1991) compared memory performance for patients in different stages of AD under several different encoding conditions. The encoding conditions included memory for (a) verbally presented nouns, (b) objects, (c) objects with a semantic-orienting question, (d) objects with self-

generated motor acts, and (e) objects with experimenter-instructed motor acts. The results revealed that when presented with retrieval cues, healthy older adults and patients with mild-stage AD were able to benefit from all encoding conditions, but demonstrated greatest recall in the condition with the experimenter-instructed motor acts. Patients with moderate-stage AD benefited in all conditions but the verbal condition, and patients with severe-stage AD benefited only in the condition with the experimenter-instructed motor acts. These findings demonstrate that the ability of AD patients to utilize cognitive support decreases as a function of dementia severity.

Lipinska, Bäckman, and Herlitz (1992) investigated the effects of prior knowledge on recognition memory in 11 patients with mild-stage AD and 11 healthy older adults. Participants were presented with 30 pictures of famous faces with their corresponding names. Half of the pictures represented individuals who had attained their fame in the 1940s and half of the pictures represented individuals who were famous at the current time. Participants were presented with each picture and asked to generate as many unique biographical statements about the person as possible during a period of one minute. Both groups generated more statements about the dated than the contemporary faces. Participants were then given a recognition task in which they were asked to make yes/no judgments for each picture in terms of whether the picture had been presented previously. Both healthy older adults and patients with mild-stage AD performed better on recognition of dated famous faces about which they had more prior knowledge than on recognition of contemporary faces about which they had

little prior knowledge. The results suggest that patients with mild-stage AD are able to utilize prior knowledge to enhance facial recognition.

Previous studies have found that self-generated cues improve memory performance in mild AD (for a review see Grandmaison & Simard, 2005). Lipinska, Bäckman, Mäntylä, and Viitanen (1995) examined the ability of patients with AD to utilize cognitive support in the form of self-generated retrieval cues. Eleven healthy older adults and 11 patients with mild-stage AD were presented with a series of 20 nouns and instructed to generate one property (descriptor) for each word. After the generation task, participants were first given an unexpected free recall task in which they were asked to recall as many words as possible from the study list. Following free recall, participants were presented with their self-generated descriptors as retrieval cues for ten of the words, and taxonomic category cues for the remaining ten words. Both the healthy older adults and patients with mild AD benefited from both types of cues compared to free recall. Both groups also demonstrated better word recall performance with the self-generated cues than with the experimenter-provided taxonomic cues. The results suggest that both self-generated cues and compatibility of conditions at encoding and retrieval promote optimal use of retrieval cues in healthy older adults and adults with mild-stage AD. The efficacy of self-generated cues may be due to the elaborative cognitive activity taking place at encoding (Grandmaison & Simard, 2003).

Summary

Although older adults demonstrate performance deficits on episodic memory tests relative to younger adults, they are able to improve their performance with provision of cognitive support at encoding or retrieval. The ability of healthy older adults to benefit from cognitive support is believed to be due to a cognitive reserve capacity that enables them to recruit existing cognitive skills to improve their memory performance. Research suggests that the ability to utilize cognitive support declines gradually with age due to a possible reduction in cognitive reserve capacity.

Previous research has demonstrated that patients with mild-stage AD can exhibit performance gains on episodic memory tasks following provision of various forms of cognitive support. Patients with mild AD have demonstrated benefit from many of the same forms of cognitive support as healthy older adults. Because of the neuropathological damage to episodic memory, patients with AD require a higher level of cognitive support than healthy older adults, and the level of support needed increases as a function of dementia severity. Patients with mild AD have benefited from various forms of cognitive support including more study time, categorical organization of material, performing motor actions during encoding, activating task-relevant prior knowledge, and self-generated semantic cues. Research has demonstrated that episodic memory in patients with mild AD is improved when (a) cognitive support has been provided at encoding and retrieval, (b) participants have been directed to engage in elaborative cognitive activities during encoding, and (c) the conditions at encoding are reinstated at

retrieval. Previous studies suggest that when sufficient support is provided at encoding and retrieval, patients with mild-stage AD benefit to the same extent as healthy older adults on recall tasks, although their performance is still significantly below that of healthy older adults.

Autobiographical Memory

The term autobiographical memory has been applied to the component of remote memory responsible for personally relevant past memories. Autobiographical memory encompasses both personal semantic and episodic memory (Conway et al., 2002; Svoboda, McKinnon, & Levine, 2006). Personal semantic memory refers to general conceptual and factual knowledge about oneself (e.g., previous addresses), whereas episodic memory involves detailed memories of personal experiences that includes temporal-spatial information (when and where an event occurred) (Westmacott et al., 2003). Research suggests that the neuroanatomy of autobiographical memory is mediated by a neural network of cortical and subcortical regions (for reviews see Greenberg & Rubin, 2003; Svoboda et al., 2006).

Autobiographical memory is posited to serve a variety of practical functions in everyday life. An individual's repertoire of past personal experiences plays an important role in many cognitive processes including problem solving, decision-making, and planning future actions (Bluck, 2003; Pillemer, 2003). Among older adults in particular, autobiographical memory serves an important role in establishing and maintaining a sense of identity (Pillemer, 2003). In recent years, increased attention has been paid to the adaptive and therapeutic functions of

autobiographical memory recall in older adults. Individual and group therapies have been developed for use with older adults that integrate recall of autobiographical memories into the counselling process, including *reminiscence* and *life review* therapies. Autobiographical memory retrieval in the context of life review therapy has been found effective in treating depressive symptoms in older adults (Serrano, Latorre, Gatz, & Montanes, 2004).

Autobiographical Memory in Healthy Aging

Although the anterograde memory deficit in AD has been studied extensively, the autobiographical component of remote memory has not received as much attention in the literature, partly due to the lack of reliable instruments. Most studies of autobiographical memory in older adults have examined the chronological distribution of memories across the lifespan (Janssen, Chessa, & Murre, 2005). Many of these studies have employed the technique derived from Crovitz and Schiffman (1974) in which persons are required to retrieve and date specific autobiographical memories in response to cue words.

Research suggests that autobiographical memories are relatively preserved in older adults (Piolino et al., 2006). Previous studies with older adults have found that autobiographical memories acquired during young and early adulthood (ages 10-30 years) are particularly robust and easily accessible. The high number of memories recalled from this period has been referred to as the *reminiscence bump*, and has been extensively documented in the literature (Fromholt et al., 2003; Janssen, Chessa, & Murre, 2005; Rubin & Schulkind, 1997). It has been suggested that memories from this life period may be more easily accessible for

retrieval due to their personal significance, vividness, imagery, increased rehearsal, and more extensive integration with neocortical networks (Greenberg & Rubin, 2003; Janssen et al., 2005; Westmacott et. al., 2004). Westmacott and Moscovitch (2003) found that on tests of free recall and recognition of famous names, healthy older adults remembered more names that were autobiographically significant than names that were not autobiographically significant.

Dijkstra and Kaup (2005) compared autobiographical memory retrieval for a group of younger and older adults. When asked to recall autobiographical memories from certain life periods, older adults were more likely than younger adults to recall positive memories, and memories with higher self-relevance and emotional intensity ratings. Older adults also reported more landmark events from elementary school than did younger adults, but not memories from five years ago. The results suggest that older adults are more likely to retain remote memories that are self-relevant and distinct, in contrast to more general memories, which may be forgotten. Research on autobiographical memory retrieval has shown that recall of autobiographical memories require less cognitive effort than recall of semantic knowledge, as measured by shorter response times (Algarabel, Pitarque, & Dasi, 2002).

Autobiographical Memory in AD

Longitudinal and cross-sectional studies of autobiographical memory in persons with AD have provided evidence of a retrograde memory deficit that is temporally-graded, with a relative sparing of remote memories and impaired recent memory (Small & Sandhu, 2008; Starkstein, Boller, & Garau, 2005). It has

been suggested that remote memories are more resistant to disease-related damage to medial temporal lobe structures, due to their storage in neocortical areas of the brain (Hou et al., 2005). A study of remote memory functioning in moderate to severe-stage AD found some preservation of remote autobiographical memories in addition to severe anterograde memory deficits (Sartori, Snitz, Sorcinelli, & Daum, 2004).

Neuroimaging studies in patients with AD have provided information about the neural structures involved in autobiographical memory (Eustache et al., 2004). Eustache et al. examined Positron Emission Tomography (PET) measures of resting cerebral glucose utilization (CMRGlc) during autobiographical recall in 17 patients with mild to moderate AD. Participants were asked to recall specific, personal events from three broad time periods: (a) the previous five years excluding the past 12 months, (b) middle age, and (c) adolescence/childhood. For each period studied, participants were required to produce specific, detailed personal event memories for each of four topics. The topics included a meeting or an event related to (a) a person, (b) a school or a professional event, (c) a trip or a journey, and (d) a family event. Each memory was scored on a 4-point episodic scale that rated the event based on degree of specificity of content, spatial-temporal information, and the presence of details. Autobiographical memory scores were obtained for each life period. Correlations were obtained between autobiographical memory scores and resting state brain glucose utilization. The patients with AD demonstrated the expected temporal gradient with relative preservation of memories from the most remote period. In addition, significant

metabolic differences were found for recall of memories from the three different time periods. A significant positive correlation was found for autobiographical memory scores from the most recent period and metabolism of the right hippocampus. Memory scores from the middle age period were positively correlated with metabolism in the bilateral prefrontal cortex, and memory scores from the most remote period (childhood and adolescence) with metabolism in the left prefrontal cortex. The finding that the hippocampal region was involved in the recall of recent memories within the past five years, but not for earlier periods, is in accordance with the standard model of long-term memory consolidation. According to this model, the retrieval of recent memories initially relies upon the medial temporal lobe, but over time, the repeated activation of this region results in the formation of a more permanent representation in the neocortical areas (Eustache et al., 2004).

Summary and Integration

Episodic memory decline is evident in both healthy older adults and adults with mild-stage AD. Previous studies demonstrate that although older adults perform more poorly on episodic memory tasks than younger adults, they are able to benefit from supportive task conditions that aid the encoding or retrieval of new episodic information. In patients with mild-stage AD, the episodic memory deficit involves a severe difficulty acquiring new information, and rapid forgetting of information over short-delay intervals. The memory deficit in AD is due to disease-related damage to the medial temporal lobe areas of the brain, including the hippocampus. This memory deficit results in a reduced ability to

benefit from supportive conditions on episodic memory tasks. Patients with mild-stage AD have demonstrated benefit from some of the same forms of cognitive support as healthy older adults, including those forms of support that utilize relatively preserved abilities (i.e., motor skills) to facilitate new learning. The learning conditions that promote optimal use of cognitive support in patients with AD are (a) that dual support has been provided at encoding and retrieval, (b) that patients have been directed to engage in elaborative cognitive activities at encoding, and (c) that the conditions at encoding are the same as the conditions at retrieval.

Autobiographical memory refers to personally relevant past memory, including general self-knowledge and memory for personal experiences. Many studies with healthy older adults have examined the distribution of memories across the life span using the word cue method. These studies have found autobiographical memories to be relatively well preserved and easily accessible in older adults. Studies of autobiographical memory in patients with AD have provided evidence of a retrograde memory deficit that is temporally-graded, with relative sparing of remote memories in relation to recent memories. Neuroimaging studies that examine metabolism during autobiographical memory retrieval confirm the involvement of the hippocampus in retrieval of memories from the past five years, and provide evidence that remote memories are stored in neocortical areas of the brain.

Although cognitive support measures that aid the encoding and retrieval of information from memory are promising, further research is needed to examine

the forms of cognitive support that are useful for individuals with mild-stage AD. The previous studies of cognitive support for persons with AD have utilized support that relies heavily on semantic processes to facilitate the encoding and retrieval of new information (i.e., semantically-organized word lists with category cues, self-generated semantic cues). As AD progresses however, the ability to utilize semantic support to enhance episodic learning decreases because of deficits in semantic memory (Bäckman & Small, 1998; Peraita et al., 2008). One potential form of cognitive support may be other aspects of memory that are preserved in normal aging and mild AD. In the present study, I examined whether one typically spared aspect of memory (i.e., autobiographical memories), could be used to support declining episodic memory. Previous studies have determined that episodic memory loss in AD follows a fairly predictable pattern, with recent memory becoming impaired first, followed by a gradual loss of long-term memory. Because long-term autobiographical memories are relatively preserved in normal aging and mild-stage AD due to their storage in cortical brain areas, these memories might potentially be used to enhance episodic memory if they are linked to new information.

In order to examine autobiographical memory as cognitive support, an autobiographical memory word-cue technique (based on Crovitz & Schiffman, 1974) was developed. For the mnemonic technique, participants associated each to-be-remembered (TBR) word on a list with a specific, personal memory that was then shortened to a one or two-word cue for use in subsequent memory testing. In order to compare the effectiveness of autobiographical

memory cues to other forms of cognitive support, the study utilized the self-generated semantic cue technique used by Lipinska et al. (1995). For the mnemonic technique, participants associated each TBR word on a list with a one-word general descriptor. The descriptor cues were subsequently presented as retrieval cues. The semantic cue task was selected because it involves a procedure similar to the autobiographical memory cue task. Both tasks involve use of participant-produced cues, which have been found to be more effective than experimenter-provided cues in improving word recall for healthy older adults and patients with mild-stage AD (Lipinska et al., 1995). The autobiographical and semantic cue techniques were compared to a control condition in which no cognitive support was provided.

Three recall tasks were utilized: An immediate free recall task in which participants were asked to recall words after being presented with the word list, a cued recall task in which participants were presented with participant-produced cues for each word on the list, and a recognition task in which participants were asked to select the correct word from the list from one of three semantically-related words.

Objectives, Questions, and Hypotheses

The objectives of the present study were (a) to compare the effects of three cognitive support conditions (i.e., no support, semantic, and autobiographical) on number of words recalled in patients with mild-stage AD and healthy older adults, and (b) to examine whether patients with mild-stage AD and healthy older adults demonstrate differential improvement in number of words recalled as a function

of support condition and recall condition (free recall, cued recall, and recognition). The effects of three main factors were examined: A group factor (three levels: young-old, old-old, mild AD), a support condition factor (three levels: no support, semantic, autobiographical), and a recall condition factor (three levels: free recall, cued recall, recognition). In addition, for the initial baseline free recall task there were two tests (immediate free recall and delayed free recall).

Comparison of Number of Words Recalled in the Semantic and Autobiographical Support Conditions

The first set of four research questions examined word recall performance in the autobiographical and semantic support condition as affected by group and recall condition. The design for the questions was a 3 (Group: Young-Old, Old-Old, Mild AD) X 2 (Support Condition: Semantic, Autobiographical) X 3 (Recall Condition: Free Recall, Cued Recall, Recognition) Analysis of Variance (ANOVA), with repeated measures on the last two factors. The no support condition (immediate and delayed free recall) was not included in this analysis, as it was used as a baseline measure of word recall performance and was examined in a separate analysis.

The first research question concerned the group factor in the above model, and addressed whether the three groups differed in the overall number of words recalled averaged across the two support conditions and three recall conditions. The first research question was, will young-old adults recall greater number of words than old-old adults, and will old-old adults recall greater number of words

than patients with mild-stage AD? Research has demonstrated that although performance gains are made with provision of support at encoding and retrieval, patients with mild-stage AD are still impaired on episodic memory tests relative to healthy older adults. Research has further demonstrated that among healthy older adults, the ability to benefit from cognitive support declines with age due to a possible reduction in cognitive reserve capacity. Thus, my first hypothesis was that (a) young-old adults will recall greater number of words than old-old adults, and (b) old-old adults will recall greater number of words than patients with mild-stage AD.

The second research question concerned the main effect of support condition, and addressed whether word recall performance differed in the two support conditions (semantic and autobiographical). Word recall performance was measured by the number of words recalled in each support condition averaged across the three groups and the three recall conditions (free recall, cued recall, and recognition). The question was, will the participants overall (i.e., combining across young-old, old-old, and mild AD) recall greater number of words in the autobiographical support condition than in the semantic support condition? Research has demonstrated that cognitive support may improve episodic memory performance in healthy older adults and in patients with mild-stage AD when support is provided at encoding and retrieval. Autobiographical memories are relatively preserved in healthy older adults and patients with mild-stage AD, and may carry a high degree of meaningfulness, vividness, and imagery. When these memories are linked to unfamiliar material to be learned (i.e., random words) they

can provide meaningless words with meaning, increasing the likelihood that the words will be encoded effectively and stored in long-term memory. Although self-generated cues have been effective in improving recall in healthy older adults and adults with mild-stage AD, I expected that autobiographical memory cues would provide a greater degree of cognitive support than participant-produced general semantic cues, due to their personal significance. Thus, my second hypothesis was that the participants overall (and across recall conditions) will recall greater number of words in the autobiographical support condition than in the semantic support condition.

The third research question concerned the two-way interaction of the above two factors, group and support condition. Word recall performance was measured by the number of words recalled for each group in each support condition averaged across the three recall conditions. The question was, will the difference in number of words recalled between the autobiographical and semantic support condition be greater for patients with mild-stage AD than for healthy older adults? In previous studies, healthy older adults have demonstrated an ability to use a variety of forms of cognitive support, including semantic cues, to improve their memory performance. In contrast, previous research suggests that semantic memory declines in mild-stage AD, making it difficult for patients to utilize forms of cognitive support that rely on semantic memory (see Peraita et al, 2008). Because of the relative preservation of autobiographical memories in mild-stage AD, I expected that autobiographical memory cues would provide a greater degree of cognitive support for patients with AD than semantic (descriptor) cues.

I therefore expected that the mean increase in number of words recalled between the semantic and autobiographical support conditions would be greater for the mild AD group than for both healthy control groups. Thus, my third hypothesis was that although the number of words recalled will be greater in the autobiographical support condition than in the semantic support condition, the difference in number of words recalled between the autobiographical and semantic support condition will be greater for patients with mild-stage AD than for healthy young-old and old-old adults.

The fourth research question concerned the third main effect of the above model, as it compared word recall performance across the three recall conditions (immediate free recall, cued recall, and recognition). Word recall performance was measured by the number of words recalled for each recall condition averaged across the three groups and the two support conditions (semantic and autobiographical). The question was, will the participants overall (young-old, old-old, and mild AD) recall greater number of words on tests of recognition than on cued recall, and on cued recall than on immediate free recall? In previous studies, older adults have recalled greater number of words on tests of recognition than on cued recall, and on cued recall than on free recall, as cued recall and recognition represent higher levels of cognitive support than free recall. In the present study, recognition tests were given for the words that participants failed to recall on the cued recall task. The recognition score was obtained by adding the words correctly recognized to the cued recall score. Thus, my fourth hypothesis was that the participants overall will recall greater number of words on

tests of recognition than on cued recall, and on cued recall than on immediate free recall.

Comparison of Immediate Free Recall Performance in Each Support Condition

The second set of three research questions examined memory performance (measured as immediate free recall) as affected by group and support condition. The design for the research questions was a 3 (Group: Young-Old, Old-Old, Mild AD) X 3 (Support Condition: No Support, Semantic, Autobiographical) ANOVA, with repeated measures on the last factor. Comparing performance in each support condition on tests of free recall allowed me to examine the effectiveness of encoding support without retrieval cues.

The fifth research question concerned the 3-level group main effect. The question was, on tests of immediate free recall, will young-old adults recall greater number of words than old-old adults, and will old-old adults recall greater number of words than patients with mild-stage AD? In previous studies, old-old adults have recalled less information than young-old adults on tests of free recall when cognitive support was provided at encoding (i.e., organizable word lists). Thus, the fifth hypothesis was that on tests of immediate free recall (a) young-old adults will recall greater number of words than old-old adults, and (b) old-old adults will recall greater number of words than patients with mild-stage AD.

The sixth research question concerned the main effect of the support condition factor. The question was, on tests of immediate free recall, will the participants overall recall greater number of words in the autobiographical support condition than in the semantic support condition, and in the semantic support condition than

in the no support condition? Because of the potential of autobiographical memories to enhance encoding in healthy aging and mild-stage AD, I expected that participants overall would demonstrate improved free recall of words with autobiographical support, and that the number of words recalled would be greater in the autobiographical than the semantic support condition. Thus, the sixth hypothesis was that on tests of immediate free recall, the participants overall will recall greater number of words (a) in the autobiographical support condition than in the semantic support condition, and (b) in the semantic support condition than in the no support condition.

The seventh research question concerned the 2-way interaction in this model. The question was, on tests of immediate free recall, will young-old and old-old adults recall greater number of words in the semantic support condition than in the no support condition, and will patients with mild-stage AD demonstrate no difference in number of words recalled between the semantic and no support conditions? In previous studies, healthy young-old and old-old adults have demonstrated improved free recall performance when cognitive support was provided at encoding (i.e., organizable word lists or more study time). In contrast, patients with mild-stage AD have demonstrated no benefit from cognitive support at encoding when memory was assessed with free recall. Based on previous research, I expected that healthy older adults would demonstrate improved free recall of words with semantic support, whereas patients with mild-stage AD would not demonstrate improved free recall with semantic support. The design will therefore test for an overall interaction of group and support condition. Thus,

the seventh hypothesis was that on tests of immediate free recall, (a) the three groups will recall greater number of words in the autobiographical than in the semantic support condition, (b) young-old and old-old adults will recall greater number of words in the semantic than in the no support condition, and (c) patients with mild-stage AD will demonstrate no difference in number of words recalled between the semantic and no support conditions.

CHAPTER 3 - METHOD

Participants

Recruitment Procedures and Initial Samples

The healthy control participants were recruited for participation through advertisements placed in local newspapers in Edmonton, Alberta. Posters advertising the study were placed in the waiting rooms of the Glenrose Rehabilitation Hospital Geriatric Clinic and the University of Alberta Hospital Seniors Clinic. The AD participants were recruited for participation from the Glenrose Rehabilitation Hospital Geriatric Clinic and the Edmonton Alzheimer Society. AD participants from the Glenrose Hospital were recruited for the study by referral from geriatricians. Participants from the Edmonton Alzheimer Society were recruited in person by the experimenter, who spoke to members of caregiver support groups about the study. All participants were reimbursed a fee of $20 to pay for the cost of parking and transportation to the research lab.

The initial control sample consisted of $N = 88$ community-dwelling, healthy older adults aged 64 to 90 (55 females and 33 males, mean age = 74.54 years, mean years of education = 13.66). In terms of ethnicity, 85 participants were Caucasian, 2 participants were First Nations, and 1 participant was Black. The initial AD sample consisted of $N = 24$ older adults diagnosed with AD or mixed dementia, aged 62 to 87 (15 females and 9 males, mean age = 74.21, mean years of education = 13.46). In terms of ethnicity, 23 participants were Caucasian, and 1 participant was Asian. All participants were fluent in English.

20-Item Versus 30-Item Word Lists

Initially, a group of $n = 46$ healthy control participants was tested using three lists of 20 words. When means were obtained for the group, there was an unexpected ceiling effect on tests of recognition in the semantic and autobiographical support conditions. The length of each word list was therefore increased to 30 words. A second group of $n = 42$ healthy control participants was tested using the 30-item word lists.

In order to determine whether the control samples with the 20-item and 30-item word lists could be combined into one group, raw scores for both list length groups were converted to percentage scores to allow for mean comparisons. I conducted a 2 (List Length Group: 20-Words, 30-Words) X 2 (Recall Condition: Immediate Free Recall, Delayed Free Recall) ANOVA, with repeated measures on the last factor. The dependent variable was the percentage of words recalled for each list length. A significant main effect was obtained for list length group, F (1, 81) = 11.84, $p < .01$, $\eta_p^2 = .13$, with the percentage of words recalled for the 20-item list ($M = 25.17$, $SD = 10.30$) being greater than for the 30-item list ($M = 17.38$, $SD = 10.30$). A significant main effect was obtained for recall condition, F (1, 81) = 31.20, $p < .01$, $\eta_p^2 = .28$, with the percentage of words recalled for immediate free recall ($M = 23.05$, $SD = 11.11$) being greater than for delayed free recall ($M = 19.78$, $SD = 11.49$). No significant interaction was obtained between list length group and recall condition, F (1, 81) = 1.11, $p > .05$, $\eta_p^2 = .01$. Because of the significant effect of list length on word recall, it was decided to include only the data from the participants with the 30-item word lists in the control

group. This ensured that the testing conditions were consistent for all control participants.

For the mild AD group, two participants with mild AD were tested using the 20-item word lists. The remaining AD participants in the group were tested using the 30-item word lists. Only the data from the participants with the 30-item word lists were included in the AD group, therefore, the interim groups consisted of $n = 42$ control and $n = 22$ AD participants.

Inclusionary Criteria for the Control and Mild AD Groups

At the time of testing, all participants in the control group were administered the Mini Mental Status Examination (MMSE; Folstein, Folstein, & McHugh, 1975) to screen for cognitive impairment. Participants with an MMSE score of 26-30 were included in the group. Although a score of 27 is considered the minimum cutoff score for no cognitive impairment, the cutoff score was lowered to 26 to allow for the inclusion of one additional participant in the group. Of the 42 participants in the control group, one participant achieved an MMSE score below 26, therefore the participant's data were not included in the analysis.

To be included in the mild AD group, participants must have received a diagnosis of probable AD, or AD with a vascular component, on the basis of clinical judgment by an experienced geriatrician. Participants with AD were diagnosed following the National Institute of Neurological and Communicative Disorders and Stroke/Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criteria to rule out other possible types of dementia (McKhann et al., 1984). Less commonly, criteria of the American Psychiatric

Association (1994) *Diagnostic and Statistical Manual of Mental Disorders* (4th edition) were utilized. Diagnostic procedures for AD include a complete medical examination, including medical history, a physical exam (i.e., thorough central nervous system exam), neurological tests when indicated (i.e., Computed Tomography (CT), Electroencephalography (EEG), Electrocardiogram (ECG)), and a psychiatric exam. Diagnostic procedures for AD further include an interview with a close informant (i.e., family member, close friend, spouse, or child), laboratory tests (blood screening and urinalysis), and a comprehensive cognitive battery.

In order to establish that AD participants were mild-stage, all participants with AD were administered the MMSE at the time of testing to determine the level of dementia severity. Individuals with a score of 19-26 (mildly impaired) on the MMSE were included in the AD group. Although 20 is considered the minimum cutoff score for mild-stage AD, the cutoff was lowered to 19 to allow for the inclusion of two additional participants in the group. Of the 22 participants in the AD group, 5 participants achieved MMSE scores below 19, therefore their data were not included in the analysis. In addition, one participant achieved an MMSE score of 30 and her medical records indicated a diagnosis of Mild Cognitive Impairment (MCI), therefore the participant's data were not included in the analysis. Of the remaining 16 participants with mild-stage AD, medical records were examined to determine the duration of diagnosis. Of the 11 participants whose medical records were obtained, 10 had received a diagnosis of dementia or confirmation of their diagnosis within the past two years. One participant had

been diagnosed four years prior to the date of testing.

Exclusionary Criteria for the Control and Mild AD Groups

For the control and mild AD group, I applied standard exclusionary criteria in neuropsychological research on aging and AD (McKhann et al., 1984) including, (a) a history of brain injury, (b) brain disease (such as encephalitis, meningitis, or cerebral neoplasma), (c) heart attack, (d) stroke, (e) intake of medication that may affect cognitive functioning (i.e., antidepressants, antipsychotics, and sedative-hypnotics), (f) major depression, or (g) evidence of cerebral vascular disease or other forms of dementia.

Information about medication use and health history was collected from participants using a self-report questionnaire (see Appendix A). When medication use was examined for the control group, three participants were using antidepressants, one participant was using a sedative-hypnotic to help with sleep, and one participant was using an antipsychotic medication for anxiety. The individual test scores of participants using psychiatric medications were not more than one standard deviation above or below the group mean, therefore these participants' data were included in the control group. When medication use was examined for the mild AD group, 14 of the 16 participants with AD were using Cholinesterase Inhibitors (ChIs). Medical records revealed that all participants using ChIs had been stabilized on the medication for a period of at least six months, therefore these participants' data were included in the group. In terms of psychiatric medications, 9 of the 16 participants were using antidepressants, and 3 of these 9 were using an antipsychotic medication. The individual test scores of AD participants using medications were not more than one standard deviation

above or below the group mean, therefore these participants' data were included in the mild AD group.

When health history was examined for the control sample, five participants had previous head injuries, five had previous heart attacks, two had previous transient ischemic attacks (TIAs), one had a previous Thrombotic Thrombocytopenic Pupura (TTP) virus, and one participant had Parkinson's disease. The participant with Parkinson's disease was excluded from the group. When the individual test scores of the participants with previous head injuries, heart attacks, TIAs, and the TTP virus were compared against the group mean, the scores were not more than one standard deviation above or below the group mean, therefore these participants' data were included in the control group. When health history was examined for the mild AD group, one participant had a previous head injury. The participant's test scores were not more than one standard deviation above or below the group mean, therefore the participant's data were included in the AD group.

Because depression is known to affect cognitive performance, all participants were screened for depression using the 30-item Geriatric Depression Scale (GDS) self-report measure (Yesavage et al., 1983). If a participant's GDS score showed evidence of a severe depression, his or her data were not included in the final analysis. In the control group, none of the participants' GDS scores indicated severe depression at the time of testing. In the mild AD group (n = 16), one participant obtained a GDS score of 24 indicating severe depression, therefore his data were excluded from the analysis.

Young-Old Versus Old-Old Groups

Because the participants in the control group ranged in age from 65-90, the control group (n = 40) was divided into two age groups: young-old (age 65-74) and old-old (age 75-90). Preliminary analyses indicated potential age group differences in memory performance between the young-old and old-old groups. These will be explored in the results section.

Characteristics of the Final Groups

Young-Old group. The young-old group consisted of n = 20 community-dwelling, healthy older adults aged 65 to 74 (15 females and 5 males, mean age = 70.90, mean MMSE = 28.70). In terms of ethnicity, 19 participants were Caucasian and 1 participant was First Nations.

Old-Old group. The old-old group consisted of n = 20 community-dwelling healthy older adults aged 75-90 (9 females and 11 males, mean age = 79.75, mean MMSE = 28.05). In terms of ethnicity, all 20 participants were Caucasian.

Mild AD group. The mild AD group consisted of n = 15 adults aged 62 to 87 diagnosed with mild-stage AD or mixed dementia (8 females and 7 males, mean age = 74.73, mean MMSE = 22.47). In terms of ethnicity, 14 participants were Caucasian and 1 participant was Asian. When medical records were reviewed for the AD sample, 5 participants had a diagnosis of Alzheimer's, 5 had a diagnosis of Mixed AD and Vascular Dementia, and 1 participant had a diagnosis of Mixed AD with Frontal Lobe Features. For 4 of the participants, the medical records could not be obtained and the dementia subtype could not be confirmed. Schreiter-Gasser, Rousson, Hentschel, Sattel, and Gasser (2008) examined differences between patients with "pure" AD and mixed AD / vascular dementia.

Neuropsychological tests showed little difference between the AD and mixed dementia groups.

Comparison of the Final Groups

Descriptive statistics for the final control and mild AD groups on age, number of years of education, MMSE scores, and GDS scores are presented in Table 1.

Table 1

Descriptive Statistics for Young-Old, Old-Old, and Mild AD Groups

Group	Age (years)	Education (years)	MMSE	GDS
Young-old	70.90 (3.02)	12.83 (2.49)	28.70 (0.98)	3.10 (3.11)
Old-old	79.75 (4.41)	14.03 (3.36)	28.05 (1.00)	5.45 (4.56)
Mild AD	74.73 (6.52)	13.33 (2.79)	22.47 (2.48)	4.60 (3.74)

Note. MMSE maximum score is 30. GDS maximum score is 30. MMSE scores ranged from 27-30 for the young-old group, 26-30 for the old-old group, and 19-27 for the mild AD group. For the young-old and old-old groups $n = 20$. For the mild AD group $n = 15$.

One-way ANOVAs revealed no significant differences for the young-old, old-old, and mild AD group for years of education, $F\ (2, 52) = 0.85$, $p > .05$; or GDS scores, $F\ (2, 52) = 1.89$, $p > .05$.

As expected, there were significant differences between groups for age, $F\ (2, 52) = 17.97$, $p < .01$. Scheffe's post-hoc tests revealed that the mean age of the young-old and old-old group were significantly different ($p < .01$). The mean age of the young-old and mild AD group were not significantly different ($p > .05$),

however, the mean age of the old-old and mild AD group were significantly different ($p < .05$).

As expected, there were significant differences between groups for MMSE scores, F (2, 52) = 81.47, $p < .01$. Scheffe's post-hoc tests revealed that the mean MMSE scores of the young-old and old-old groups were significantly different than the mild AD group ($p < .01$). There were no significant differences in MMSE scores between the young-old and old-old group ($p > .05$).

Measures

Geriatric Depression Scale

Because depression is known to affect cognitive performance, all participants were administered the Geriatric Depression Scale (GDS; Yesavage et al., 1983). On this scale, a score from 0-10 would indicate no depression; 11-20 a mild depression; and 21-30 a severe depression. If participants achieved a GDS score of 21 or above, indicating severe depression, their data were not included in the final analysis.

Mini Mental Status Examination

The Mini Mental Status Exam (MMSE; Folstein, Folstein, & McHugh, 1975) was used to establish the level of cognitive functioning of the participants. Although regarded as a screening test for cognitive impairment, the MMSE is often utilized to track the progression of AD over time. The MMSE is divided into two sections, the first of which requires verbal responses only and measures orientation, memory, and attention. The second section assesses the participant's ability to name objects, follow verbal and written commands, write a sentence,

and copy a figure. The maximum score an individual can receive is 30. A score of 27-30 would suggest no cognitive impairment, 20-26 would suggest mild cognitive impairment, 11-19 would suggest moderate cognitive impairment, and any score under 11 would be indicative of severe cognitive impairment. At the time of testing, control participants were administered the MMSE to screen for cognitive impairment. If control participants achieved an MMSE score below 26, their data were not included in the final analysis. AD participants were administered the MMSE to determine the stage of dementia. If AD patients achieved an MMSE score below 19 indicating moderate or severe-stage dementia, their data were not included in the final analysis.

Word Lists

Because in the experimental design each participant was tested under three support conditions, three different lists of words were used to avoid practice effects. Initially, three lists of unrelated words consisting of 20 common English nouns were developed using the Battig and Montague (1969) category norms. As explained previously, the length of each word list was later increased to 30 words due to a ceiling effect on the recognition task for the 20-item word list. A copy of each word list is presented in Appendix B. A study by Howard (1980) found that 21 of the 56 categories in the Battig and Montague (1969) norms were appropriate for research with older adults. In the present study, words were selected following a procedure similar to that used by Bäckman and Small (1998). Each word on the word lists represented a unique taxonomic category in order to minimize organizability. For each list, words were selected from each of the 21

Howard (1980) categories, as well as from the other Battig and Montague categories. When developing the word list used in the autobiographical memory support condition, words were selected that were likely to enable participants to retrieve specific autobiographical memories for each word.

To establish an equal level of difficulty for each word list, each list contained an equal number of one and two-syllable words, and no word on each list was less than three letters or more than eight letters in length, similar to word lists used in previous studies. The words on the three lists were comparable in terms of frequency, concreteness, and imagery as determined by previous normative studies (Battig & Montague, 1969; Paivio, Yuille, & Madigan, 1968). The frequency, concreteness, and imagery ratings for each word are presented in Appendix B. A table comparing the mean ratings for each word list is presented in Appendix C. One-way ANOVAs revealed that there were no significant differences between the three word lists in terms of word frequency, F (2, 87) = 1.87, $p > .05$, concreteness, F (2, 74) = 1.11, $p > .05$, or imagery, F (2, 74) = 0.59, $p > .05$.

Procedure

Participants were individually tested by the experimenter, Karen Cochrane, in Dr. Roger Dixon's research lab at the University of Alberta. Prior to testing, participants were told the purpose and nature of the study, and were given the information letter and consent form to read and sign (see Appendix D). In the case of participants with AD who did not have legal capacity to give informed consent, consent to participate in the study was obtained from the guardian or

primary caregiver and assent was obtained from each of these AD participants. Subsequently, the participants were administered a demographic self-report questionnaire, followed by the MMSE and the GDS.

Prior to presentation of the word lists, participants were instructed to remember as many words as possible for purposes of later recall. For the presentation of the words, participants were seated in front of a computer screen. Words were presented one at a time on the computer screen for two seconds each and simultaneously read aloud by the participant. The task pacing of two seconds per word was based on that used in previous studies with older adults and adults with AD (Almkvist et al., 1999). To enhance legibility, words were printed in bold-face type using 30-point font size. A total of three 30-word lists were used in the study, and a separate word list was used for each support condition. The three word lists were not rotated through the three support conditions.

Participants were first administered a list of words in a condition with no cognitive support. Immediately following presentation of the last word on the list, participants were asked to orally free recall as many words as possible from the list. After a brief delay of approximately five minutes in which the participants were asked to count backwards from 100 by twos[1], the participants were again asked to recall as many words from the list as possible (without re-presenting the words). The experimenter recorded the participants' correct or missed responses on a checklist, and all responses were audiotaped to ensure accurate data

[1] The control participants completed this task more quickly than the participants with AD and therefore the length of the delay was briefer for the control participants. Participants were stopped if the counting task took longer than five minutes. Some AD participants could not count backwards, so they were asked to count forwards. For some AD participants the counting task was discontinued if they showed signs of frustration or fatigue, or if they asked to stop the task.

collection. The immediate and delayed free recall tests completed the no support condition.

Next, the participants were presented with either the semantic or autobiographical support condition. For the semantic and autobiographical support conditions, the order of presentation was counterbalanced across participants to control for possible order effects. The final control and AD groups were examined after exclusionary procedures to determine if counterbalancing had been affected. In terms of the two control groups, one case had been excluded from the young-old group and one case had been excluded from the old-old group, which did not affect counterbalancing. For the AD group (n = 15), eight participants had received the first order of presentation and seven participants had received the second order.

Prior to the presentation of the word list in the autobiographical support condition, participants were instructed to associate each word with a specific, personal memory. After a word was presented (for two seconds), participants were given up to 90 seconds to associate the word with a personal memory and to shorten the memory to a one or two-word cue. As soon as participants stated a word cue, they were instructed to click the mouse to go to the next word on the list. A copy of the task instructions is presented in Appendix E. Prior to the presentation of the word list for the semantic encoding condition, participants were instructed to state one word that described each word presented on the screen (Lipinska et al., 1995). After a word was presented (for two seconds), participants were given up to 90 seconds to verbalize a descriptor for the word.

As soon as participants stated a descriptor, they were instructed to click the mouse to go to the next word on the list. A copy of the task instructions is presented in Appendix F. For both conditions, the experimenter recorded the participant's cue words on a response sheet, and all responses were audiotaped.

Immediately following presentation of the last word on the list for both the semantic and autobiographical support condition, participants were asked to orally free recall as many words as possible from that list. After an approximate five-minute delay during which participants were asked to count backwards from 100 by threes or fours, the participants were administered a cued recall task in which they were verbally presented with their own cues (either semantic or autobiographical) for each word on the list. Correct and missed responses were recorded by the experimenter on a checklist, and all responses were audiotaped. Following completion of the cued recall task in either the semantic or autobiographical support condition, participants were administered a recognition task for each word they had failed to recall with cues. In the recognition task, participants were asked choose the correct word from one of three semantically-related alternatives verbally presented by the experimenter (i.e., "Was the word from the list ruby, garnet, or sapphire?"). The recognition task was chosen for the study because previous studies have found recognition cues to be a sensitive measure of encoding. A copy of the recognition tests for the semantic and autobiographical support conditions are presented in Appendix G. Participants were debriefed by the experimenter following the last test trial. A copy of the debriefing is presented in Appendix H.

Design of the Study

Main Variables

Three main independent variables were involved in this study. The first independent variable included three groups of participants that differed in age or cognitive status. The three groups compared in this study included two groups of healthy older adults divided by age into young-old and old-old, and a group of adults diagnosed with mild-stage AD. The second independent variable included three cognitive support conditions: participant-produced autobiographical memory cues (autobiographical support), participant-produced descriptor cues (semantic support), and a control condition in which no support was provided. The third independent variable included three recall conditions: immediate free recall, cued recall, and recognition. A fourth design factor was included only in the no support condition, as both immediate and delayed free recall were tested. The dependent variable was the number of words recalled.

Analyses

Three main sets of analyses were conducted. First, a baseline ANOVA was performed on the free recall data of the word list presented with no support. The design for this analysis was a 3 (Group: Young-Old, Old-Old, Mild AD) X 2 (Delay Condition: Immediate Free Recall, Delayed Free Recall) ANOVA, with repeated measures on the last factor. Second, research questions 1, 2, 3, and 4 were addressed with one 3-way ANOVA. To allow for overall comparison of word recall performance in the autobiographical and semantic support conditions, the data were analyzed with a 3 (Group: Young-Old, Old-Old, Mild AD) X 2

(Support Condition: Semantic, Autobiographical) X 3 (Recall Condition: Free Recall, Cued Recall, Recognition) ANOVA, with repeated measures on the last two factors. Third, research questions 5, 6, and 7 were addressed with one 2-way ANOVA. To allow for comparison of immediate free recall in all three support conditions, the data were analyzed with a 3 (Group: Young-Old, Old-Old, Mild AD) X 3 (Support Condition: No Support, Semantic, Autobiographical) ANOVA, with repeated measures on the last factor.

Timeline

Ethical approval for the study was obtained from the Health Research Ethics Board: Panel B in June, 2005. Data collection for the control and AD participants commenced in October, 2005 and was completed in July, 2007.

CHAPTER 4 - RESULTS

The objectives of the study were to (a) compare the effects of three cognitive support conditions (no support, semantic, and autobiographical) on number of words recalled in patients with mild-stage AD and healthy older adults, and (b) to examine whether patients with mild-stage AD and healthy older adults demonstrate differential improvement in number of words recalled as a function of support condition and recall condition (free recall, cued recall, and recognition). The research questions were:

1. Will young-old adults recall greater number of words than old-old adults, and will old-old adults recall greater number of words than patients with mild-stage AD?
2. Will participants overall recall greater number of words in the autobiographical support condition than in the semantic support condition?
3. Will the difference in number of words recalled between the autobiographical and semantic support condition be greater for patients with mild-stage AD than for healthy older adults?
4. Will participants overall recall greater number of words on tests of recognition than on cued recall, and on cued recall than on immediate free recall?
5. On tests of immediate free recall, will young-old adults recall greater number of words than old-old adults, and will old-old adults recall greater number of words than patients with mild-stage AD?

6. On tests of immediate free recall, will participants overall recall greater number of words in the autobiographical support condition than in the semantic support condition, and in the semantic support condition than in the no support condition?
7. On tests of immediate free recall, will young-old and old-old adults recall greater number of words in the semantic support condition than in the no support condition, and will patients with mild-stage AD demonstrate no difference in number of words recalled between the semantic and no support conditions?

Three sets of analyses were conducted. First, a two-way ANOVA was used to compare free recall performance for each group in the no support condition. Second, a three-way ANOVA was used to compare word recall performance in the autobiographical and semantic support conditions. In the second analysis, research questions one, two, three, and four were addressed. Third, a two-way ANOVA was used to compare immediate free recall in all three support conditions (no support, semantic, and autobiographical). In the third analysis, research questions five, six, and seven were addressed.

Comparison of Baseline Word Recall Performance for Each Group

I first examined baseline word recall performance for older adults in the no support condition. The purpose of the analysis was to compare immediate and delayed free recall performance for each group without cognitive support. Mean recall performance for the young-old, old-old, and mild AD group are presented in Table 2.

Table 2

Baseline Word Recall Performance in the No Support Condition for Each Group

Group	Immediate free recall	Delayed free recall
Young-old	6.95 (3.40)	5.35 (3.17)
Old-old	4.65 (2.35)	3.90 (2.49)
Mild AD	1.60 (1.35)	0.80 (1.08)

Note. Maximum score is 30. Values enclosed in parentheses represent standard deviations. For the young-old and old-old groups $n = 20$. For the mild AD group $n = 15$.

The data were analyzed with a 3 (Group: Young-Old, Old-Old, Mild AD) X 2 (Delay Condition: Immediate Free Recall, Delayed Free Recall) ANOVA, with repeated measures on the last factor. A significant main effect was obtained for group, F (2, 52) = 17.81, $p < .01$, $\eta_p^2 = .41$. Scheffe's post hoc tests revealed that the number of words recalled for the young-old ($M = 6.15$, $SD = 2.41$) and old-old ($M = 4.28$, $SD = 2.41$) groups were greater than for the mild AD group ($M = 1.20$, $SD = 2.44$) ($p < .01$). The difference in the number of words recalled between the young-old and old-old group was not significant ($p > .05$). A significant main effect was obtained for delay condition, F (1, 52) = 26.47, $p < .01$, $\eta_p^2 = .34$, with number of words recalled for immediate free recall ($M = 4.40$, $SD = 2.60$) being greater than for delayed free recall ($M = 3.35$, $SD = 2.52$) ($p < .01$). No significant interaction was obtained between group and delay condition, F (2, 52) = 1.95, $p > .05$, $\eta_p^2 = .07$. The results indicate that with no cognitive support, both groups of healthy older adults recalled greater number of words than the

mild AD group. Participants overall recalled greater number of words in the immediate than in the delayed free recall condition, and the mean decrease in number of words recalled after a delay was similar for the three groups.

Comparison of Number of Words Recalled in the Semantic and Autobiographical Support Conditions

In this section I address research questions one, two, three, and four. In the analysis reported here, I compared the word recall performance of the three groups across recall conditions using only the data for the semantic and autobiographical support conditions. With this analysis, my first four hypotheses were tested:

Hypothesis 1: (a) Young-old adults will recall greater number of words than old-old adults, and (b) old-old adults will recall greater number of words than patients with mild-stage AD.

Hypothesis 2: The participants overall (and across recall conditions) will recall greater number of words in the autobiographical support condition than in the semantic support condition.

Hypothesis 3: Although the number of words recalled will be greater in the autobiographical support condition than in the semantic support condition, the difference in number of words recalled between the autobiographical and semantic support condition will be greater for patients with mild-stage AD than for healthy young-old and old-old adults.

Hypothesis 4: The participants overall will recall greater number of words on tests of recognition than on cued recall, and on cued recall than on immediate free recall.

The data were analyzed with a 3 (Group: Young-Old, Old-Old, Mild AD) X 2 (Support Condition: Semantic, Autobiographical) X 3 (Recall Condition: Free Recall, Cued Recall, Recognition) ANOVA, with repeated measures on the last two factors. The results of the main effects hypotheses are described first, followed by the 2-way and 3-way interactions.

A significant main effect was obtained for group, F (1, 52) = 54.29, $p < .01$, $\eta_p^2 = .68$. Scheffe's post hoc tests revealed that the difference in mean number of words recalled for the young-old (M = 20.23, SD = 2.73) and old-old (M = 19.76, SD = 2.73) group was not significant ($p > .05$), failing to support hypothesis 1a. The mean number of words recalled for the young-old and old-old groups were greater than for the mild AD group (M = 11.43, SD = 2.71) ($p < .01$), supporting hypothesis 1b.

A significant main effect was obtained for support condition, F (1, 52) = 36.90, $p < .01$, $\eta_p^2 = .42$, with the overall mean number of words recalled in the autobiographical condition (M = 18.13, SD = 3.12) being greater than in the semantic condition (M = 16.15, SD = 2.89), supporting hypothesis 2.

A significant main effect was obtained for recall condition, F (2, 51) = 1128.47, $p < .01$, $\eta_p^2 = .96$. Scheffe's post hoc tests revealed that the mean number of words recalled were greater for recognition (M = 28.05, SD = 2.15) than for cued recall (M = 17.48, SD = 4.38) ($p < .01$), and for cued recall than for immediate free recall (M = 5.89, SD = 3.26) ($p < .01$), supporting hypothesis 4.

A significant interaction was obtained between group and support condition, F (2, 52) = 5.27, $p < .01$, $\eta_p^2 = .17$. The means involved in this interaction are presented in Table 3. To illustrate the nature of this interaction, these means are also presented in Figure 1.

Table 3

Mean Word Recall Performance in the Semantic and Autobiographical Support Conditions Averaged Across Recall Conditions

	Support condition	
Group	Semantic	Autobiographical
Young-old	19.85 (2.86)	20.60 (3.08)
Old-old	18.87 (2.86)	20.65 (3.08)
Mild AD	9.73 (2.86)	13.13 (3.06)

Note. Maximum score is 30. Numbers enclosed in parentheses represent standard deviations. For the young-old and old-old groups $n = 20$. For the mild AD group $n = 15$.

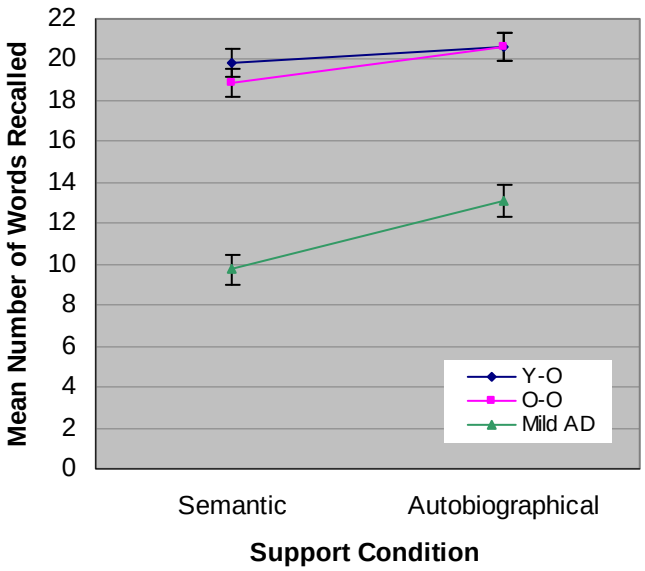

Figure 1. Word recall performance for each group in the semantic and autobiographical support conditions averaged across recall conditions.

To explore the nature of this interaction, follow-up t-tests were performed. The difference in the number of words recalled between the autobiographical and semantic support condition was not significant for the young-old group, t (59) = -1.81, $p > .05$. In contrast, the difference between support conditions was significant for the old-old group, t (59) = -3.77, $p < .01$, and for the mild AD group, t (44) = -4.84, $p < .01$.

The means for the young-old and old-old group were not significantly different in the semantic support condition, t (118) = 0.53, $p > .05$, or in the autobiographical support condition, t (118) = -0.03, $p > .05$. In contrast, the means for the old-old and mild AD group were significantly different in the

semantic support condition, t (103) = 4.47, $p < .01$, and in the autobiographical support condition, t (103) = 3.64, $p < .01$. The follow-up tests indicate that the 2-way interaction was due to the differential benefit of autobiographical support for the old-old and mild AD groups, as compared with the young-old group. In hypothesis 3, I predicted that the difference in the number of words recalled between the autobiographical and semantic support condition would be greater for patients with mild AD than for healthy young-old and old-old adults. The follow-up tests indicate that the difference in number of words recalled between support conditions was greater for the mild AD group than for the young-old group, partially supporting hypothesis 3.

Although no specific predictions were made, the remaining 2-and 3-way interactions reflect the overall study objectives, and these terms are reported next. First, a significant interaction was obtained between group and recall condition, F (4, 104) = 25.66, $p < .01$, $\eta_p^2 = .50$. The means involved in this interaction are presented in Table 4.

Table 4

Mean Word Recall Performance in Each Recall Condition Averaged Across Support Conditions

	Recall condition		
Group	Free recall	Cued recall	Recognition
Young-old	8.48 (3.26)	22.33 (4.34)	29.88 (2.15)
Old-old	7.23 (3.26)	22.35 (4.34)	29.70 (2.15)
Mild AD	1.97 (3.25)	7.77 (4.30)	24.57 (2.17)

Note. Maximum score is 30. Numbers enclosed in parentheses represent standard deviations. For the young-old and old-old groups $n = 20$. For the mild AD group $n = 15$.

To explore the nature of this interaction, follow-up t-tests were performed. The difference in the number of words recalled between recognition and cued recall was significant for the young-old group, t (39) = -12.30, $p < .01$, the old-old group, t (39) = -10.39, $p < .01$, and the mild AD group, t (29) = -18.59, $p < .01$. The difference in the number of words recalled between cued recall and free recall was significant for the young-old group, t (39) = -21.49, $p < .01$, the old-old group, t (39) = -25.65, $p < .01$, and the mild AD group, t (29) = -6.97, $p < .01$.

The means for the young-old and old-old group were not significantly different on tests of free recall, t (78) = 1.38, $p > .05$, cued recall, t (78) = -0.03, $p > .05$, or recognition, t (78) = 1.52, $p > .05$. In contrast, the means for the old-old and mild AD group were significantly different on free recall, t (68) = 5.46, $p < .01$, cued recall, t (68) = 11.12, $p < .01$, and recognition, t (68) = 5.98, $p < .01$. As these

follow-up tests failed to clarify the source of the 2-way interaction between group and recall condition, the reader is referred to the 3-way interaction presented below.

No significant interaction was obtained between support condition and recall condition, F (2, 104) = .04, $p > .10$, $\eta_p^2 = .00$, indicating that the mean difference in number of words recalled between the autobiographical and semantic support condition were similar in each recall condition.

A significant three-way interaction was obtained between group, support condition, and recall condition, F (4, 104) = 5.90, $p < .01$, $\eta_p^2 = .19$. The means involved in this interaction are presented in Table 5. For ease of interpretation of this 3-way interaction, the means in Table 5 are illustrated in the three graphs of Figure 2. There is one graph for each group, and each graph illustrates the pattern of means for the two support conditions and three recall conditions.

Table 5

Mean Word Recall Performance by Group for Each Recall Condition in the Semantic and Autobiographical Support Conditions

Recall condition	Support condition: Semantic	Support condition: Autobiographical	Significance
	Young-old		
Free recall	7.70 (3.51)	9.25 (3.74)	n.s.
Cued recall	22.00 (4.37)	22.65 (3.59)	n.s.
Recognition	29.85 (0.36)	29.90 (0.31)	n.s.
	Old-old		
Free recall	5.45 (3.36)	9.00 (4.72)	$p < .01$
Cued recall	21.55 (4.94)	23.15 (4.46)	n.s.
Recognition	29.60 (0.82)	29.80 (0.41)	n.s.
	Mild AD		
Free recall	1.40 (1.60)	2.53 (4.41)	n.s.
Cued recall	6.00 (5.16)	9.53 (6.94)	$p < .05$
Recognition	21.80 (5.98)	27.33 (2.82)	$p < .01$

Note. Maximum score is 30. Values enclosed in parentheses represent standard deviations. For the young-old and old-old groups $n = 20$. For the mild AD group $n = 15$. The significance column refers to the support condition comparison for each group, as tested by follow-up analyses.

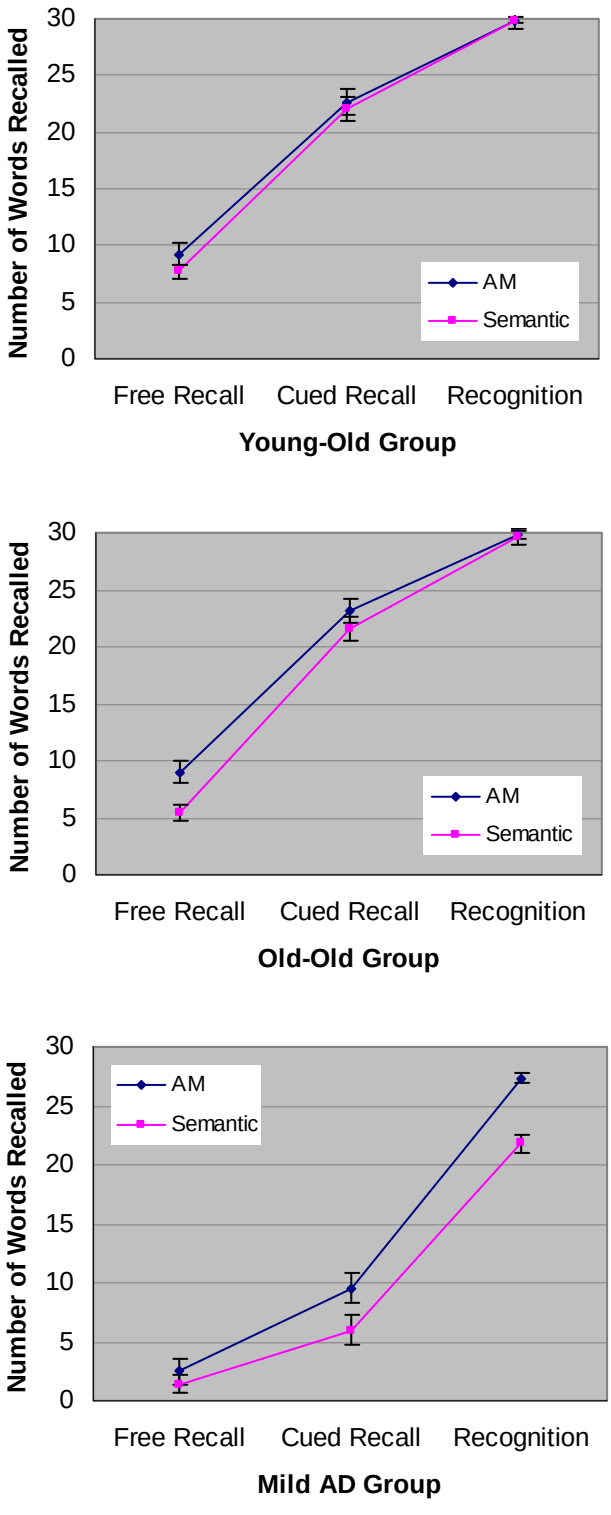

Figure 2. Word recall performance for each group as a function of support condition and recall condition.

Follow-up t-tests revealed that for the young-old group, the difference in number of words recalled between the autobiographical and semantic support condition was not significant on the immediate free recall task, t (19) = -1.98, $p > .05$, on the cued recall task, t (19) = -0.68, $p > .05$, or on the recognition task, t (19) = -0.44, $p > .05$.

The old-old group recalled more words in the autobiographical than in the semantic support condition on the immediate free recall task, t (19) = -4.06, $p < .01$. In contrast, the difference in number of words recalled between the autobiographical and semantic support condition was not significant on the cued recall task, t (19) = -1.61, $p > .05$, or on the recognition task, t (19) = -1.07, $p > .05$.

An opposite pattern was observed for the mild AD group. For the mild AD group, the difference in number of words recalled between the autobiographical and semantic support condition was not significant on the immediate free recall task, t (14) = -1.30, $p > .05$. In contrast, the mild AD group recalled more words in the autobiographical than in the semantic support condition on the cued recall task, t (14) = -2.59, $p < .05$, and on the recognition task, t (14) = -4.79, $p < .01$. Although the mild AD group benefited from both semantic and autobiographical support on tests of cued recall and recognition, the AD group benefited the most on recognition in the autobiographical support condition. In the autobiographical support condition, the recognition scores of the mild AD group (M = 27.33) were similar to the scores of the young-old group (M = 29.90) and the old-old group (M = 29.80). Follow-up t-tests revealed that the mean of the mild AD group was

significantly different than the young-old group, t (33) = 4.06, $p < .01$, and the old-old group, t (33) = 3.88, $p < .01$.

In summary, the three-way interaction was due to the differential benefit of autobiographical support for each group in each recall condition. For young-old adults, the difference in number of words recalled between the autobiographical and semantic support condition was not significant in each recall condition. Old-old adults recalled more words in the autobiographical than in the semantic support condition on tests of immediate free recall. In contrast, patients with mild AD recalled more words in the autobiographical than in the semantic support condition on tests of cued recall and recognition.

Comparison of Immediate Free Recall Performance in Each Support Condition

In this section I address research questions five, six, and seven. The purpose of the analysis of the immediate free recall data was to examine the effectiveness of encoding support without retrieval cues in improving memory performance. In the analysis reported here, I compared word recall performance of the three participant groups in all three support conditions (no support, semantic, and autobiographical) using only the data for immediate free recall. With this analysis, my fifth, sixth, and seventh hypotheses were tested:

Hypothesis 5: On tests of immediate free recall, (a) young-old adults will recall greater number of words than old-old adults, and (b) old-old adults will recall greater number of words than patients with mild-stage AD.

Hypothesis 6: On tests of immediate free recall, the participants overall will recall greater number of words (a) in the autobiographical support condition

than in the semantic support condition, and (b) in the semantic support condition than in the no support condition.

Hypothesis 7: On tests of immediate free recall (a) the three groups will recall greater number of words in the autobiographical than in the semantic support condition, (b) young-old and old-old adults will recall greater number of words in the semantic than in the no support condition, and (c) patients with mild-stage AD will demonstrate no difference in number of words recalled between the semantic and no support conditions.

The immediate free recall data were analyzed with a 3 (Group: Young-Old, Old-Old, Mild AD) X 3 (Support Condition: No Support, Semantic, Autobiographical) ANOVA, with repeated measures on the last factor. The means and standard deviations for each group in each support condition are presented in Table 6. The means in Table 6 are also illustrated in Figure 3.

Table 6

Mean Immediate Free Recall Performance in Each Support Condition

	Support condition		
Group	No support	Semantic	Autobiographical
Young-old	6.95 (3.40)	7.70 (3.51)	9.25 (3.74)
Old-old	4.65 (2.35)	5.45 (3.36)	9.00 (4.72)
Mild AD	1.60 (1.35)	1.40 (1.60)	2.53 (4.41)

Note. Maximum score is 30. Values enclosed in parentheses represent standard deviations. For the young-old and old-old groups $n = 20$. For the mild AD group $n = 15$.

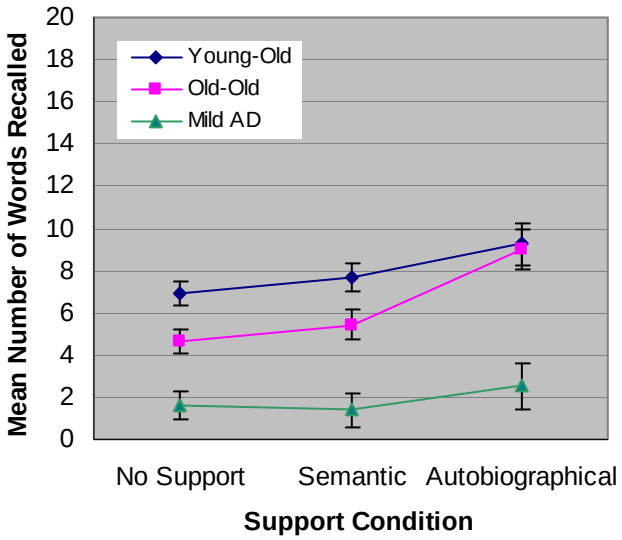

Figure 3. Immediate free recall performance as a function of support condition and group.

A significant main effect was obtained for group, F (2, 52) = 23.39, $p < .01$, $\eta_p^2 = .47$. Scheffe's post hoc tests revealed that the difference in mean number of words recalled for the young-old (M = 7.97, SD = 2.68) and old-old group (M = 6.37, SD = 2.68) was not significant ($p > .05$), failing to support hypothesis 5a. The mean number of words recalled for the young-old and old-old groups were significantly greater than for the mild AD group (M = 1.84, SD = 2.67) ($p < .01$), supporting hypothesis 5b.

A significant main effect was obtained for support condition, F (2, 51) = 11.30, $p < .01$, $\eta_p^2 = .31$. Scheffe's post hoc tests revealed that the mean number of words recalled in the autobiographical condition (M = 6.93, SD = 4.38) were

greater than in the semantic condition (M = 4.85, SD = 3.12) ($p < .01$), supporting hypothesis 6a. The difference in the mean number of words recalled for the semantic and no support conditions (M = 4.40, SD = 2.60) was not significant ($p > .05$), failing to support hypothesis 6b.

A significant interaction was not obtained between group and support condition, F (4, 102) = 1.70, $p > .05$, $\eta_p^2 = .06$. Because I had a priori expectations about group differences in word recall between support conditions, I conducted planned comparisons to test hypothesis 7 (for means please refer to Table 6). In the first set of comparisons I tested hypothesis 7a, that on tests of immediate free recall, all 3 groups would recall greater number of words in the autobiographical than in the semantic support condition. Results of t-tests revealed that the old-old group recalled more words in the autobiographical than in the semantic support condition, t (19) = -4.06, $p < .01$. In contrast, the difference between support conditions was not significant for the young-old group, t (19) = -1.98, $p > .05$, or the mild AD group, t (14) = -1.30, $p > .05$.

In the second set of planned comparisons I conducted t-tests to examine differences between the semantic and no support conditions for the three groups, in order to test hypothesis 7b and 7c. The difference in number of words recalled between the semantic and no support condition was not significant for the young-old group, t (19) = -0.84, $p > .05$, the old-old group, t (19) = -1.29, $p > .05$, or the mild AD group, t (14) = 0.43, $p > .05$. The results fail to support hypothesis 7b, that young-old and old-old adults would recall greater number of words in the semantic support condition than in the no support condition. The results support

hypothesis 7c, that for patients with mild AD, there would be no difference in number of words recalled between the semantic and no support conditions.

CHAPTER 5 – DISCUSSION

Summary of Results

The objectives of the study were (a) to compare the effects of three cognitive support conditions (no support, semantic, and autobiographical) on number of words recalled in patients with mild-stage AD and healthy older adults, and (b) to examine whether patients with mild-stage AD and healthy older adults demonstrate differential improvement in number of words recalled as a function of support condition and recall condition (free recall, cued recall, and recognition).

The first set of research questions and hypotheses examined word recall performance in the autobiographical and semantic support conditions as affected by group and recall condition. Because of the observed interactions, the results of the main effects hypotheses are described only briefly. In my first hypothesis, I expected that (a) young-old adults would recall a greater number of words than old-old adults, and (b) old-old adults would recall a greater number of words than patients with mild-stage AD. Contrary to hypothesis 1a, the young-old group did not recall significantly more words than old-old group, however the young-old and old-old groups recalled greater number of words than the mild AD group, supporting hypothesis 1b.

In my second hypothesis, I expected that the participants overall (and across recall conditions) would recall greater number of words in the autobiographical support condition than in the semantic support condition. Results revealed that participants overall recalled greater number of words in the autobiographical than

in the semantic support condition, supporting hypothesis 2.

In my fourth hypothesis, I expected that the participants overall would recall greater number of words on tests of recognition than on cued recall, and on cued recall than on immediate free recall. Results revealed that participants overall recalled greater number of words on recognition than on cued recall, and on cued recall than on immediate free recall, supporting hypothesis 4. The results are consistent with previous studies in which healthy older adults and patients with mild AD recall greater number of words with increasing levels of cognitive support at recall (Bäckman & Small, 1998; Dixon et al., 2004; Grandmaison & Simard, 2003).

In my third hypothesis, I expected that the difference in number of words recalled between the autobiographical and semantic support condition would be greater for patients with mild-stage AD than for healthy young-old and old-old adults. As illustrated in Figure 1, a significant 2-way interaction between group and support condition was obtained. Follow-up tests indicated that mean word recall performance was greater in the autobiographical than in the semantic support condition for the old-old and mild AD group, but not for the young-old group (see Figure 1). The difference in number of words recalled between support conditions was greater for the mild AD group than for the young-old group, partially supporting hypothesis 3. This is illustrated by the non-parallel line slopes of the young-old and mild AD group in Figure 1. In previous studies, patients with mild-stage AD have benefited to the same extent as healthy older adults on episodic memory tasks if sufficient support was provided at encoding

and retrieval (Bäckman & Small, 1998). The fact that mild AD patients benefited to a greater extent than healthy young-old adults with autobiographical support is significant, as this differential pattern of improvement has not been demonstrated in previous studies using other forms of cognitive support. The results suggest that autobiographical memory cues are particularly effective for improving memory performance in patients with mild-stage AD.

A significant 2-way interaction between group and recall condition was obtained (see Table 4). As the follow-up tests failed to clarify the source of the interaction, the results were interpreted in the context of the following 3-way interaction.

A significant 3-way interaction between group, support condition, and recall condition was obtained (see Figure 2). Follow-up tests revealed a differential pattern of benefit from autobiographical support for each group in each recall condition. Although the young-old group recalled somewhat more words in the autobiographical than in the semantic support condition across the three recall conditions, the differences were not significant. The old-old group recalled significantly more words in the autobiographical than in the semantic support condition on tests of immediate free recall, but not on cued recall or recognition. In contrast, the mild AD group recalled more words in the autobiographical than in the semantic support condition on tests of cued recall and recognition, but not on immediate free recall. As illustrated in Figure 2, a ceiling effect was obtained on tests of recognition for the young-old and old-old group.

The finding that young-old adults benefited relatively to the same degree from semantic and autobiographical support is consistent with previous studies indicating that healthy young-old adults are able to use a variety of forms of cognitive support effectively (Dixon et al., 2004). For the mild AD group, the differences between support conditions were not evident on immediate free recall due to poor performance of the mild AD group in both the autobiographical and semantic support conditions. The benefit of autobiographical support for the mild AD group only became evident on tests of cued recall and recognition, as the provision of retrieval cues allowed mild AD patients to access the information from long-term memory. This is consistent with previous studies, in which patients with mild AD have demonstrated improvement on episodic memory tasks only when support was provided at encoding and retrieval (Almkvist et al., 1999; Bäckman & Small, 1998; Bäckman, Small, & Fratiglioni, 2002). Although the mild AD group benefited from both semantic and autobiographical support on tests of cued recall and recognition, the mild AD group benefited the most on recognition in the autobiographical support condition, with scores similar to healthy young-old and old-old adults (see Table 5). The fact that the mild AD group recalled more words with autobiographical than with semantic support is consistent with previous research that semantic memory declines in mild-stage AD (Peraita et al., 2008), making it more difficult for patients to use forms of cognitive support that rely on semantic memory (i.e., semantic cues). The effectiveness of autobiographical memory cues in relation to semantic cues are therefore more evident for the mild AD group.

The second set of research questions and hypotheses examined immediate free recall performance as affected by group and support condition. The significant 3-way interaction in the first analysis indicated a differential pattern of benefit from autobiographical support for each group in each recall condition. In my fifth hypothesis, I expected that on tests of immediate free recall, (a) young-old adults would recall greater number of words than old-old adults, and (b) old-old adults would recall greater number of words than patients with mild-stage AD. Results revealed that the difference in number of words recalled for the young-old and old-old group was not significant, failing to support hypothesis 5a. As expected, the young-old and old-old groups recalled greater number of words than the mild AD group, supporting hypothesis 5b. Due to the pattern of results in Figure 3, follow-up t-tests were performed to examine differences for the young-old and old-old group in each support condition. Results revealed that the young-old group recalled significantly more words than the old-old group in the no support condition, t (38) = 2.49, $p < .05$, and in the semantic support condition, t (38) = 2.07, $p < .05$. In contrast, there were no differences between age groups in the autobiographical support condition, t (38) = 0.19, $p > .05$ (see Figure 3). These results are consistent with previous studies, which reveal a decreased ability for old-old adults to benefit from cognitive support on tests of free recall, due to a possible reduction in cognitive reserve capacity (Dixon et al., 2004). An important finding of the current study is that the age-related differences on tests of free recall disappeared in the autobiographical support condition. This suggests that autobiographical memory support at encoding allows old-old adults to

compensate for memory deficits through recruitment of this preserved area of memory.

In my sixth hypothesis, I expected that on tests of immediate free recall, the participants overall would recall greater number of words (a) in the autobiographical than in the semantic support condition, and (b) in the semantic than in the no support condition. Results revealed that on tests of free recall, participants overall recalled greater number of words in the autobiographical than in the semantic support condition, supporting hypothesis 6a. The difference in the mean number of words recalled for the semantic and the no support condition was not significant, failing to support hypothesis 6b.

In my seventh hypothesis, I expected that on tests of immediate free recall, (a) the three groups would recall greater number of words in the autobiographical than in the semantic support condition, (b) young-old and old-old adults would recall greater number of words in the semantic than in the no support condition, and (c) patients with mild-stage AD would demonstrate no difference in number of words recalled between the semantic and no support condition. Contrary to my expectation, a significant interaction was not obtained between group and support condition. Planned comparisons revealed that the difference in number of words recalled between the autobiographical and semantic support condition was significant for the old-old group, but not for the young-old group or the mild AD group. Contrary to my expectation, the young-old group and the mild AD group benefited to the same extent with autobiographical and semantic support on tests of free recall. The performance of patients with mild-stage AD is consistent with

previous studies, in which patients with mild AD have failed to demonstrate benefit from cognitive support on tests of free recall (Almkvist et al., 1998; Bäckman et al., 1999). The results suggest that autobiographical support at encoding may be particularly effective at improving memory in old-old adults.

Further planned comparisons revealed that the difference in number of words recalled between the semantic and no support condition was not significant for the young-old or the old-old group, failing to support hypothesis 7b. This result contrasts with previous studies in which healthy older adults have demonstrated benefit from cognitive support on tests of free recall. As expected, patients with mild-stage AD demonstrated no difference in number of words recalled between the semantic and no support conditions, supporting hypothesis 7c. The results suggest that this form of semantic support at encoding (without retrieval cues), is not effective at improving memory in healthy older adults or patients with mild-stage AD. The semantic cue task, which involved associating each word with a one-word descriptor, may not have involved the depth of processing necessary to allow the words to be encoded effectively.

In summary, the results of the present study indicate that autobiographical memory cues are an effective form of cognitive support for healthy young-old and old-old adults and for patients with mild-stage AD. The study found that autobiographical memory cues were significantly more effective than participant-produced semantic cues at improving word recall in old-old adults and in patients with mild-stage AD. Specifically, the effectiveness of autobiographical support in relation to semantic support was evident for old-old adults on tests of immediate

free recall, and for patients with mild AD on tests of cued recall and recognition.

An informal and untested observation is that participants with mild AD often had difficulty using retrieval cues in the autobiographical memory cue task. After being presented with a participant-produced word cue following the interference task, the one-or two-word cue was out of context, and participants with AD often had difficulty retrieving the original memory. The retrieval of the correct word from the list seemed to be dependent on recalling the autobiographical memory from the participant-produced cue word. This is consistent with the *encoding specificity principle*, which posits that the more congruent a cue is with the cognitive operations carried out at encoding, the more effective it will be at retrieval (see Grandmaison & Simard, 2003). Future studies could increase the length of the word cues from one or two words to several words, in order to reduce demands on memory for patients with AD.

Limitations of the Study

Limitations of the study include the ceiling effect for the two healthy control groups on tests of recognition. The ceiling effect was evident despite attempts to reduce the ceiling effect by increasing length of the word lists from 20 to 30 words. The self-generated cue tasks combined with recognition cues represented a very high degree of cognitive support for healthy older adults. The ceiling effect made conclusions difficult to generate when comparing performance in the autobiographical and semantic support condition on tests of recognition. If the ceiling effect were eliminated, would healthy older adults recall more words with autobiographical than with semantic support on tests of recognition? In addition,

would the mean increase in number of words recalled from cued recall to recognition be similar for the mild AD and healthy control groups? Future studies could increase the length of the word lists, increase the difficulty of the word lists, or decrease the amount of word presentation time; all might decrease the likelihood of a ceiling effect.

A further limitation is that the three word lists used in the study were not counterbalanced across the three support conditions. On the word list used in the autobiographical support condition, words were selected that were likely to enable the participants to retrieve specific autobiographical memories. This presents a possible confounding factor, as the effects of support condition on word recall may have been influenced by differences in the word lists used in each support condition. Steps were taken to ensure that the three word lists were equivalent in terms of difficulty. The words on each list were comparable in terms of frequency, concreteness, and imagery as determined by previous normative studies (see Appendix C). For each list, each word was from a unique taxonomic category to minimize organizability. In addition, words of similar length and number of syllables were used for each list.

Another study limitation was the additional time of encoding for the two support conditions. After a word was presented on the computer screen for two seconds, participants had up to 90 seconds to associate the word with a descriptor or a personal memory. To decrease the chance of rehearsal, immediately after associating a word with a cue (either autobiographical or semantic), participants were asked to click the mouse to move to the next word on the list. In the

autobiographical memory condition, the recall of the personal memory may have led to increased rehearsal of the word due to repeating the target word in the story.

Another limitation of the study was the relatively small sample size for the mild AD group (n = 15). Future studies should attempt to supplement the mild AD sample. In addition, the mild AD sample contained some cases of "pure" AD and some cases of mixed AD and vascular dementia. As mentioned previously, neuropsychological tests have demonstrated little difference in cognitive performance between pure AD and mixed dementia groups (Schreiter-Gasser et al., 2008).

Another limitation of the current study was that the testing, researching, and scoring were conducted by the same person, leading to possible experimenter effects. Future studies should have multiple researchers administering the tests, who are unaware of the expectations for the outcome.

Significance of the Study

Implications

The current study contributes to the growing body of evidence that adults with mild-stage AD are able to benefit from cognitive support interventions to improve memory. The study presents new findings about the benefit of using autobiographical memories to support declining episodic memory in healthy aging and AD. In particular, the study provides evidence that autobiographical memory cues are more effective than self-generated semantic cues at improving word recall in healthy old-old adults and adults with mild-stage AD. The use of autobiographical memories in cognitive support may become a focus of future

studies with this population, and may represent a new direction in clinical research.

Future studies might examine the effectiveness of autobiographical memory support for individuals with Mild Cognitive Impairment (MCI) or moderate-stage AD. As mentioned previously, five of the AD participants' data were not included in the analyses, as their MMSE scores were in the range of moderate or severe-stage dementia. Informal observations of these participants' data revealed a diminished ability to benefit from cognitive support on tests of free and cued recall with increased dementia severity. These participants however, demonstrated an ability to benefit from cognitive support on tests of recognition (although recognition performance was lower than for participants with mild-stage AD). On tests of recognition, the advantage of autobiographical support in relation to semantic support was more evident for patients with moderate and severe-stage AD than for patients with mild-stage AD. The findings are consistent with previous research indicating that autobiographical memories remain relatively spared in moderate to severe-stage AD (Sartori et al., 2004). These observations are promising, as autobiographical memory cues may be effective for use with patients with more advanced AD.

Other research questions to be addressed in future studies could include: What testing conditions enable older adults and patients with AD to use autobiographical cues effectively? What kinds of autobiographical memories promote more efficient encoding, (i.e., highly significant life events, vs. general everyday memories, "I put sugar on my cereal in the morning")? How can

autobiographical memory cues be applied to tasks in everyday life?

Applications

The study is of practical significance because it provides evidence that a person's autobiographical memories can be used as a resource for supporting everyday memory performance. This knowledge may aid the development of cognitive interventions for individuals with age-related memory decline and with early-stage AD. Autobiographical memory cues could be an effective self-initiated strategy for healthy older adults to compensate for age-related decline in episodic memory. Personal memories could be associated with to-be-remembered information, such as names of people, or appointment dates.

The results of the present study confirm that patients with mild AD can benefit from cognitive support with provision of retrieval cues. In real-life settings, cueing strategies that utilize autobiographical memory can be taught to caregivers to assist AD patients with their everyday memory performance. In the current study, one participant's caregiver encouraged her spouse with mild AD to remember the year of his birthdate when completing the information questionnaire. She prompted him by asking, "What is your belt size?", to which the participant answered, "28", and was able to remember that his birth year was 1928. Another participant with mild AD reported that he remembered the experimenter's name by associating her first name with his wife's, who had the same name. Interventions that improve memory functioning, even temporarily, may allow patients with AD to achieve greater functional independence in their own environments, and reduce stress for patients and their caregivers.

To facilitate long-term retention of information, autobiographical memory cues can be used in combination with other memory techniques, such as spaced retrieval training. Spaced retrieval training involves repeated recall of newly learned information at increasingly longer intervals. For example, a person is taught a piece of information (i.e., a name) and is tested at intervals that are systematically increased over successful recall trials. If an error occurs at recall, the information is restated and the next recall interval is decreased to the previous interval (for a review see Hawley, Cherry, Boudreaux, & Jackson, 2008). There is evidence that with spaced retrieval training, patients with AD can learn and retain a small amount of information important to their daily activities for up to several months (Cherry & Simmons-D'Gerolamo, 2005; Hawley & Cherry, 2004). For example, autobiographical memory cues and spaced retrieval techniques could be used to facilitate learning of name-face associations. Similar to the task used by Hawley and Cherry (2004), patients with mild AD would first be presented with a photo of a face (i.e., a caregiver) and verbally presented with a corresponding name. For the autobiographical cue task they would be asked to associate the to-be-remembered name with the name of a familiar person, and recall a brief memory about the person. The memory would then be shortened to a word cue. After a brief interval (i.e., one minute) filled with a distracter task, the photo would be re-presented and the person would be asked to recall the name. If the person were unable to provide the name for the picture, the autobiographical memory cue would be provided. The same procedure would be followed with recall intervals increased after each successful recall trial (i.e., 2, 5,

10, 15, 30 minutes). The training sessions could be followed up with a live transfer task, in which the patient with AD would be tested on name recall of the actual person featured in the photo (Hawley & Cherry, 2004).

Older adults with mild-stage AD describe reduced self-confidence and loss of control as consequences of their memory loss (Clare, 2003). In a qualitative study by Clare (2002), patients with mild AD identified that use of memory compensation strategies (i.e., mnemonic strategies) had positive effects on self-confidence, and resulted in increased hope. Although cognitive support interventions that use autobiographical memory do not reverse AD-related deficits, the learning of useful information and the successful completion of memory tasks may increase competence and confidence in navigating one's environment.

REFERENCES

Albert, M. S., & Moss, M. B. (2002). Neuropsychological approaches to preclinical identification of Alzheimer's disease. In L. R. Squire & D. L. Schacter (Eds.), *Neuropsychology of memory* (3rd ed.; pp. 248-258). New York: Guilford Press.

Algarabel, S., Pitarque, A., & Dasi, C. (2002). Retrieval effort as a function of type of information and accessibility of recall. *Psicothema, 14*, 393-398.

Allen, G., Barnard, H., McColl, R., Hester, A. L., Fields, J. A., Weiner, M. F., Ringe, W. K., Lipton, A. M., Brooker, M., McDonald, E., Rubin, C. D., & Cullum, M. (2007). Reduced hippocampal functional connectivity in Alzheimer's disease. *Archives of Neurology, 64*, 1482-1487.

Almkvist, O., Fratiglioni, L., Agüerro-Torres, H., Viitanen, M., & Bäckman, L. (1999). Cognitive support at episodic encoding and retrieval: Similar patterns of utilization in community-based samples of Alzheimer's disease and vascular dementia patients. *Journal of Clinical and Experimental Neuropsychology, 21*, 816-830.

Alzheimer Society of Canada (2008). Alzheimer's Disease Statistics. Retrieved November 12, 2008, from http://www.alzheimer.ca/english/disease/stats-people.htn.

Bäckman, L., Jones, S., Berger, A. K., Jonsson Laukka, E., & Small, B. J. (2005). Cognitive impairment in preclinical Alzheimer's disease: A meta-analysis. *Neuropsychology, 19*, 520-535.

Bäckman, L., & Small, B. J. (1998). Influences of cognitive support on episodic remembering: Tracing the process of loss from normal aging to Alzheimer's disease. *Psychology and Aging, 13*, 267-276.

Bäckman, L., Small, B. J., & Fratiglioni, L. (2002). The nature and course of the memory impairment in Alzheimer's disease. In P. Graf and N. Ohta (Eds.), *Lifespan development of human memory* (pp. 205-232). Cambridge, MA: The MIT Press.

Bäckman, L., Small, B. J., Wahlin, A., & Larsson, M. (2000). Cognitive functioning in very old age. In F. I. M. Craik & T. A. Salthouse (Eds.). *Handbook of cognitive aging* (2nd ed., pp. 499-558). Mahwah, NJ: Erlbaum.

Bäckman, L., Wahlin, A., Small, B. J., Herlitz, A., Winblad, B., & Fratiglioni, L. (2004). Cognitive functioning in aging and dementia: The Kungsholmen project. *Aging Neuropsychology and Cognition, 11*, 212-244.

Baltes, P. B., Kliegl, R., & Dittmann-Kohli, F. (1988). On the locus of training gains in research on the plasticity of fluid intelligence in old age. *Journal of Educational Psychology, 80*, 392-400.

Baltes, P. B., Sowarka, D., & Kliegl, R. (1989). Cognitive training research on fluid intelligence in old age: What can older adults achieve by themselves? *Psychology and Aging, 4*, 217-221.

Battig, W. F., & Montague, W. E. (1969). Category norms for verbal items in 56 categories: A replication and extension of the Connecticut category norms. *Journal of Experimental Psychology Monographs, 80*, 1-46.

Bayles, K. A., & Kim, E. S. (2003). Improving the functioning of individuals with Alzheimer's disease: Emergence of behavioural interventions. *Journal of Communication Disorders, 36,* 327-343.

Bluck, S. (2003). Autobiographical memory: Exploring its functions in everyday life. *Memory, 11,* 113-123.

Braak, H., & Braak, E. (1991). Neuropathological staging of Alzheimer-related changes. *Acta Neuropathologica, 82,* 239-259.

Bullock, R., & Lane, R. (2007). Executive dyscontrol in dementia, with emphasis on subcortical pathology and the role of butyrylcholinesterase. *Current Alzheimer Research, 4,* 277-293.

Bunce, D. (2003). Cognitive support at encoding attenuates age differences in recollective experience among adults of lower frontal lobe function. *Neuropsychology, 17,* 353-361.

Burns, A., & Rabins, P. (2000). Carer burden in dementia. *International Journal of Geriatric Psychiatry, 15,* S9-S13.

Cahn-Weiner, D. A., Malloy, P. F., Rebok, G. W., & Ott, B. R. (2003). Results of a randomized placebo-controlled study of memory training for mildly impaired Alzheimer's disease patients. *Applied Neuropsychology, 10,* 215-223.

Canadian Study of Health and Aging Working Group (1994). Canadian study of health and aging: Study methods and prevalence of dementia. *Canadian Medical Association Journal, 150,* 899-913.

Cherry, K. E., & Simmons-D'Gerolamo, S. (2005). Long-term effectiveness of spaced retrieval memory training for older adults with probable Alzheimer's disease. *Experimental Aging Research, 31*, 261-289.

Clare, L. (2003). Managing threats to self: Awareness in early stage Alzheimer's disease. *Social Science & Medicine, 57*, 1017-1029.

Clare, L. (2002). We'll fight it as long as we can: Coping with the onset of Alzheimer's disease. *Aging & Mental Health, 6*, 139-148.

Clare, L., & Woods, B. (2003). Cognitive rehabilitation and cognitive training for early-stage Alzheimer's disease and vascular dementia. *Cochrane Database of Systematic Reviews, 4*, CD003260.

Coleman, P. D., & Yao, P. J. (2003). Synaptic slaughter in Alzheimer's disease. *Neurobiology of Aging, 24*, 1023-1027.

Conway, M. A., Pleydell-Pearce, C. W., Whitecross, S., & Sharpe, H. (2002). Brain imaging and autobiographical memory. *The Psychology of Learning and Motivation, 41*, 229-264.

Corral, M., Rodriguez, M., Amenedo, E., Sanchez, J. L., & Diaz, F. (2006). Cognitive reserve, age, and neuropsychological performance in healthy participants. *Developmental Neuropsychology, 29*, 479-491.

Crovitz, H. F., & Schiffman, H. (1974). Frequency of episodic memories as a function of their age. *Bulletin of the Psychonomic Society, 4*, 517-518.

Delbeuck, X., Van der Linden, M., & Collette, F. (2003). Alzheimer's disease as a disconnection syndrome. *Neuropsychology Review, 13*, 79-92.

Derwinger, A., Stigsdotter Neely, A., & Bäckman, L. (2005). Design your own memory strategies. Self-generated strategy training versus mnemonic training in old age: An 8-month follow-up. *Neuropsychological Rehabilitation, 15,* 37-54.

Derwinger, A., Stigsdotter Neely, A., Persson, M., Hill, R. D., & Bäckman, L. (2003). Remembering numbers in old age: Mnemonic training versus self-generated strategy training. *Aging Neuropsychology and Cognition, 10,* 202-214.

Dijkstra, K., & Kaschak, M. P. (2006). Encoding in verbal, enacted, and autobiographical tasks in young and older adults. *The Quarterly Journal of Experimental Psychology, 59,* 1338-1345.

Dijkstra, K., & Kaup, B. (2005). Mechanisms of autobiographical memory retrieval in younger and older adults. *Memory & Cognition, 33,* 811-820.

Dixon, R. A., de Frias, C. M., & Bäckman, L. (2001). Characteristics of self-reported memory compensation in older adults. *Journal of Clinical and Experimental Neuropsychology, 23,* 650-661.

Dixon, R. A., Hopp, G. A., Cohen, A. L., de Frias, C. M., & Bäckman, L. (2003). Self-reported memory compensation: Similar patterns in Alzheimer's disease and very old adult samples. *Journal of Clinical and Experimental Neuropsychology, 25,* 382-390.

Dixon, R. A., Wahlin, Å., Maitland, S. B., Hultsch, D. F., Hertzog, C., & Bäckman, L. (2004). Episodic memory change in late adulthood: Generalizability across samples and performance indices. *Memory & Cognition, 32,* 768-778.

Eustache, F., Piolino, P., Giffard, B., Viader, F., De La Sayette, V., Baron, J. C., & Desgranges, B. (2004). 'In the course of time': A PET study of the cerebral substrates of autobiographical amnesia in Alzheimer's disease. *Brain, 127*, 1549-1560.

Fromholt, P., Mortensen, D. B., Torpdahl, P., Bender, L., Larsen, P., & Rubin, D. C. (2003). Life-narrative and word-cued autobiographical memories in centenarians: Comparisons with 80-year-old control, depressed, and dementia groups. *Memory, 11*, 81-88.

Graham, N. L., Emery, T., & Hodges, J. R. (2004). Distinctive cognitive profiles in Alzheimer's disease and subcortical vascular dementia. *Journal of Neurology, Neurosurgery, & Psychiatry, 75*, 61-71.

Grandmaison, E., & Simard, M. (2003). A critical review of memory stimulation programs in Alzheimer's disease. *Journal of Neuropsychiatry and Clinical Neuroscience, 15*, 130-144.

Greenberg, D. L., & Rubin, D. C. (2003). The neuropsychology of autobiographical memory. *Cortex, 39*, 687-728.

Hawley, K. S., & Cherry, K. E. (2004). Effects of spaced retrieval on name-face recognition in older adults with probable Alzheimer's disease. *Behaviour Modification, 28*, 276-296.

Hawley, K. S., Cherry, K. E., Boudreaux, E. O., & Jackson, E. M. (2008). A comparison of adjusted spaced retrieval versus a uniform expanded retrieval schedule for learning a name-face association in older adults with probable Alzheimer's disease. *Journal of Clinical and Experimental Neuropsychology, 30*, 639-649.

Head, D., Rodrigue, K. M., Kennedy, K. M., & Raz, N. (2008). Neuroanatomical and Cognitive Mediators of Age-Related Differences in Episodic Memory. *Neuropsychology, 22*, 491-507.

Herlitz, A., Adolfsson, R., Bäckman, L., & Nilsson, L. G. (1991). Cue utilization following different forms of encoding in mildly, moderately, and severely demented patients with Alzheimer's disease. *Brain and Cognition, 15*, 119-130.

Hertzog, C., Dixon, R. A., Hultsch, D. F., & MacDonald, S. W. S. (2003). Latent change models of adult cognition: Are changes in processing speed and working memory associated with changes in episodic memory? *Psychology and Aging, 18*, 755-769.

Hill, R., & Bäckman, L. (2000). Theoretical and methodological issues in memory training. In R. D. Hill, L. Bäckman, & A. Stigsdotter Neely (Eds.), *Cognitive rehabilitation in old age* (pp. 23-41). New York: Oxford University Press.

Hou, C. E., Miller, B. L., & Kramer, J. H. (2005). Patterns of autobiographical memory loss in dementia. *International Journal of Geriatric Psychiatry, 20*, 809-815.

Howard, D. V. (1980). Category norms: A comparison of the Battig and Montague (1969) norms with responses of adults between the ages of 20 and 80. *Journal of Gerontology, 35*, 884-890.

Janssen, S. M. J., Chessa, A. G., & Murre, J. M. J. (2005). The reminiscence bump in autobiographical memory: Effects of age, gender, education, and culture. *Memory, 13*, 658-668.

Killiany, R. J., Gomez-Isla, T., Moss, M., Kikinis, R., Sandor, T., Jolesz, F., Tanzi, R., Jones, K., Hyman, B. T., & Albert, M. S. (2000). Use of structural magnetic resonance imaging to predict who will get Alzheimer's disease. *Annals of Neurology, 47*, 430-439.

Lambon Ralph, M. A., Patterson, K., Graham, N., Dawson, K., & Hodges, J. R. (2003). Homegeneity and heterogeneity in mild cognitive impairment and Alzheimer's disease: A cross-sectional and longitudinal study of 55 cases. *Brain, 126*, 2350-2362.

Larsson, M., Nyberg, L., Bäckman, L., & Nilsson, L. G. (2003). Effects on episodic memory of stimulus richness, intention to learn, and extra study repetition: Similar profiles across the adult life span. *Journal of Adult Development, 10*, 67-73.

Lee, S., Buring, J. E., Cook, N. R., & Grodstein, F. (2006). The relation of education and income to cognitive function among professional women. *Neuroepidemiology, 26*, 93-101.

Lipinska, B., Bäckman, L., & Herlitz, A. (1992). When Greta Garbo is easier to remember than Stefan Edberg: Influences of prior knowledge on recognition memory in Alzheimer's disease. *Psychology and Aging, 7*, 214-220.

Lipinska, B., Bäckman, Mäntyla, T., & Viitanen, M. (1995). Effectiveness of self-generated cues in early Alzheimer's disease. *Journal of Clinical and Experimental Neuropsychology, 16*, 809-819.

MacDonald, S. W. S., Dixon, R. A., Cohen, A. L., & Hazlitt, J. E. (2004). Biological age and 12-year cognitive change in older adults: Findings from the Victoria Longitudinal Study. *Gerontology, 50*, 64-81.

McArdle, J. J., Fisher, G. G., & Kadlec, K. M. (2007). Latent variable analyses of age trends of cognition in the health and retirement study, 1992-2004. *Psychology and Aging, 22*, 525-545.

Mckhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E. M. (1984). Clinical diagnosis of Alzheimer's disease. Report of the NINCDS-ADRDA work group under the auspices of the Department of Health and Human Services Task Force on Alzheimer's Disease. *Neurology, 34*, 939-944.

Mimura, M., & Komatsu, S. (2007). Cognitive rehabilitation and cognitive training for mild dementia. *Psychogeriatrics, 7*, 137-143.

Moore, S., Sandman, C. A., McGrady, K., & Kesslak, J. P. (2001). Memory training improves cognitive ability in patients with dementia. *Neuropsychological Rehabilitation, 11*, 245-261.

Neri, M., Iaconi, S., Renzetti, C., & De Vreese, L. P. (2001). Cognitive training in aging and disease (COTRAD): Does it work in Italy? *Archives of Gerontology and Geriatrics, Suppl. 7,* 285-293.

Nilsson, L. G. (2003). Memory function in normal aging. *Acta Neurologica Scandinavia, 107,* 7-13.

Nyberg, L., Maitland, S. B., Rönnlund, M., Bäckman, L., Dixon, R. A., & Wahlin, A. (2003). Selective adult age differences in an age-invariant multifactor model of declarative memory. *Psychology and Aging, 18,* 149-160.

Paivio, A., Yuille, J. C., & Madigan, S. A. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology Monograph Supplement, 76,* 1-25.

Peraita, H., Diaz, C., & Anllo-Vento, L. (2008). Processing of semantic relations in normal aging and Alzheimer's disease. *Archives of Clinical Neuropsychology, 23,* 33-46.

Persson, J., Nyberg, L., Lind, J., Larsson, A., Nilsson, L. G., Ingvar, M., & Buckner, R. L. (2006). Structure-function correlates of cognitive decline in aging. *Cerebral Cortex, 16,* 907-915.

Pillemer, D. B. (2003). Directive functions of autobiographical memory: The guiding power of the specific episode. *Memory, 11,* 193-202.

Piolino, P., Lamidey, V., Desgrange, B., & Eustache, F. (2007). The semantic and episodic subcomponents of famous person knowledge: Dissociation in healthy subjects. *Neuropsychology, 21,* 122-135.

Rajah, M. N., & McIntosh, A. R. (2005). Overlap in the functional neural systems involved in semantic and episodic memory retrieval. *Journal of Cognitive Neuroscience, 17*, 470-482.

Razani, J., Kakos, B., Orieta-Barbalace, C., Wong, J. T., Casas, R., Lu, P., Alessi, C., & Josephson, K. (2007). Predicting caregiver burden from daily functional abilities of patients with mild dementia. *Journal of the American Geriatric Society, 55*, 1415-1420.

Reuter-Lorenz, P. A. (2000). Cognitive neuropsychology of the aging brain. In D. Park, & N. Schwarz (Eds.), *Cognitive aging: A primer* (pp. 93-114). Philadelphia: Psychology Press.

Rubin, D. C., & Schulkind, M. D. (1997). The distribution of autobiographical memories across the lifespan. *Memory & Cognition, 25*, 859-866.

Sartori, G., Snitz, B. E., Sorcinelli, L., & Daum, I. (2004). Remote memory in advanced Alzheimer's disease. *Archives of Clinical Neuropsychology, 19*, 779-789.

Schaeffer, E. L., & Gattaz, W. F. (2008). Cholinergic and glutamatergic alterations beginning at the early stages of Alzheimer disease: Participation of the phospholipase A2 enzyme. *Psychopharmacology, 198*, 1-27.

Scheff, S. W., & Price, D. A. (2003). Synaptic pathology in Alzheimer's disease: A review of ultrastructural studies. *Neurobiology of Aging, 24*, 1029-1046.

Schreiter Gasser, U., Rousson, V., Hentschel, F., Sattel, H., & Gasser, T. (2008). Alzheimer disease versus mixed dementias: An EEG perspective. *Clinical Neuropsychology, 119*, 2255-2259.

Serrano, J. P., Latorre, J. M., Gatz, M., & Montanes, J. (2004). Life review therapy using autobiographical retrieval practice for older adults with depressive symptomology. *Psychology and Aging, 19*, 272-277.

Sitzer, D. I., Twamley, E. W., & Jeste, D. V. (2007). Cognitive training in Alzheimer's disease: A meta-analysis of the literature. *Acta Psychiatrica Scandinavica, 114,* 75-90.

Small, J. A., & Sandhu, N. (2008). Episodic and semantic memory influences on picture naming in Alzheimer's disease. *Brain and Language, 104*, 1-9.

Spaan, P. E. J., Raaijmakers, J. G. W., & Jonker, C. (2003). Alzheimer's disease versus normal ageing: A review of the efficiency of clinical and experimental memory measures. *Journal of Clinical and Experimental Neuropsychology, 25*, 216-233.

Starkstein, S. E., Boller, F., & Garau, L. (2005). A two-year follow-up study of remote memory in Alzheimer's disease. *Journal of Neuropsychiatry and Clinical Neurosciences, 17*, 336-341.

Stern, Y. (Ed.). (2006) *Cognitive reserve: Theory and applications*. New York: Psychology Press.

Stopford, C. L., Snowden, J. S., Thompson, J. C., & Neary, D. (2007). Distinct memory profiles in Alzheimer's disease. *Cortex, 43*, 846-857.

Storandt, M. (2008). Cognitive deficits in the early stages of Alzheimer's disease. *Current Directions in Psychological Science, 17*, 198-202.

Svoboda, E., McKinnon, M. C., & Levine, B. (2006). The functional neuroanatomy of autobiographical memory: A meta-analysis. *Neuropsychologica, 44*, 2189-2208.

Taconnat, L., Clarys, D., Vanneste, S., Bouazzaoui, B., & Isingrini, M. (2007). Aging and strategic retrieval in a cued recall test: The role of executive functions and fluid intelligence. *Brain and Cognition, 64*, 1-6.

Terry, R. D. (2006). Alzheimer's disease and the aging brain. *Journal of Geriatric Psychiatry and Neurology, 19*, 125-128.

Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Reviews in Psychology, 53*, 1-25.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory* (pp. 382-403). New York: Academic Press.

Vandenberghe, R., & Tournoy, J. (2005). Cognitive aging and Alzheimer's disease. *Postgrad Medical Journal, 81*, 343-352.

West, R. (1996). An application of prefrontal cortex function theory to cognitive aging. *Psychological Bulletin, 120*, 272-292.

Westmacott, R., Black, S. E., Freedman, M., & Moscovitch, M. (2003). The contribution of autobiographical significance to semantic memory: Evidence from Alzheimer's disease, semantic dementia, and amnesia. *Neuropsychologia, 42*, 25-48.

Westmacott, R., Freedman, M., Black, S. E., Stokes, K. A., & Moscovitch, M. (2004). Temporally graded semantic memory loss in Alzheimer's disease: Cross-sectional and longitudinal studies. *Cognitive Neuropsychology, 21*, 353-378.

Westmacott, R., & Moscovitch, M. (2003). The contribution of autobiographical significance to semantic memory. *Memory & Cognition, 31*, 761-774.

Yesavage, J. A., Brink, T. L., Rose, T., Lum, O., Huang, O., Adey, V., & Lierer, V. (1983). Development and validation of the Geriatric Depression Screen Scale: A preliminary report. *Journal of Psychiatric Research, 17*, 37-49.

APPENDIX A

PERSONAL DATA SHEET

In order to better understand the results of our study, we need to know a few things about you and your background. We will use this information for research purposes only, and it will be kept strictly private. You will note that we do not ask for your name on the form. Please respond to the following items completely.

1. My gender is (please circle)**:** Male Female

2. My birth date is:

_____

(Day) (Month) (Year)

3. What is your native language?

English: _____ French: _____

Other (please specify): _____

4. What is your citizenship?

Canadian: _____ Other (please specify): _____

4b. What is your ethnic background? Please check the appropriate response.

_____ **White**, not of Hispanic origin (A person having origins in any of the original peoples of Europe, North Africa, or the Middle East).

_____ **Black**, not of Hispanic origin (A person having origins in any of the black racial groups of Africa).

_____ **First Nations origin** (A person having origins in any of the original peoples of North America, and who maintains a cultural identification through tribal or band affiliation or community recognition).

_____ **Asian or Pacific Islander** (A person having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands. This area includes, for example, China, India, Pakistan, Japan, Korea, the Philippines, and Samoa).

_____ **Hispanic** (A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

5. Currently, I am (please circle one)**:**

a) married
b) single
c) widowed
d) divorced
e) separated
f) common-law

6. What type of dwelling do you live in? (Please circle one)**:**

a) single family home
b) duplex/townhouse
c) apartment or condominium
d) congregate or senior care facility
e) other _____

7. Which academic diplomas or degrees or certificates have you obtained? (Please circle **ALL** that apply).

a) no degree/diploma/certificate
b) high school diploma
c) technical/trade school or community college
d) Bachelor's degree (e.g., BA, BSc, BComm)
e) Master's (e.g., MA, MSc, MEd, LLM)
f) Bachelor's of Law (LLB)
g) Medical degree (MD)
h) PhD or other doctoral degree
i) other or additional degrees/diplomas/certificates (please specify):
_____

8. For EACH of the following levels of education, please circle the highest grade or years of full-time attendance you have COMPLETED. Do not include part-time or extension courses taken for interest.

a) <u>Grade/Intermediate School</u>

Grade 1 Grade 2 Grade 3 Grade 4 Grade 5 Grade 6 Grade 7 Grade 8 Grade 9

b) <u>Secondary/High School</u>

none Grade 10 Grade 11 Grade 12 Grade 13

c) <u>Technical, Trade, Nursing or Business School, or Community College</u>

none 1 year 2 years 3 years 4 years 5+ years

d) <u>University</u> (Bachelor's Level)

none 1st year 2nd year 3rd year 4th year 5+ years

e) <u>Post-Graduate School</u> (e.g., LLB, Master's, MD, PhD)

none 1 year 2 years 3 years 4 years 5+ years

9. What professions or jobs have you held? (please write)**:**

_____

_____

10. Are you currently involved in volunteer work?

Yes _____ No _____

If **YES**, please briefly describe your volunteer activities:

_____

11. Are you currently a student or taking classes for interest?

Yes_____ No _____

If **YES**, how many hours a week do you spend in classes? _____ hrs

Are you pursuing a specific certificate, diploma, or degree?

Yes _____ No _____

Please describe briefly what you are studying:

_____

_____

Now we would like to ask you some questions about your health.

12. Compared to a perfect state of health, I believe my overall health to be (Please circle one)**:**

a. very good
b. good
c. fair
d. poor
e. very poor

13. Compared to other people my age, I believe my overall health to be (Please circle one)**:**

a. very good
b. good
c. fair
d. poor
e. very poor

14. Compared to other people my age, I believe my eyesight to be (Please circle one)**:**

a. very good
b. good
c. fair
d. poor
e. very poor

15. Compared to other people my age, I believe my hearing to be (Please circle one)**:**

a. very good
b. good
c. fair
d. poor
e. very poor

16. Compared to other people my age, I believe my memory to be (Please circle one)**:**

a. very good
b. good
c. fair
d. poor
e. very poor

17. Are you currently taking any medications? Yes __ No __

If **YES**, please name them (If possible):

_____

_____

18. Do you have a history of any of the following medical conditions?

Heart attack Yes _____ No_____
Stroke Yes _____ No _____
Head Injury Yes _____ No _____

APPENDIX B

Word List 1- No Support Condition

Noun	Frequency (%)	Rating: Concreteness	Rating: Imagery
1. CAT	93	7.00	6.80
2. SILK*	66	6.55	5.60
3. DESK*	52	6.83	6.17
4. STOVE*	17	6.58	5.47
5. JUDGE	6	6.25	6.27
6. LEMON	30	6.96	6.83
7. AXE*	8	6.80	5.77
8. UNCLE	97	--	--
9. RULER*	17	6.80	5.77
10. TENT	43	--	--
11. BUTTER	7	6.96	6.57
12. WOOD	50	--	--
13. DOCTOR	82	6.62	6.40
14. ISLAND	5	--	--
15. BASEBALL	85	--	--
16. FLOOD	89	6.62	6.33
17. HAT*	45	6.63	6.17
18. WINDOW	76	7.00	6.37
19. CANOE*	18	6.93	6.67
20. TRAIN*	58	6.45	6.23
21. DOLLAR	75	6.62	6.50
22. NOSE*	64	6.58	6.40
23. EAGLE*	36	6.96	6.67
24. ONION*	11	6.76	5.83
25. COPPER*	70	6.76	5.87
26. BEETLE*	60	6.80	6.10
27. DRUM*	73	5.67	6.25
28. TROUT	49	--	--
29. PINE*	48	7.00	6.77
30. SHOES	87	7.00	6.63
Mean	**50.57**	**6.71**	**6.27**

Note. Frequency ratings were obtained from Battig and Montague category norms (1969). Concreteness and imagery ratings were obtained from Paivio et al. (1968). Values for concreteness and imagery represent average ratings on a 7-point scale ranging from 1 (low) to 7 (high). *Concreteness and imagery ratings were not obtained for the exemplar, therefore ratings for the taxonomic category were obtained. Dashes indicate that no rating was found for the word.

Word List 2 – Autobiographical Memory Support Condition

Noun	Frequency (%)	Rating: Concreteness	Rating: Imagery
1. MOTHER	84	6.52	6.67
2. GOLD	61	6.76	6.47
3. HORSE	79	6.94	6.80
4. COTTON	91	6.90	6.00
5. APPLE	97	7.00	6.73
6. RIFLE*	37	6.38	5.73
7. STORM	23	6.45	6.43
8. THEFT*	39	3.81	4.43
9. TEACHER	35	6.38	5.77
10. FLU*	11	5.63	4.87
11. BASEMENT	24	6.83	6.03
12. SKATES*	5	6.58	6.10
13. GUITAR*	52	5.67	6.25
14. SUGAR	38	6.96	6.57
15. TOOTH*	12	6.58	6.40
16. WAGON*	19	6.45	6.23
17. COAT*	59	6.63	6.17
18. MATH	26	4.35	4.50
19. HOUSE	90	6.93	6.67
20. OCEAN	17	6.90	6.77
21. LAMP*	51	6.83	6.17
22. HOCKEY	29	--	--
23. BIKE*	9	6.63	6.17
24. WASP*	24	6.80	6.10
25. LETTER	8	6.94	6.37
26. CONCERT	4	--	--
27. DIAMOND	98	6.94	6.67
28. WINE	66	6.96	6.60
29. TULIP*	47	6.96	6.57
30. WALTZ	83	--	--
Mean	**43.93**	**6.47**	**6.16**

Note. Frequency ratings were obtained from the Battig and Montague category norms (1969). Concreteness and imagery ratings were obtained from Paivio et al. (1968). Values for concreteness and imagery represent average ratings on a 7-point scale ranging from 1 (low) to 7 (high). *Concreteness and imagery ratings were not obtained for the exemplar, therefore ratings for the taxonomic category were obtained. Dashes indicate that no rating was found for the word.

Word List 3 - Semantic Support Condition

Ratings

Noun	Frequency (%)	Concreteness	Imagery
1. RUBY*	95	6.59	6.40
2. BOOK	84	6.96	6.43
3. CAPTAIN	67	--	--
4. FORK	79	6.94	6.57
5. CHURCH	98	6.59	6.63
6. AIRPLANE*	63	6.45	6.23
7. HAMMER	98	6.96	6.73
8. GAS	41	--	--
9. KNEE*	18	6.58	6.40
10. COFFEE	51	6.89	6.73
11. PENNY*	55	6.90	6.50
12. DOLL	64	6.94	6.17
13. SPIDER*	40	6.80	6.10
14. ROSE*	95	6.96	6.57
15. GOLF	35	6.10	6.70
16. OAK*	89	7.00	6.77
17. SPARROW*	54	6.96	6.67
18. TABLE	92	7.00	6.50
19. WHALE	18	6.96	6.50
20. CARROT*	71	6.76	5.83
21. LION*	51	6.75	6.10
22. PLUM	38	--	--
23. ARROW	5	7.00	6.57
24. NURSE*	11	3.65	3.83
25. MOUNTAIN	91	7.00	6.77
26. SHIRT*	80	6.63	6.17
27. MAYOR	45	--	--
28. JAZZ	77	--	--
29. IGLOO	14	--	--
30. TIN*	39	6.76	5.87
Mean	**58.60**	**6.67**	**6.32**

Note. Frequency ratings were obtained from Battig and Montague category norms (1969). Concreteness and imagery ratings were obtained from Paivio et al. (1968). Values for concreteness and imagery represent average ratings on a 7-point scale ranging from 1 (low) to 7 (high). *Concreteness and imagery ratings were not obtained for the exemplar, therefore ratings for the taxonomic category were obtained. Dashes indicate that no rating was found for the word.

APPENDIX C

Mean Word Frequency, Concreteness, and Imagery Ratings for Each Word List

Word list	Frequency	Concreteness	Imagery
List 1	50.57 (29.37)	6.71 (0.30)	6.27 (0.39)
List 2	43.93 (30.29)	6.47 (0.78)	6.16 (0.64)
List 3	58.60 (28.62)	6.67 (0.68)	6.32 (0.60)

Note. Numbers enclosed in parentheses represent standard deviations. Frequency values represent percentages. Concreteness and imagery values are out of 7 points.

APPENDIX D

INFORMATION LETTER FOR PARTICIPANTS

<u>Research Project Title</u>: Cognitive Support and Memory in Older Adults.

You are invited to take part in the following research study. The purpose of this document is to describe the study so that you may make an informed decision about whether you wish to take part.

What is the purpose of the research?

The purpose of the study is to examine a new method to improve memory performance in older adults (age 60-90).

Who is conducting the study?

This study is being conducted by Karen Cochrane, a Ph.D. student in the Department of Educational Psychology at the University of Alberta. Karen is conducting the study for her thesis research under the supervision of Dr. Robert Frender in the Department of Educational Psychology, and Dr. Roger Dixon in the Department of Psychology.

Will I be expected to take part more than once? How long will the session take?

You are expected to take part only once. The session will last about 1½ - 2 hours after which your part in the project is finished.

What will I do in this study?

If you agree to take part in the study, you will be asked to complete two questionnaires which should each take about 10 minutes. For one questionnaire you will be asked to give information about your age, education, health, and medications. In another questionnaire you will be asked questions about how you are feeling lately. You will also be asked to perform several memory tasks that include remembering lists of words shown on a computer screen and recalling personal

memories. Instructions will be given for all tasks and you will be given a chance to ask questions if you do not understand. All of your responses will be recorded on audio tape to ensure accurate data collection.

Are the tasks going to be too hard or too personal?

You can expect the memory tasks to be challenging but not too difficult. We do not expect you to have any discomfort while taking part in this study. One of the tasks will involve recall of personal past memories. If recall of a particular memory is too stressful you may stop the task. It is important for you to know that you may refuse to do any specific task and you may withdraw from the study at any time.

How private are my answers?

All information will be held private. All questionnaires and response sheets will be given a code number and your name and identifying information will not appear on them. Your name will never be used in any presentations or publications of the study results. Any information you provide including audio taped and written responses will be stored in a locked cabinet in a locked lab and will be reviewed only by the researcher and her supervisors. The test scores will be stored in group form on secure computers with no identifying information. The information you provide will be held for at least five years after the study is done. The information gathered for this study may be looked at again in the future to help us answer other study questions. If so, the ethics board will first review the study to make sure the information is used ethically.

By signing the consent form you give permission to the researcher to access any personally identifiable health information which is under the custody of other health care professionals as deemed necessary for the conduct of the research.

Why is this study important? What are the benefits to me?

Taking part in the study will provide knowledge about ways to improve memory in older adults and people with early Alzheimer's disease.

Do I get paid for taking part?

You will be paid a fee of $20 to cover the cost of travel and parking.

Will I find out the results of the study? Can I find out how I did personally?

The overall results of the study will be published in Karen Cochrane's Ph.D. thesis. The results of the study may also be described in research articles published in scientific journals. The researcher will give you your test scores at the end of the session.

May I withdraw from the study once I have begun?

Your participation is voluntary. You may decide not to take part now, or you may stop at any time during the study. Refusal or withdrawal of participation will involve no penalty or loss of benefits. If you withdraw during the session we prefer to keep the information you have provided to that point. However, if you wish, we will destroy your data from the whole session.

Who do I contact if I want more information or if there is a problem?

Any questions about the project can be addressed to **Karen Cochrane** at **492-7602**, or **Dr. Roger Dixon, Professor of Psychology** at **492-5850**.

If you have any concerns about any part of the study, please contact the **Patient Relations Department** of the **Capital Health Authority** at **407-1040**.

CONSENT FORM FOR PARTICIPANTS

Research Project Title: Cognitive Support and Memory in Older Adults.

Part 1: Researcher Information

Name of Principal Investigator: Karen Cochrane
Affiliation: University of Alberta, Department of Educational Psychology
Contact Information: (780) 492-7602

Name of Supervisor: Dr. Roger A. Dixon
Affiliation: University of Alberta, Department of Psychology
Contact Information: (780) 492-5850

Part 2: Consent of Participant

	Yes	No
Do you understand that you have been asked to be in a research study?		
Have you read and received a copy of the attached information sheet?		
Do you understand the benefits and risks involved in taking part in this research study?		
Have you had a chance to ask questions about the study?		
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason and it will not affect your care.		
Has the issue of privacy been explained to you? Do you understand who will have access to your records, including personally identifiable health information?		

Part 3: Signatures

This study was explained to me by:

_____

Date:

_____

I agree to take part in this study.

Signature of Research Participant:

_____

Printed Name:

_____

Signature of Witness (If Available):

_____

Printed Name:

_____

I believe that the persons signing this form understand what is involved in the study and voluntarily agrees to participate.

Researcher:

_____

Printed Name:

_____

APPENDIX E

Instructions for Autobiographical Memory Cue Task

Adapted from Rubin and Schulkind (1997).

EXPERIMENTER: In this task you will be asked to recall personal memories in response to cue words. You will be presented with a series of 30 words that you will later be asked to recall. Each word will appear one at a time on the computer screen for two seconds. When a word appears on the screen please read it aloud. When the word disappears from the screen you will have up to 90 seconds to think of a personal memory associated with the word. The memory you think of does not have to be important or interesting. It can come from any point of time in your life, from as far back as you can remember to as early as this morning. The memory does have to be specific in that it must have happened at a particular place and point in time. For example, in response to the word 'store', you might think of having gone to the hardware store yesterday, or you may remember having gone to a little country store with your grandfather when you were five. When you have thought of a memory, please describe the memory briefly and then shorten the memory to **one or two cue words**. The cue words may not include the word to be remembered from the list. I will record your cue words on a response sheet. After you have stated the cue words, you are to immediately go to the next word on the list by clicking the mouse once. If you fail to produce a cue word in the 90-second time period, the computer will automatically go to the next word. You may withdraw from the task at any time. Do you have any questions? Let's start by doing several practice items.

APPENDIX F

Instructions for Semantic Cue Task

EXPERIMENTER: In this task you will be asked to provide descriptor cues for words. You will be presented with a series of 30 words that you will later be asked to recall. Each word will appear one at a time on the computer screen for two seconds. When a word appears on the screen please read it aloud. When the word disappears from the screen you will have up to 90 seconds to think of **one** word that you think represents an appropriate **description** of the word presented. For example, in response to the word 'banana', you might think of the word 'fruit' or the word 'yellow'. When you have thought of a word you are to say it aloud. I will record each cue word on a response sheet. After you have stated a descriptor for the word, you are to immediately go to the next word on the list by clicking the mouse once. If you fail to generate a cue word in the 90-second time period, the computer will automatically go to the next word. You may withdraw from the task at any time. Do you have any questions? Let's start by doing several practice items.

APPENDIX G

Recognition Test - Autobiographical Support Condition

1. **MOTHER** FATHER SISTER
2. SILVER **GOLD** BRASS
3. DOG COW **HORSE**
4. **COTTON** WOOL LINEN
5. ORANGE **APPLE** PEACH
6. CLUB SWORD **RIFLE**
7. **STORM** CLOUD RAINBOW
8. LYING **THEFT** CHEATING
9. DENTIST LAWYER **TEACHER**
10. **FLU** COLD MEASLES
11. ATTIC **BASEMENT** CEILING
12. BOOTS SKIS **SKATES**
13. **GUITAR** FLUTE PIANO
14. PEPPER **SUGAR** SPICE
15. EYE MOUTH **TOOTH**
16. **WAGON** TRACTOR SLED
17. GLOVES **COAT** PANTS
18. BIOLOGY SCIENCE **MATH**
19. **HOUSE** APARTMENT HOTEL
20. LAKE **OCEAN** RIVER
21. MIRROR STOOL **LAMP**
22. **HOCKEY** SOCCER BASKETBALL
23. CAR **BIKE** TRUCK
24. MOSQUITO FLEA **WASP**
25. **LETTER** PAPER JOURNAL
26. SYMPHONY **CONCERT** OPERA
27. PEARL OPAL **DIAMOND**
28. **WINE** BEER BRANDY
29. DAFFODIL **TULIP** ORCHID
30. TANGO BALLET **WALTZ**

Recognition Test - Semantic Support Condition

1. **RUBY** GARNET SAPPHIRE
2. NEWSPAPER **BOOK** MAGAZINE
3. COLONEL SERGEANT **CAPTAIN**
4. **FORK** KNIFE SPOON
5. SHRINE **CHURCH** TEMPLE
6. BUS SAILBOAT **AIRPLANE**
7. **HAMMER** CHISEL WRENCH
8. COAL **GAS** WATER
9. ANKLE TOE **KNEE**
10. **COFFEE** TEA MILK
11. DIME **PENNY** NICKEL
12. BALLOON GAME **DOLL**
13. **SPIDER** ANT WORM
14. DAISY **ROSE** LILY
15. FOOTBALL TENNIS **GOLF**
16. **OAK** ELM MAPLE
17. ROBIN **SPARROW** BLUEJAY
18. CHAIR BED **TABLE**
19. **WHALE** DOLPHIN SHARK
20. POTATO **CARROT** CORN
21. TIGER BEAR **LION**
22. **PLUM** CHERRY GRAPE
23. SPEAR **ARROW** STICK
24. FARMER SALESMAN **NURSE**
25. **MOUNTAIN** VALLEY CANYON
26. DRESS **SHIRT** SHORTS
27. GOVERNOR SHERIFF **MAYOR**
28. **JAZZ** CLASSICAL BLUES
29. HUT **IGLOO** CAVE
30. IRON STEEL **TIN**

Note. Words in boldface type represent the correct word from the list.

APPENDIX H

Participant Debriefing

The purpose of the study is to examine personal memory as an aid to improve word recall for older adults. In this study we compared two memory cueing strategies: the ***memory cue task*** (in which you were asked to retrieve a personal memory for each word), and the ***descriptor cue task*** (in which you were asked to state a descriptor for each word). Our theory is that the memory cues will be more effective than the descriptor cues because they are personal and more meaningful than general descriptors. Research has shown that personal memories tend to be fairly well-preserved in people with early-stage Alzheimer's and in healthy older adults.

In this study we are also comparing the effectiveness of the memory cues for a group of people with mild-stage Alzheimer's and a group of older adults without Alzheimer's. We want to see if this memory aid benefits them to the same or differing degrees.

Past research has shown some improvement in recall for people with mild-stage Alzheimer's when support is provided at learning and at time of recall. The memory cue technique has not been used in previous studies as a method to improve word recall. This study represents a possible new direction in research on memory support and Alzheimer's.

Thank you very much for taking part in this study. The study will provide knowledge about new ways to improve memory performance in older adults and in adults with early Alzheimer's. Do you have any questions that I can answer right now? If you have any questions later on about the study, please contact Karen Cochrane at 492-7602. If you have general questions about the study you may also contact Dr. Roger Dixon in the Department of Psychology at 492-5850.