Autobiographical Memory in Mild and Moderate Dementia of the Alzheimer's Type.

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AUTOBIOGRAPHICAL MEMORY IN MILD AND MODERATE DEMENTIA OF THE ALZHEIMER'S TYPE

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in

The Department of Psychology

by

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# Table of Contents

Acknowledgments ................................................................................................................... ii

List of Tables ........................................................................................................................... v

List of Figures ......................................................................................................................... vi

Abstract .................................................................................................................................. vii

Introduction ............................................................................................................................... 1

Review of the Literature ......................................................................................................... 5
  Description of the Disease .......................................................................................... 5
  Neuropathology ............................................................................................................. 6
  Prevalence ....................................................................................................................... 8
  Diagnosis ......................................................................................................................... 9

Etiology of AD ....................................................................................................................... 12
  Genetic ............................................................................................................................. 12
  Transmissible Agents ................................................................................................. 14
  Environmental Toxins ............................................................................................... 14
  Abnormal Proteins ....................................................................................................... 15
  Acetylcholine Theory ................................................................................................. 16
  Inflammatory Mechanisms ......................................................................................... 17

Risk Factors ............................................................................................................................ 18
  Age ................................................................................................................................. 18
  Family History ............................................................................................................... 18
  Gender ............................................................................................................................ 19
  Head Injury .................................................................................................................... 19
  Education ....................................................................................................................... 20
  Smoking ......................................................................................................................... 21
  ε4 Allele of the Apolipoprotein E Gene .................................................................... 21
  Other ............................................................................................................................. 22

Other Changes ....................................................................................................................... 23
  Behavioral ....................................................................................................................... 23
  Psychiatric ...................................................................................................................... 23
  Attention ........................................................................................................................ 24
  Olfaction ......................................................................................................................... 25
  Visuospatial Functions, Construction, and Praxis ..................................................... 25
  Language ....................................................................................................................... 26
  Memory ........................................................................................................................... 27

Autobiographical Memory ..................................................................................................... 33

Present Study .......................................................................................................................... 43
  Temporal Gradients ....................................................................................................... 43
  Fractionation of Remote Memory ............................................................................... 44
## Table of Contents

Anterograde and Autobiographical Memory ........................................................... 44  
Semantic and Autobiographical Memory .............................................................. 45  
Autobiographical Incidents and Personal Semantic Memory ................................ 46  
Hypotheses ............................................................................................................. 47  

Method .................................................................................................................. 49  
Subjects ................................................................................................................ 49  
Materials ................................................................................................................ 51  
  Mini-Mental State Examination ..................................................................... 51  
  Autobiographical Memory Interview .......................................................... 52  
  Controlled Oral Word Association ............................................................... 53  
  Famous Faces ................................................................................................. 53  
  Babcock Story Recall Test ........................................................................... 55  
  WRAT3 Reading Subtest .............................................................................. 56  
Procedure ............................................................................................................. 56  

Results .................................................................................................................. 58  
Tests of Hypotheses ............................................................................................. 58  

Discussion .......................................................................................................... 76  
Specific Findings ................................................................................................. 76  
General Observations .......................................................................................... 84  

References ............................................................................................................ 87  

Appendix A: NINCDS-ADRDA Criteria for Clinical Diagnosis of Alzheimer’s Disease .............................................................................. 101  

Appendix B: Autobiographical Memory Interview .................................................. 104  

Appendix C: Consent Forms .................................................................................. 106  

Vita ......................................................................................................................... 111
List of Tables

1. Reliability Coefficients for the Autobiographical Memory Interview ......................... 54
2. Demographic Information and Test Scores ............................................................... 59
3. Overall Performance on Autobiographical and Remote Memory Tests..................... 60
4a. Age Adjusted Scores for Autobiographical Incidents of the AMI ......................... 62
4b. Scores for Autobiographical Incidents of the AMI ................................................. 62
5a. Age Adjusted Scores for Personal Semantic Memory of the AMI ......................... 65
5b. Scores for Personal Semantic Memory of the AMI ............................................... 65
6a. Age Adjusted Scores of Percentage Correct for Life Periods of the Famous Faces Test ................................................................. 68
6b. Percentage Correct for Life Periods of the Famous Faces Test ............................... 68
7. Correlations for Famous Faces with Autobiographical Incidents and Personal Semantic Memory for AD Participants ......................................................... 71
8. Correlations for Delayed Story Recall with Autobiographical Incidents and Personal Semantic Memory for the Four Experimental Groups ...................... 72
9. Correlations for Semantic Category Fluency with Autobiographical Incidents and Personal Semantic Memory for AD Participants ........................................... 74
10. Correlations for Autobiographical Incidents and Personal Semantic Memory for the Four Experimental Groups ................................................................. 75
List of Figures

1. Autobiographical Incidents ............................................................... 63
2. Personal Semantic Memory ................................................................. 66
3. Famous Faces ..................................................................................... 69
Abstract

Alzheimer's disease (AD) is a progressive disease that particularly affects memory with difficulties starting insidiously and gradually progressing. Anterograde amnesia for semantic and episodic types of declarative knowledge becomes the most prominent and disproportionately impaired cognitive symptom. By the middle stages of the disease, this memory loss progresses to severe impairment. The neuropathology of early AD involves the hippocampal complex, which is involved in new learning and storage of recent experiences. As the disease progresses, it involves neocortical areas, which are involved in the storage of more remote memories.

Participants, including minimal stage AD, mild stage AD, moderate stage AD, and normal controls were interviewed using the Autobiographical Memory Interview (AMI), which consists of an autobiographical incidents component and a personal semantic component. They were also administered a brief mental status exam and tests of remote memory, anterograde memory, semantic category word fluency, and reading. Autobiographical memory was impaired in all three groups of AD patients. There was a temporally graded loss (poorer recall of recent than childhood memories) for the minimal and mild AD groups on the autobiographical incidents schedule of the AMI. The moderate group showed equal impairment across life periods. On the personal semantic memory schedule of the AMI, the mild and moderate AD groups showed a temporal gradient. Remote public memory was also impaired in all three groups of AD patients. All AD groups performed worse on the recent life period than on earlier time periods.

Overall, there were low correlations between remote public memory and autobiographical memory for the AD groups, supporting the separability of these
subcomponents. Deficits in autobiographical memory were significantly correlated with anterograde memory deficits when AD patients reached the moderate stage of disease. There was an increasing correlation between category fluency and autobiographical memory across groups from the minimal to the moderate AD group, lending support to concurrent deterioration of both semantic and autobiographical memory as the disease progresses. This pattern also fit the correlation between the two schedules of the AML, autobiographical incidents and personal semantic memory.
Introduction

There has been an upward trend in life expectancy during this century, which has led to a significant increase in the elderly population. Unfortunately, along with this increase there has also been an increase in prevalence of conditions generally associated with aging, such as dementia. Dementia is defined as an acquired persistent impairment of intellectual function produced by brain dysfunction (Cummings & Benson, 1992). There is compromise in at least three of the following areas: language, memory, visuospatial skills, emotion or personality, and cognition (i.e., abstraction, calculation, judgment, executive function). The specification that the intellectual impairment be acquired differentiates dementia from the congenital mental retardation syndromes. The criterion includes “persistence” to exclude confusional states often found in acute traumatic, metabolic, and toxic disorders. Patients with relatively isolated neuropsychological deficits are excluded, but it should be recognized that few, if any, dementias are actually global. Identifiable neuropsychological patterns within the dementia syndromes are discernible by looking at the retention of specific intellectual functions versus the decline of others (Cummings & Benson).

More than 50 disorders may cause dementia (Katzman, 1986) including Alzheimer’s disease, vascular disease, Pick’s disease, Cruetzfeld-Jakob’s disease, Korsakoff’s syndrome, Huntington’s chorea, Parkinson’s disease, multiple sclerosis, and myasthenia gravis (Kolb & Wishaw, 1990). The prototype for a dementia syndrome is Alzheimer’s disease (AD), a chronic, progressive, and irreversible global impairment of intellect, especially in the elderly (Mahler & Benson, 1990). AD is the
most common cause of dementia with an estimate of over 65% of the people with dementia (Terry & Katzman, 1992; Kolb & Wishaw). A recent epidemiological study found the rate to be even higher in a sample of individuals with moderate to severe cognitive impairment with 84.1% having AD, 7.1% with concomitant AD and another dementing illness, and 8.8% with a different type of dementia (Evans et al., 1989). For people age 65 years and older, the prevalence of probable AD is estimated at 10.3% (Zec, 1993). AD patients make up more than 60% of the patients in nursing homes and various chronic care hospitals (Kolb & Wishaw) and account for between 120,000 and 200,000 deaths per year (Katzman et al., 1988). The prevalence of AD is expected to triple by the year 2050 if prevention or effective treatment is not discovered (Terry & Katzman). In 1990, the annual cost of AD in the United States was over $80 billion.

Impaired memory is the cardinal feature of Alzheimer's type dementia. Yet memory is a heterogeneous entity composed of various distinct but interacting systems and subsystems (Heindel, Salmon, & Butters, 1993). The usual initial presentation is with impairment of anterograde episodic memory. With progression of AD, there is impairment of many subsystems of memory including episodic, semantic, working and remote. The stage at which these subsystems become involved and the degree of involvement are uncertain. There has been relatively little research in remote memory, and these studies concentrated on memory for public events and famous faces (Sagar, Cohen, Sullivan, Corkin, & Growdon, 1988). Within the domain of remote memory, there has been little knowledge of autobiographical memory in Alzheimer's dementia until recently. Little systematic research has been conducted
pertaining to the effect of dementia on the accessibility of a person's past history.

Normal elderly people have knowledge of their own lives that gives them a cognizance of having a past history that is uniquely their own. When a person develops Alzheimer's dementia, this knowledge, integral to self-identity, becomes endangered.

Most of the few studies that have looked at autobiographical memory in AD have used the Crovitz technique, which asks subjects to respond to a cue word with an incident from autobiographical memory (Crovitz & Schiffman, 1974). One study, which used the Autobiographical Memory Interview, did find impairment relative to controls (Kopelman, 1989). This instrument, which divides the life span into three parts, also found evidence of a gentle temporal gradient revealing a relative preservation of more distant memories. Since the Kopelman study did not separate the AD participants into severity stages, it was not possible to tell at what stage of the disease autobiographical memory becomes impaired. A more recent study did divide patients into minimal and mild groups (Greene, Hodges, & Baddeley, 1995) and showed significant differences between both patient groups and controls but no difference between the two patient groups. It is commonly believed that AD spares remote memory in the early stages of the disease, but this study found impairment in the minimal group comparable to the impairment of the mild group. This suggests that neuropathology had expanded by the time their patients were identified clinically. Greene et al. did not find a temporal gradient for personal semantic memory portion of the AMI, but did find one for the autobiographical incidents component. One could suspect that as the degenerative neuropathology progresses, the temporal gradient will
disappear, and the retrograde amnesia may become equal across all past decades. The present study will investigate whether the distribution of memories across the life span is differentially affected in the minimal, mild, and moderate stages of Alzheimer's disease. This study may increase knowledge about the progression of memory problems in AD, and subsequently lead to the development of more effective interventions for patients and their families.
Review of the Literature

Description of the Disease

By the 1800's, it was noted that the brains of individuals with senile dementia showed cortical atrophy and ventricular dilation (Kolb & Wishaw, 1990). In 1892, Blocq and Marinesco observed miliary lesions in senile brains; these lesions were named "senile plaques" by Simchowicz in 1910 (Adams & Victor, 1997). Alois Alzheimer, a German physician, described a case in 1907 as follows:

The first noticeable symptom of illness shown by this 51-year-old woman was suspiciousness of her husband. Soon, a rapidly increasing memory impairment became evident; she could no longer orient herself in her own dwelling, dragged objects here and there and hid them, and at times, believing that people were out to murder her, started to scream loudly. On observation at the institution, her entire demeanor bears the stamp of utter bewilderment. She is completely disoriented to time and place (as quoted in LaRue, 1992, p. 163).

After four years of progressive dementia, the woman died, and Alzheimer described the neuropathological findings as a presence of abnormal nerve cells that contained tangles of fibers and clusters of degenerative nerve endings (Zec, 1993). This presenile dementia came to be known as Alzheimer's disease, and disagreement ensued about whether the cognitive changes seen in the elderly were the same as those of younger patients. It was generally believed that dementia that began after age 65 was caused by vascular changes and was called "hardening of the arteries," though it is now commonly thought that Alzheimer's disease is a single entity affecting all ages but with a predilection for old age (Kolb & Wishaw; LaRue).

Alzheimer's disease is characterized by an insidious onset of mental changes and continuing decline, which causes a significant impairment in social or occupational functioning. The particular cognitive processes that are affected and the
severity of a particular cognitive dysfunction can vary, especially early in the course of this disease (Butters, Salmon, & Butters, 1994). A common pattern is the gradual development of forgetfulness and then word finding difficulties (Adams & Victor, 1997). Other cognitive deficits that may develop include dysphasia, dyscalculia, visuospatial orientation, and apraxia. As the disease progresses changes may be seen in motility, behavior, temperament, and conduct. Ultimately the patient may develop gait and motor disturbances and in time become mute and bedridden (American Psychiatric Association, 1994). In order to provide a broader delineation of AD, the etiology, diagnosis, and physical and psychological manifestations will be described.

Neuropathology. The brain of a person with Alzheimer's disease shows diffuse atrophy with narrowed cerebral gyri and widened sulci usually involving the frontal, temporal, and parietal lobes (Adams & Victor, 1997). The association cortices, the hippocampus and amygdala, and subcortical and brainstem nuclei that project to the neocortex are selectively affected, while the primary sensory and motor cortices, the basal ganglia, the thalamus, and the cerebellum are altogether or relatively spared (Parks, Haxby, & Grady, 1993). As the disease progresses, the cortex loses as much as one third of its volume (Kolb & Wishaw, 1990). The atrophy primarily affects gray matter but may also affect white matter (Lerner & Whitehouse, 1994).

The two most prevalent pathophysiological hallmarks of AD are senile plaques and neurofibrillary tangles (Lerner & Whitehouse, 1994). The one neuropathologic irregularity required for the diagnosis of definite AD is a number of amyloid plaques in excess of a particular cut-off value (Khachaturian, 1985). The cut-off is necessary
because these plaques, as well as neurofibrillary tangles, can also be found in normal aging. These senile or neuritic plaques are spherical structures consisting of an amyloid core encircled by glia and distorted nerve cell processes (Whitehouse, Lerner, & Hedera, 1993). The major protein of the core is β or A4 amyloid, a basically transmembrane portion of the amyloid precursor protein (APP; Lerner & Whitehouse). Amyloid is also deposited in the walls of small cerebral blood vessels near the plaques and diffusely throughout the cortex (Adams & Victor, 1989; La Rue, 1992).

Neurofibrillary tangles (NFT) are intracellular lesions of straight and paired helical filaments that are probably made up of tau, a microtubule-associated protein, and other proteins, such as ubiquitin (Whitehouse et al., 1993). It appears that NFT occur initially in medial temporal lobe structures, and as the severity of the disease increases, NFT can be found in association areas of the cortex (Hyman, Arriagada, Van Hoesen, & Damasio, 1993).

In addition, the nucleus basalis of Meynert, located in the basal forebrain beneath the globus pallidus, has about 75 per cent loss of neurons (Guyton, 1991). These neurons dispatch acetylcholine-secreting fibers to much of the neocortex. It is thought that the acetylcholine is involved in the neuronal mechanisms for storing and recalling memories. The nucleus basalis receives input signals from the limbic system, which provides the motivational drive for the memory process. The noradrenergic neurons of the locus ceruleus and the serotonergic neurons of the raphe nucleus are also reduced in number. Somatostatin and substance P are other neurotransmitters that are also deficient in Alzheimer’s disease. Additionally, there is loss of large cortical neurons and neurons of the hippocampus and entorhinal cortex.
This pattern may, in effect, "disconnect" the hippocampus from other brain regions. Vermersch, Scheltens, Barkhof, Steinling, and Leys (1993) found a significant reduction in the thickness of the corpus callosum in Alzheimer's patients. They speculated that the reduced cross sectional area of the corpus callosum is an indicator that reflects a loss of axons. DeKosky and Scheff (1990) found synaptic loss in the frontal cortex in Alzheimer's patients at early to middle stages, though they found an increase in the size of the remaining synapses. The progressive loss of synapses implies a reduction in overall connections and decreased potential for cellular interaction. Apparently, a compensatory response took place to enlarge the remaining synapses in order to increase synaptic capability. The synapses can maintain their total synaptic contact area up to a 30 to 35% loss of synapses. As the disease progresses and more synapses are lost, the total contact area cannot be preserved.

Prevalence. The prevalence of AD varies from 4.5% to 18.5% for people 65 years old and greater (Amaducci, Falcini, & Lippi, 1992). Variability in prevalence rates can be influenced by different definitions of the disease and different case ascertainment procedures. Some investigators include only individuals with moderate to severe AD while others include milder, therefore less certain, cases. The East Boston Study (Evans et al., 1989), which included less severe cases, reported that prevalence rates are strongly correlated with age, ranging from 3% in the 60-74 year old age group, 18.7% in the 75-84 year old group, and 47.2% for those over 85 years old. In the Framingham Study, Bachman and colleagues (1992) included only moderate to severe cases of AD and reported lower rates of AD, which they suggested
be interpreted as minimum rates. These rates also tended to increase with advancing age, with 0.6% of individuals between 65 and 69, 0.4% of those between 70 and 74, 2.1% of participants between 75 and 79, 7.2% of those from 80 to 84, and 13.1% of those from 85 to 93.

Of all prevalent cases of dementia, AD accounted for 65% of all cases in Shanghai (Zhang et al., 1990), 55.6% in the Framingham Study (Bachman et al., 1992), and 64% in Canada (Canadian Study of Health and Aging, 1994a). AD is becoming an increasingly common health problem due to the rapid growth of the older age groups of our population (Terry & Katzman, 1992). When these figures are applied to the population of the United States, estimates of 4 million people with AD are extrapolated (Lerner & Whitehouse, 1994). Others have estimated that 1.5 to 3 million individuals in the United States have the disorder (Terry & Katzman; Evans et al., 1989).

The incidence of dementia is difficult to estimate because the disease onset is insidious and may not be identified until the disease is more advanced (Amaducci et al., 1992). Incidence rates, like prevalence, increase sharply with age with estimates of 0.002 cases per 100 population for ages 40 to 60 years and 0.127 cases per 100 aged 60 years and older (Lerner & Whitehouse, 1994).

Diagnosis. There is no simple biological marker for reliable positive identification of Alzheimer’s disease. A confirmed diagnosis requires histopathological verification from biopsy or autopsy findings. To try to improve the diagnosis of dementia and provide some consistency, the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer’s Disease
and Related Disorders Association (NINCDS-ADRDA) formed the Work Group on the Diagnosis of Alzheimer's Disease. This group published inclusion and exclusion criteria for diagnoses of definite, probable, and possible AD (McKhann et al., 1984). The criteria are listed in Appendix A. For definite diagnosis of AD, it requires that all criteria for probable AD be met plus there must be histopathological evidence of the microscopic pathology of AD procured from an autopsy or biopsy. This diagnosis is seldom made during a person's life due to the invasive nature and subsequent risk of biopsy (Kaszniak & Christenson, 1994). A diagnosis of probable AD can be made for individuals with two or more areas of cognitive impairment, a history of gradual decline, and negative medical diagnostic findings for specific causes (McKhann et al.). Other clinical evidence that either raises doubts about the diagnosis or supports it is also given. The NINCDS-ADRDA criteria require that the dementia be established by clinical examination, documented by the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975) or some similar examination, and confirmed by neuropsychological tests. Possible AD can be diagnosed when the onset or course is atypical, a coexisting illness is identified, or a single progressive cognitive deficit is present.

The most commonly used diagnostic criteria for AD in North America are those in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994; Kaszniak & Christenson, 1994). These criteria require memory impairment in addition to one of the following cognitive disturbances: aphasia, apraxia, agnosia, or disturbance in executive functioning. These disturbances must significantly interfere with social or occupational
functioning, must not occur exclusively during the course of a delirium, and portray a significant decline from previous functioning. There must be an insidious onset and progressive course of deterioration, and all other possible causes of dementia must be excluded by history, physical examination, and laboratory tests.

Comparing the DSM-IV criteria with the NINCDS-ADRDA criteria, as Kawas (1990) did using the DSM-III-R criteria, they differ in that the latter do not require that memory necessarily be one of the two impaired areas of cognitive function, do require formal mental status and neuropsychological testing evidence of cognitive impairment, do not require specific evidence of decline in social or occupational functioning, and do not require the exclusion of other DSM-IV diagnoses, such as depression. With the NINCDS-ADRDA criteria, diagnostic accuracy confirmed at autopsy has run as high as 86% to 100% (Katzman, 1986; Katzman & Jackson, 1991; Martin et al., 1987; Morris, McKeel, Falling, Torach, & Berg, 1988; Tierney et al., 1988).

Clinical diagnosis relies on information from the patient and family history, a neurological examination, physiological and neuroradiographic studies, and laboratory assessments (Lezak, 1995). These tests are not sufficient to confirm a diagnosis of AD, but are necessary in order to rule out other causes of dementia, possibly reversible. On the average, the degree of atrophy detected on CT scans is greater for AD patients than for controls; however, early in the disease, the changes may not exceed those expected for age alone (Adams & Victor, 1997). With advanced AD, the lateral and third ventricles are enlarged to about twice normal size, and the cerebral sulci are widened. The most common electroencephalograph (EEG) finding for AD
patients is diffuse slowing, but, like the CT scan, there is much overlap with controls, particularly in mild dementia (La Rue, 1992). Basically the cerebrospinal fluid (CSF) is normal, although sometimes the total protein is slightly elevated (Adams & Victor).

**Etiology of AD**

The specific etiology of Alzheimer's disease is unknown. A variety of factors can contribute to the clinical-pathologic syndrome of Alzheimer's disease suggesting that AD is often a convergence syndrome, especially with later onset (Blass, 1993). There may be many underlying causes that combine in numerous ways in different patients. A number of theoretical models have been proposed and will be discussed briefly.

**Genetic.** A genetic contribution has been suspected since Meggendorfer in 1926 identified an autosomal dominant form of familial AD (as cited in Lerner & Whitehouse, 1994). In the 1980's a small number of large pedigrees were studied which revealed autosomal dominant inheritance over several generations (Kay, 1991). Patients in the autosomal dominant families tend to have a relatively early and consistent age of onset and severe course of disease (Blass, 1993). First-degree relatives of AD patients have an increased risk of developing AD (Breitner, Silverman, Mohs, & Davis, 1988; Hofman et al., 1989; Nalbantoglu, LaCoste-Royal, & Gauvreau, 1990). In families with later-onset disease, the cumulative incidence among first-degree relatives was 49% by age 87 (Breitner, Silverman, Mohs, & Davis). The genetic pattern may be hard to distinguish because affected individuals are at greater risk of having died of other causes before the age of prime risk for AD.
One twin study showed essentially the same concordance rates in monozygotic (41%) and dizygotic (40%) twins (Nee et al., 1987). In identical twins who are concordant, the age of onset of AD may differ by as much as six to fifteen years (Kay, 1989). This suggests that nongenetic factors are also involved in AD.

At this time genetic studies have identified mutations in three genes that are responsible for early-onset inherited AD. The genes are amyloid precursor protein (APP) on chromosome 21 (St. George-Hyslop et al., 1987), presenilin-1 on chromosome 14 (Schellenberg et al., 1992), and presenilin-2 on chromosome 1 (Levy-Lahad et al., 1995). APP leads to the formation of β or Aβ amyloid found in the core of senile plaques. The genetic mutation in Down's syndrome (DS) is also on chromosome 21. The brains of individuals with DS who live past age 30 show significant numbers of plaques and tangles in the cerebral cortex and hippocampus as well as a decrease in choline acetyltransferase (Wisniewski, Wisniewski, & Wen, 1985). Many individuals with DS go on to develop dementia at a relatively early age (Evenhuis, 1990; Holland & Oliver, 1995). The gene defect on chromosome 21 accounts for a small percentage of familial cases, whereas the gene mutations of chromosome 14 may be responsible for up to 80 percent of familial cases and chromosome 1 may account for the other 20 percent (Adams & Victor, 1997).

A region of chromosome 19 has been associated with late-onset familial AD (Pericak-Vance et al., 1991). One of the genes present in this region is apolipoprotein E. The presence of the ε4 allele of the APOE gene appears as a risk factor for late-onset sporadic AD (Brousseau et al., 1994).
**Transmissible Agents.** The theory that transmissible agents could cause AD was proposed because it was believed that viral infections were involved in other neurodegenerative conditions such as Creutzfeldt-Jakob disease (CJD; LaRue, 1992). CJD gives rise to a progressive subacute or chronic decline in cognitive or motor function and eventual death, and it was thought that because of this similarity there might be a virus involved in AD also. The agent that causes CJD was discovered not to be a virus but a protein particle called a prion (Prusiner & Hsiao, 1994). Prusiner and Hsiao propose that the amyloid of AD may be a collection of prions. Nonetheless, attempts to transmit AD to experimental animals have failed (Wurtman, 1985), and AD has not been found to be transmissible through routine personal contact or blood transfusions (LaRue). However, research gathered in the study of prion diseases may help to develop an effectual approach for discovering the etiologies and the molecular pathogenesis of AD (Prusiner & Hsiao).

**Environmental Toxins.** There has been substantial interest in the possibility that environmental toxins have a causative role in AD. The substance that has received the most attention is aluminum. Aluminum has been found in the neurofibrillary tangles of AD (Perl & Brody, 1980), and aluminum silicate is present in the core of neuritic plaques (Candy et al., 1986). In high concentrations, aluminum can produce toxicity through drinking water, and it has been found to be neurotoxic in animals (Blass, 1993). However, there is no evidence that the risk of AD is increased by exposure to such sources as aluminum antacids or even the large amount used in renal dialysis (Katzman, 1986), but an increased risk has been described with the use of aluminum-containing antiperspirants (Graves et al., 1990). The buildup of
aluminum in neurofibrillary tangles and plaques may simply mean that they have an affinity for aluminum (Wurtman, 1985). Furthermore, the neurofibrillary tangles produced by aluminum in the brains of animals have single-strand filaments instead of paired helical filaments and are found in different parts of the nervous system. More recently, the aluminum accumulation in AD has commonly been interpreted as secondary to some more basic process, possibly involving a breakdown of the blood-brain barrier (LaRue, 1992).

Abnormal Proteins. The clear pathologic changes in the AD brain are the abnormal proteins, the amyloid in the core of the neuritic plaque and the abnormal proteins that compose the paired helical filaments present in the neurofibrillary tangle (Katzman & Jackson, 1991). The neuritic plaque has a central core of fibrillar amyloid surrounded by degenerating neurites. Amyloid is a general term for a group of fibrillar proteins with a β-pleated structure. The precursor protein was identified in 1983 by Glenner & Wong and has become known as amyloid precursor protein (APP; Katzman & Jackson). It is coded by a gene on chromosome 21 and is one of the most prevalent proteins during fetal brain development. It has a trophic function in the adult brain, but its precise role is unknown. A role for amyloid in the early pathogenesis of AD is supported by studies of Down’s syndrome patients. DS individuals develop neuritic plaques and neurofibrillary tangles between 35 and 40 years of age. However, younger DS patients who have died at the age of 15 to 25 years frequently have focal deposits of the amyloid or APP called diffuse plaques, but no neurofibrillary tangles are present. It has been posited that these diffuse plaques may form 10 to 20 years before the Alzheimer process fully develops. This proposal
views the diffuse plaques as a precursor of this process that ultimately leads to the complete pathology of AD. A problem with this hypothesis is the fact that with DS patients diffuse plaques are found in the cerebellum as well as the parts of the brain affected by AD. The cerebellum does not usually develop the neuritic plaque that is diagnostic for AD (Katzman & Jackson). Another problem with this hypothesis is that neuritic plaques can be found in older adults without the clinical syndrome (Blass, 1993). Some of these elderly have displayed enough plaques at autopsy to meet neuropathologic criteria for AD but were cognitively intact on repeated testing premortem (Katzman et al., 1988).

Neurofibrillary tangles are bundles of fibrous proteins and most of the individual fibers consist of two filaments wrapped around each other to form a helix, hence their name of paired helical filaments (PHF). The main protein linked with PHF is tau, a microtubule-related protein (Katzman & Jackson, 1991).

Acetylcholine Theory. Of all the neurotransmitter changes in AD, the most remarkable are in the cholinergic system. Choline acetyltransferase (CAT) is the enzyme that is required to synthesize acetylcholine (ACh). In AD patients, CAT is reduced by as much as 90% in the cerebral cortex and hippocampus (LaRue, 1992). Biopsies show a reduction as early as the first year of symptoms (Katzman, 1986). In endeavors to increase ACh, precursors choline and lecithin have been tried, but these treatments were not successful (Katzman). Another approach has been to block acetylcholinesterase, which is responsible for the breakdown of ACh into its component parts, therefore increasing the availability of ACh within the synaptic cleft. This can be accomplished with the drug physostigmine, but its side effects far
outweigh the mild improvements that have sometimes been shown. Findings with the acetylcholinesterase inhibitor tetrahydroaminoacridine (THA or Tacrine) have been controversial (LaRue). However, there may be a subgroup of AD patients who improve with this treatment (Small, 1992). Focusing on ACh frequently overshadows the fact that there are decreases in other neurotransmitters as well.

**Inflammatory Mechanisms.** There has been some speculation that activation of inflammatory and immune mechanisms happens with the degenerative process in AD. Aisen and Davis (1994) state that sensitive serologic and tissue studies show evidence of inflammatory activity. This is a sign that a process is activating an acute phase response, which they theorize could be the degeneration of brain tissue. They propose that disruption of the blood-brain barrier could be significant in the beginning sequence in AD. One of the proteins identified in amyloid deposits is apparently not derived locally. Formerly safeguarded brain antigens may be exposed to the immune system if there is damage of the blood-brain barrier. Inflammatory and immune mechanisms may start this way and lead to destruction of brain tissue (Aisen & Davis). The prevalence of AD in rheumatoid arthritis patients is low; this leads to the hypothesis that arthritis medications like the non-steroidal anti-inflammatory drugs protect from AD (McGeer, McGeer, Rogers, & Sibley, 1990). In a co-twin control study of 50 elderly twin pairs with onset of AD separated by three or more years, the onset of AD was inversely associated with prior use of corticosteroids or nonsteroidal anti-inflammatory drugs (Breitner et al., 1994).
Risk Factors

AD can be looked at as a convergence syndrome with a variety of factors contributing to the clinical-pathologic manifestation (Blass, 1993). This disease is especially hard to study quantitatively due to problems in establishing the premortem diagnosis, the prevalence of confounding conditions in elderly people, the length of the illness, problems ascertaining the onset date, the intricacy of studying the inheritance of diseases of such late onset, and the complexities of cross-cultural studies of disorders of intellect (Friedland, 1994). Certain reputed factors commonly cited include age, family history of dementia, gender, prior head trauma, smoking, and level of education. The results of studies examining many, but not all, of these factors are often contradictory or inconclusive.

Age. Age is the major risk factor for AD, since the prevalence increases exponentially with age (Canadian Study of Health and Aging, 1994b; Evans et al., 1989; Fratiglioni et al., 1991; Katzman, 1986; Mortimer, 1990; Zhang et al., 1990). Nearly all studies show a steep increase in prevalence from middle age to older old age (LaRue, 1992).

Family History. Many researchers have observed an increased risk of AD in families with AD or other dementia in first-degree relatives (Canadian Study of Health and Aging, 1994b; Mayeux, Sano, Chen, Tatemichi, & Stern, 1991; Mendez et al., 1992; Prince, Cullen, & Mann, 1994; van Duijn et al., 1991). There appears to be an increased risk with increased number of first-degree relatives affected (Hofman et al., 1989; van Duijn et al.). The cumulative risk of AD for first degree relatives has been estimated to be 28.8% (Hocking & Breitner, 1995). One group investigated the
occurrence of AD in children where both parents were diagnosed with AD (Bird, Nemens, & Kukull, 1993). The prevalence of AD in offspring of affected couples was much greater than that in offspring in which one parent had AD or those in which neither parent had AD.

**Gender.** Research concerning the relationship between gender and the occurrence of AD shows that women appear to be at greater risk. Incidence rates of AD were consistently higher in females in all age groups in a study in Appignano, Italy (Amaducci et al., 1992; Rocca et al., 1990). Additionally, the Framingham Study found the prevalence rate of AD to be 30.1/1000 for women compared to 11.7/1000 for men (Bachman et al., 1992). Restricting cases to only those over 65 years old, the Canadian Study of Health and Aging (CSHA; 1994a) showed the prevalence of probable AD was 5.8% for women and 3.8% for men.

**Head injury.** Head trauma has been reported as a risk factor for AD in some studies (Graves, White, Koepsell, Reifler, van Belle, Larson, & Raskind, 1990; Heyman et al., 1984) but not confirmed by others (Chandra, Kokmen, Schoenberg, & Beard, 1989; Mendez et al., 1992). CSHA (1994b) found an increased risk of AD with head injury, although it was not quite significant. Because of the low statistical power of many case-control studies, Mortimer et al. (1991) re-analyzed the data from 11 of these studies using meta-analytical techniques. They only included studies whose cases had head trauma with loss of consciousness and whose controls were from the community. The pooled relative risk for AD following head trauma was 1.82, which supports an association between reported head trauma and AD.
Dementia pugilistica (DP) has the best established relationship between head trauma and degenerative neurological disorder (Mortimer et al., 1991). This syndrome can follow a career of professional or amateur boxing where repeated blows to the head are experienced. Neuropathologically, DP is characterized by a cavum septum, neuronal loss, cerebellar scarring, and intense neurofibrillary tangle formation in the cortex (Roberts et al., 1994). DP had been considered as distinctly different from other common dementias because there was indiscernible plaque formation. However, Roberts and his colleagues found that the brains of boxers with DP have large numbers of diffuse plaques containing β amyloid protein (βAP). They also found the tangles of DP to be indistinguishable from those in AD. In addition, βAP has been detected in the cortex of 30% of patients dying of a single incidence of severe head injury (Roberts, Gentleman, Lynch, & Graham, 1991). These researchers propose that head injury could, in some cases, activate the process of Alzheimer’s disease.

Education. In the CSHA (1994b), people with less education appeared to be at higher risk of AD, with the group at most risk being those with 0 to 6 years of education. A higher prevalence of dementia in less educated subjects was also found in studies in Shanghai, China (Zhang et al., 1990), and Appignano, Italy (Bonaiuto et al., 1990). This is supportive of Katzman’s reasoning that increased education may be protective against AD or may delay the onset of symptoms (1993). In their study of older Catholic nuns, Snowdon, Ostwald, and Kane (1989) found that the nuns who were college graduates were two to four times more likely to be functionally independent as they grew older than their sisters with less education. However, Fratiglioni and colleagues in Sweden (1991) did not find a prevalence difference for
AD between people with only elementary schooling and those with high school or university education. The Framingham Study (Cobb, Wolf, Au, White, & D’Agostino, 1995), the group from Rochester, Minnesota (Beard, Kokmen, Offord, & Kurland, 1992), and the United Kingdom Medical Research Council (Prince et al., 1994) also failed to detect this education effect.

**Smoking.** A decreased number of smokers among AD patients was first reported in 1981 (Graves et al., 1991). Cigarette smoking has been negatively associated with AD in many studies (Brenner et al., 1993; van Duijn & Hofman, 1991). In a collaborative re-analysis of several case-control studies, the EURODEM group found a statistically significant inverse association between smoking and AD with a trend towards decreasing risk with increasing consumption (Graves et al.). This suggests that smoking may have a protective effect (Friedland, 1994). On the other hand, the CSHA (1994b) found a slightly elevated risk for smoking and AD. The Medical Research Council of the United Kingdom also found an increased risk of AD in smokers (Prince et al., 1994).

In a review of studies on the use of nicotinic cholinergic agonists in therapy with AD, Whitehouse and Kalaria (1995) concluded that there are positive effects of nicotine on cognition in humans with and without AD. Nicotinic compounds may slow the progression of AD and other neurologic diseases.

**ε4 Allele of the Apolipoprotein E Gene.** An elevated risk of developing AD is linked with the ε4 allele of the apolipoprotein E gene (ApoE-ε4). In one study, the percentage of late-onset sporadic AD patients carrying at least one ε4 allele was 41.7% compared to 10.5% in controls (Brousseau et al., 1994). Using a Bayesian
analysis with data from eight studies on the ApoE-ε4 genotype, the risk of developing AD for unaffected 65 year olds with and without this allele was calculated to be 9% if no ApoE-ε4 is present and 29% for those with one ApoE-ε4 (Seshadri, Drachman, & Lippa, 1995). Because the prevalence of the ApoE-ε4 allele was found to be small in very old individuals who have remained cognitively intact, this allele is considered a strong risk factor for AD (Rebeck et al., 1994).

Other. Epidemiological studies have suggested other risk factors. As in several of the factors discussed above, findings are inconsistent, or they are preliminary, needing further investigation. The prevalence of AD in patients with rheumatoid arthritis has been reported as unexpectedly low, which leads to a hypothesis that medications such as nonsteroidal anti-inflammatory drugs (NSAIDs) give protection from AD (McGeer et al., 1990). CSHA (1994b) and the EURODEM group (Graves et al., 1991) both found an inverse relationship between AD and arthritis. In addition, the Canadians found a significantly low risk of AD with the use of NSAIDs. Onset was also delayed in those reporting sustained use of histamine blocking drugs.

Any association of glues, and pesticides and fertilizers with AD was confounded with education, and there was no association with antacids containing aluminum (CSHA, 1994b; Graves, White, Koepsell, Reifler, van Belle, & Larson, 1990). The picture is less clear with antiperspirants. Graves and colleagues found a modest increase in risk with aluminum-containing antiperspirants, while the CSHA found a slight, but nonsignificant, increase in risk.
Other Changes

Behavioral. Behavioral disturbance is a common feature of AD. These behaviors may be a more critical management problem than cognitive decline (Swearer, Drachman, O'Donnell, & Mitchell, 1988). They also have a significant impact on the daily life of AD patients and their caregivers and can lead to increased family burden, distress, and patient institutionalization (Teri, Borson, Kiyak, & Yamagishi, 1989). The most common symptoms are repetitive questions, losing or hiding things, lack of interest in daily activities, nocturnal wakefulness, unwarranted accusations, excessive daytime sleeping, pacing, repetitive actions, and verbal abusiveness or cursing (Baumgarten, Becker, & Gauthier, 1990). Another group found the most frequently occurring aberrant behaviors to be angry outbursts, dietary change, disordered sleep, paranoid thoughts and phobic ideas (Swearer et al.).

In managing behavioral problems such as fearfulness, agitation, and wandering, caregivers commonly use the following strategies: reduce or adjust the environmental stimulation to eliminate agitation, avoid reality orientation techniques, and provide verbal and/or nonverbal reassurance (Richter, Roberto, & Bottenberg, 1995). Enhancing caregivers' skills to manage behavior problems may prolong their ability to provide in-home care.

Psychiatric. There is a wide range of estimates regarding the frequency of depression in AD extending from 0% to 86%, although most fall within the 10% to 50% range (Gilley, 1993). Assessment of depression in AD is complicated by the overlapping symptoms that can be found in both disorders such as loss of interest, agitation, loss of insight, and sleep and appetite disturbances (Cummings & Benson,
Mild to moderate symptoms of depression may occur at nearly any time in the
disease course, but major depressive episodes seem to be rare. Although there are
exceptions, overall the incidence of depression decreases as severity of dementia
increases (Teri & Wagner, 1992).

Delusions and hallucinations are not infrequent in AD with approximately 50%
of patients experiencing delusion in the course of the disease (Cummings & Benson,
1992). Delusions are usually the persecutory type concerning infidelity of the spouse,
fears of personal harm, and theft of property. A recent study found that 20% of their
AD patients met criteria for delusional disorder with the most frequent types being
paranoid, hypochondriacal, Capgras syndrome (the false belief that someone has been
replaced by an identical-appearing impostor), house misidentification, and grandiose
delusions (Migliorelli et al., 1995).

Attention. In the early stages of AD, many patients do not display problems
with attention and perform quite well on tests such as Digit Span, Wechsler Memory
Scale Mental Control, and number cancellation (LaRue, 1992). However, as task
complexity increases and the disease progresses, so may deficits (Lezak, 1995). Tasks
requiring sustained attention to complex task demands and cognitive flexibility such as
Trail Making Test, Part B or the interference condition of the Stroop Color-Word
Interference Test may show impairment (LaRue). There are considerable individual
differences in attention.

Another aspect of attention that can become significantly compromised in AD
patients is self-awareness (Lezak, 1995). Diminished awareness of cognitive and
behavioral deficits, known as anosognosia, often develops in the early stages. Auchus,
Goldstein, Green, and Green (1994) found that unawareness of cognitive impairment was accompanied by visuoconstructive dysfunction and propose that this reflects involvement of the right cerebral hemisphere in the degenerative process. One study found that there was variability in awareness of deficits in different abilities with greatest impairment for recent memory and everyday activities, less impairment for attention, and none for remote memory (Green, Goldstein, Sirockman, & Green, 1993). It has been suggested that anosognosia is an important patient-care issue and improved assessment may facilitate patient management.

**Olfaction.** Perceptual dysfunctions in olfaction have been shown in AD patients with regard to detection, quality discrimination, recognition memory, and identification (Morgan, Nordin, & Murphy, 1995; Nordin & Murphy, 1996). Because odor identification tests have relied on lexical functioning as the response mode, Morgan et al. replaced words with pictures and still found impairment in odor identification. They also found that while odor detection does contribute to the odor identification deficit, it does not account for it completely. Odor identification tests had a correct classification rate of 83% to 100% when classifying AD patients and matched controls.

**Visuospatial Functions, Construction, and Praxis.** Visuospatial deficits may present practical problems for AD patients in their everyday life. They may get lost in familiar surroundings, lose their way while driving, become disoriented in their own homes, have trouble dressing, and have difficulty recognizing familiar faces (Cummings & Benson, 1992). In a study examining topographical orientation, AD patients performed more poorly on a wayfinding task than normal elderly controls,
with all AD patients failing to reach the destination and return to the point of departure without errors (Passini, Rainville, Marchand, & Joanette, 1995).

As the disease progresses, the inability to copy designs declines from complex geometric figures and three-dimensional representations to simple elementary figures (LaRue, 1992). Perseverations are common in AD patients' drawings. On the WAIS-R, they typically obtain one of their lowest scores on the Block Design subtest. AD patients with prominent impairment on Block Design often show severe hypometabolism as measured by PET scans of the right posterior parietal lobe (LaRue; Zec, 1993).

Ideomotor and ideational apraxia occur later in the course of AD with limb transitive movements being especially impaired (Zec, 1993). Since ideational apraxia involves impaired tool use, it can have a particularly adverse effect on functioning in the home and thus can be a serious management issue.

**Language.** Difficulty in word finding frequently occurs early in the course of AD and may be manifested in several ways, including frequent circumlocutions, semantic paraphasias, use of vague superordinate or generic words, and explanatory paraphrasing (Zec, 1993). Lexical access problems in early AD can be measured by verbal fluency tasks. Qualitative and quantitative changes in fluency have been noted in AD (LaRue, 1992). Recent studies have found category fluency to be superior to other verbal fluency measures (letter, first names) for discriminating AD patients from elderly normal controls (Mickanin, Grossman, Onishi, Auriacombe, & Clark, 1994; Monsch et al., 1992). Monsch and colleagues concluded that this was because the structure of semantic knowledge deteriorates in the early stages of AD. Furthermore,
Mickanin et al. declared that deficits on measures of fluency in AD are due in large part to semantic memory impairments.

One of the most common complaints in patients with AD is a problem with naming ability (Hart, 1988). The Boston Naming Test has been found by some to be one of the best clinical measures for distinguishing mild AD and normal aging (Storandt & Hill, 1989). AD patients in the early stages of the disease can repeat words or phrases relatively well (LaRue, 1992). It has been reported that oral reading of single words can be done with remarkable accuracy which has led to the use of this task as an estimate of premorbid intelligence (Cummings, Houlihan, & Hill, 1986; Friedman, Ferguson, Robinson, & Sunderland, 1992). However, Patterson, Graham, and Hodges (1994) found that AD patients do have a considerable impairment in word reading, but only on low frequency, exception words. Specifically, on the National Adult Reading Test (NART; Nelson & O’Connell, 1978), AD patients showed a dramatic decrease as a function of disease severity. Overall, AD patients tend to perform better on auditory comprehension than reading comprehension, and reading for meaning is more likely to be impaired than reading aloud (Hart). As the disease progresses, comprehension deficits become more severe (Cummings & Benson, 1992).

Memory. Memory deficits are the most obvious of early symptoms in AD and have attracted the greatest amount of research attention (Lezak, 1995). The ability to recall or recognize information or events that are newly experienced is designated anterograde memory (Butters & Delis, 1995). A deficit in this area usually affects a wide variety of new learning. The ability to recall or recognize information or events...
that were encountered in the past is referred to as retrograde memory. The temporal dimension of retrograde amnesia usually makes a distinction between recent and remote memory with recent including the information acquired just prior to the onset of a memory disorder, and remote encompassing information regarding events or experiences acquired years or decades before the disorder began.

Another conceptual division of memory is declarative or explicit versus nondeclarative or implicit (Butters & Delis, 1995). Declarative or explicit memory is directly available to conscious awareness and includes the acquisition of facts, experiences, and information about events. Nondeclarative or implicit memory involves unconscious changes in task performance credited to previous exposure to information including procedural memory (skill and habit learning), some forms of classical conditioning, and priming (Heindel et al., 1993). AD impairs declarative memory but spares nondeclarative memory (Squire & Zola-Morgan, 1991). The medial temporal lobe, which is the site of early neuropathology in AD, is involved in only declarative memory.

Tulving (1972) further divided declarative knowledge into episodic and semantic memory. Episodic memory relates to a person’s personal record of events or episodes specifiable in time and place, memory for personally experienced events, while semantic memory refers to general knowledge of the world in terms of memory for facts, concepts, and language and is not linked to a particular temporal or spatial context (Tulving).

Poor learning and retention of information over time typify the memory problems of AD (Butters & Delis, 1995). Repetition over trials increases learning
very little, if any, and there is a tendency to display an exaggerated recency effect and a reduced primacy effect (Zec, 1993). Tests of delayed recall were found to be particularly useful in the early detection of AD (Welsh, Butters, Hughes, Mohs, & Heyman, 1992). Recognition memory is likewise impaired relatively early in AD, which suggests that the new learning disorder is one of information storage rather than retrieval (Zec).

AD patients also show deficits in retrograde memory. Ribot’s (1882) law of regression (as cited in Kopelman, 1989) proposed that the probability of forgetting an event is inversely related to the time since the occurrence of that event (i.e., poorer recall of recent compared to distant memories). This view implies that remote memory impairment involves a destruction of memory storage (Kopelman). There is interest from a theoretical point of view in the anatomical locus of the pathological changes in the early stages of AD including the subsequent pattern of spread. Braak and Braak (1991) found that the characteristic neurofibrillary tangles of AD earliest accumulation was in the transentorhinal cortex followed by the CA1 region of the hippocampus. The tangles later progress to involve limbic cortices, the amygdala, and eventually the isocortical areas with most marked involvement in the temporal lobe, the convexity of the occipital lobe, and the inferior parts of the frontal lobes. It follows that memory deficits would accompany these neuropathological changes.

Squire (1992) postulated that pathology confined to the hippocampus per se can produce moderately severe anterograde amnesia with temporally limited retrograde amnesia, in other words memory loss covering a limited time period premorbidly. However, more widespread damage involving parahippocampal
structures causes profound anterograde amnesia with a severe but temporally graded retrograde amnesia, greater loss for more recent premorbid information with decreasing loss further back in time. In other words, the hippocampus is involved in the establishing of new memories and their temporary storage, but over time these memories become independent of the hippocampus due to a process of reorganization or consolidation. There is increasing evidence that regions of the temporal neocortex may be a storage site for remote memories (Hodges, 1995). Structures in the nonmedial temporal region are important for the retrieval of previous learning (Tranel & Damasio, 1995). These structures are in the anterior, inferior, and lateral portions of the temporal lobe. The left nonmedial structures are specialized in the retrieval of lexical knowledge, and the right structures are key for knowledge such as faces and geographical routes. The anterior part of this right system may be important for the retrieval of unique personal information such as various entities and events that embody the autobiography of a person (Tranel & Damasio).

The remote memory impairment of AD has been less extensively addressed than the anterograde episodic memory impairment. Investigators have focused on the overall temporal pattern of performance, specifically whether AD patients show a preservation of more distant memories. Four studies have examined the ability of patients with AD to name photographs of famous people. Three of these studies used versions of the Boston Famous Faces Test (Albert, Butters, & Levin, 1979), and one used a modified and updated version of the Famous Faces Test used in Great Britain (Hodges & Ward, 1989). All have shown remote memory impairment in AD. While Wilson, Kaszniak, and Fox (1981) reported no difference in AD patients’ performance...
across the decades, the other studies found a significant temporal gradient with better performance on items from more distant decades (Beatty et al., 1988; Greene & Hodges, 1996a; Hodges, Salmon, & Butters, 1993).

Since the Wilson et al. (1981) study found only a slight and statistically insignificant trend for preservation of memories from the distant past, they concluded that the remote memory impairment of AD is not temporally graded. They reported that their AD sample “may be somewhat less intellectually impaired than are dementia patients in general.” However, they based this on the history provided by the families that the “patients had been exhibiting symptoms for an average of about two years” rather than on any psychometric test for classifying the stage of their illness. Some of their patients may have been in a more advanced stage of disease. Inasmuch as performance on remote memory tests is poor even in the early stages of AD, it is possible that a temporal gradient may be present in the early stages and disappear as the AD progresses. This possibility receives some support from the remaining three studies that showed a temporal gradient for remote memory.

Beatty et al. (1988) used a revised and updated version of the Boston Remote Memory Battery (Albert et al., 1979) consisting of two components, Famous Faces and Public Events Recall Questionnaire. Scores from the two components were combined for one remote memory score. Because of floor effects, these investigators included a standard set of semantic cues if the subject answered incorrectly or could not respond. This combined score for the uncued and the cued conditions was similar to the findings of Wilson et al. (1981) in that there was only a weak and insignificant trend for the relative preservation of very remote memories. They also examined the
proportion of items correctly answered by decades. These proportions were calculated by dividing the number of items answered correctly for each decade by the total number of items answered correctly for all decades combined. Using this proportional measure, the AD patients did show a temporally graded retrograde amnesia when semantic cues were provided.

Hodges et al. (1993) used the Boston Famous Faces Test to test for recognition of famous faces from among non-famous foils, naming, identification (i.e. the ability to provide specific details about unnamed faces), and cued naming using semantic and first name cues. They found impairment in all five conditions, with a temporal gradient for recognition and identification of famous faces, but not for naming. This study found a significant but modest degree of sparing of distant memories.

Greene and Hodges (1996a) using a British Famous Faces Test designed to assess face recognition, identification, and naming examined remote memory in 33 AD patients with Mini-Mental State Examination scores between 17 and 30. AD patients were impaired on all three components of the Famous Faces Test and demonstrated evidence of a mild temporal gradient in the naming condition, with relatively better performance for earlier decades.

Pictorial famous scenes tests have been used in two studies. Sagar et al. (1988) showed a striking impairment in the recall of information specific to each famous event with evidence of a temporal gradient showing better recall of older scenes. Kopelman (1989) also found that AD patients were severely impaired relative to controls on a similar British test, and they also showed a gentle temporal gradient with relative sparing of the most distant memories. Wilson, Kaszniak, and Fox (1981)
compared the performance of AD patients with age-matched normal controls on a famous events questionnaire test. AD subjects were severely impaired on this task with no evidence of a temporal gradient. The floor effect with the patient group could have obscured any temporal pattern. Likewise, Gade and Mortensen (1990) compared the scores of AD patients and patients with amnesia of various etiologies on a famous events questionnaire test with free recall and forced choice conditions. The AD group was severely impaired in both conditions, with no evidence of a temporal gradient.

As can be seen from examination of the patterns found by different researchers, there is variation of the remote memory impairment and the slope of the temporal gradient. These studies grouped all of their AD patients together. Only the Greene and Hodges study (1996a) restricted their patients on the basis of their MMSE score using only patients in what they called minimal and mild stages. Since remote memory tests reveal severe impairment even in the early stages of AD, it is possible that in the moderate to severe stages of AD the retrograde memory deficits become equal across all past decades of their lives (Butters & Delis, 1995) and thus produce a "flat" curve. In the earliest stages, there may be less involvement of the nonmedial temporal cortex pathologically and therefore a lesser degree of loss of older memories.

**Autobiographical Memory**

The term autobiographical memory has been used to describe a particular type of episodic memory that focuses on a person's own recent and remote personal experiences, as opposed to his or her performance on tests such as free recall or paired-associate learning (Baddeley & Wilson, 1987). In spite of its apparent importance in everyday life, autobiographical memory has been investigated very little.
in AD (Hodges, 1995). Most studies of autobiographical memory have used the Crovitz technique (Crovitz & Schiffman, 1974) which was derived from Galton's work in the 1870's (Kopelman, Wilson, & Baddeley, 1989). With this method, subjects are asked to describe and date an incident from autobiographical memories in response to a list of cue words. A major problem with this technique is that any temporal gradient found may relate to the subjects' bias to report memories from certain time periods rather than assessing their raw ability to do so (Kopelman et al.). Other problems in studies using the Crovitz test and measures of semantic memory to look at deficits in autobiographical and semantic memory are that the tests may not be matched in terms of the age at which the memories were acquired, their salience to the subject's life, or in the degree of their recent rehearsal. Using a modified Crovitz method, Sagar, Cohen, Sullivan, Corkin, and Growdon (1988) found that normal subjects showed a forgetting function across remote time periods so that more recent events were recalled more frequently. They reported that AD subjects with higher Blessed Dementia Scale Scores (higher indicates a greater degree of dementia; Blessed, Tomlinson, & Roth, 1968) recalled a greater proportion of their memories from the remote time periods than did patients with lower Blessed Dementia Scale scores, suggesting the temporal gradient for autobiographical memory steepens with dementia progression. However, in the analysis of the age of episodes recalled, data were used only for specific memories that were consistently recalled on two successive days of testing.

One other method that has been utilized in the study of autobiographical memory is that of free narratives, where participants are asked to recall important
events in their lives. This method has the potential problem of recall bias much as the
Crovitz method does. Fromholt & Larsen (1991) used this method to compare
autobiographical memory in older AD patients and matched controls (aged 71 to 89
years). The AD subjects were divided into three subgroups based on the severity of
their condition; each subgroup recalled a decreasing number of memories as dementia
progressed (means 13, 8.8, and 4.5). Each subject’s life span was divided into five
intervals. AD subjects recalled fewer memories from all the time intervals than
normal controls, but the overall shape of the distributions of the two groups was
similar. The number of memories recalled from each quintile (numbered
chronologically) of the normal control subjects were rank ordered as follows: 2 > 1 >
5 > 3 = 4. The quintiles for the AD participants were ordered 2 = 1 = 5 > 3 = 4. In the
first and second fifths of their life spans, the differences in number of memories
recalled between AD subjects and normal controls was more marked than in their
middle age and recent memories. Unfortunately these analyses were only reported for
all the AD participants grouped together. Had the AD subjects been divided into the
original three subgroups based on severity of condition, there could have been an
examination of the distributions at progressive stages of AD to see how they change as
the disease advances.

In their development of the Autobiographical Memory Interview (AMI; see
Appendix B), Kopelman, Wilson, and Baddeley (1990) endeavored to overcome the
problems previously mentioned: bias to report memories from particular time periods
rather than ability to do so, age at which memory was acquired may not match
occurrence of event, salience to an individual’s life, and degree of recent rehearsal.
The AMI has several benefits over other remote memory tests (Spreen & Strauss, 1998). It assesses information that any person is likely to have and is not dependent on a person’s interest in current affairs and tendency to read the newspaper or watch television. Nor does the test quickly become out of date and require restandardization.

This semi-structured interview consists of two components coming from the subdivision of autobiographical memory into personal semantic memory (e.g. name of elementary school) and autobiographical incident memory (e.g. memory of an event from elementary school). In a study comparing the performance of amnesic patients with healthy controls who did not differ in age or premorbid IQ, the total autobiographical incidents score and the total personal semantic score were significantly different for the two groups ($t = 6.69, p < .001$; $t = 6.93, p < .001$, respectively; Kopelman et al., 1989). The differences between the two groups were greater on these two scores than on the established remote memory tests of famous personalities and the Crovitz test in terms of the size and statistical significance of the $t$ values (famous personalities: $t = 3.14, p < .005$; Crovitz test: $t = 2.67, p < .05$).

Kopelman et al. (1989) found that patients with memory deficits showed reduced capacity for new learning and impaired remote memory when assessed with the AMI as well as other tests, such as the Logical Memory of the Wechsler Memory Scale, the Recognition Memory Test, the Rivermead Behavioral Memory Test, the Prices test, and the Crovitz Test of Autobiographical Memory. The remote memory tests correlated lowly to moderately with each other (.28 to .64), suggesting that the AMI and other retrograde memory tests are measuring similar but not identical components of memory. In addition, the AMI has greater face validity than the
Crovitz Test in that it asks subjects to recollect memories about commonly experienced events, instead of responding to a rather artificial list of cue words (Kopelman et al.).

The accuracy of recall was assessed by questioning relatives of the subjects. There was some inaccuracy and confabulation, but the amount was small (Kopelman et al., 1990). On examination of each subject's initial score compared to the modified scores following discussions with the relatives, it was observed that the discrepancies reflected a number of minor inaccuracies. Correlations between the two scores for the three time periods in the AD subjects were .99, .97, and .96.

Each component of the AMI assesses memories across the three broad time frames of childhood, early adult life, and recent events and facts. On both the autobiographical incidents component and personal semantic memory component, the controls in the Kopelman et al. (1990) study displayed a slight recency effect with better scores for the more recent memories and gradually decreasing scores to the earliest time period. The amnesic patients showed an overall decrement in performance on both tests and a "gentle" temporal gradient with relative sparing of the earliest memories. Kopelman's overall temporal gradient compared the childhood and recent life periods.

In another study, Kopelman (1989) assessed autobiographical memory using the AMI with Korsakoff (n = 16) and AD patients (n = 16). On the personal semantic memories, both patient groups were impaired across all earlier time periods. The healthy controls showed a recency effect while both the AD and Korsakoff groups showed just the opposite with better performance on earlier memories and scores.
decreasing to the most recent time period. There was a similar pattern for autobiographical incidents. AD subjects in this study had a mean duration of symptoms of 2.9 years (range 9 months to 6 years). Their scores on a memory and orientation questionnaire covered a wide range. It could be that if these patients were divided into stages of AD, a different temporal pattern might emerge for the groups on autobiographical memory.

In order to investigate this, Greene et al. (1995) divided their AD patient sample into two subgroups on the basis of their Mini Mental State Examination scores. The subgroups were designated as minimal for scores 24 to 30 (n = 17) and mild for scores 17 to 23 (n = 16). These investigators modified the questions for the late adulthood time period to try to assess memory for events occurring before the onset of AD (e.g., an incident occurring on holiday prior to onset of memory problems). On both components of the AMI, controls (n = 30) performed significantly better than both minimal and mild AD groups. The minimal group performed slightly better than the mild group on the personal semantic memory, but this was not statistically significant. There was no difference between the two patient groups on the autobiographical incident memory. There was no evidence of a temporal gradient for personal semantic memory, but there was a gentle temporal gradient present in the autobiographical incident memory. This gradient was present for both patient groups, but was significant only in the mild patient group. The recall of autobiographical incidents from late adulthood was significantly poorer than from childhood and early adulthood. In attempting to explain this temporal gradient, the authors stated that it could relate to the status of autobiographical memories of differing time periods.
within the episodic-semantic spectrum. Memories from more recent decades may be truly “episodic,” in that temporal and contextual cues are used in their retrieval. In contrast, older memories may have been retrieved more often, therefore losing temporal and contextual specificity and attaining features of semantic knowledge (Cermak, 1984). Retrieval of semantic memories may depend less on the limbic system (Greene et al.). In early AD, the perihippocampal pathology will impair episodic recent autobiographical memories, but older, more “semantic” memories will be relatively spared. This could possibly account for the temporal gradient.

Kopelman (1989) calculated a memory quotient (MQ) as an index of anterograde impairment using immediate and delayed story recall, object learning, and recognition memory for words and faces. MQ correlated significantly with the personal semantic memory performance \( r = .65, p < .01 \) and the autobiographical incidents \( r = .52, p < .05 \) in the AD subjects but not in the Korsakoff subjects \( r = .35, \text{ns}; r = .32, \text{ns}, \text{respectively} \). As Squire (1992) has proposed, based on the study of amnesic patients with anoxic damage confined to the hippocampus or extending to additional hippocampal-related structures, pure hippocampal pathology causes an anterograde amnesia by itself; but, as soon as other surrounding structures are involved, there is inevitably a combination anterograde-retrograde amnesia. Studies of remote memory in AD have involved patients with well established disease. Based on the distribution of pathology in AD, patients in the initial stages of AD should have relatively less impairment with retrograde memory while having relatively more impairment with anterograde memory and thus a reduced level of correlation between
the two. As the disease progresses, the correlation between the two will become stronger.

Butters, Granholm, Salmon, Grant, and Wolfe (1987) found that category fluency was more impaired than letter fluency in AD patients. They proposed that this difference was related to the deterioration of semantic knowledge. Because generating types of animals depends on knowledge of the characteristics that define the concept "animal," any loss of these defining attributes should result in fewer correct examples being produced in a fixed period of time. In contrast, since letter fluency tasks can be achieved with the use of phonemic cues, any breakdown in the structure of semantic knowledge should have relatively little effect on a patient's overall performance, especially in the early stages of the disease.

Mickanin et al. (1994) also found that AD patients were significantly more impaired in their semantic category naming than their letter fluency and that AD patients produced many semantic category violations. In order to further explore the "semantic deficit" hypothesis, this group assessed performance on nonverbal fluency tasks, including drawing examples of a semantic category (fruits, tools) and drawing designs that could not be recognized or named using only curvy lines. They found that fluency was significantly reduced on the nonverbal, semantically guided fluency drawing task and that the impairment on this task was significantly greater than on the nonverbal fluency drawing task that was not guided by a semantic target. AD patients' performances on a verbal semantic category task and the semantic category drawing task were significantly correlated. These findings support the assertion that a deficit in semantic processing contributes to the fluency impairment in AD.
As stated earlier, autobiographical memory has been subdivided into autobiographical incident memory and personal semantic memory. These subdivisions may have separate cognitive and neural support (Greene, Hodges, & Baddeley, 1995). It is possible that all personal memories are initially episodic in nature, but some episodic traces lose their contextual dependence when spontaneously recollected many times and obtain the generic organization of semantic knowledge (Cermak, 1984). Recall of personal semantic memory may be similar to recall of general semantic memory, but recall of autobiographical incident memory may entail a more active and reconstructive retrieval and recollection process (Greene et al., 1995). In a group of amnesic patients (n = 61), the personal semantic score correlated .603 (p < .001) with the autobiographical incidents score (Kopelman et al., 1990). When normal and memory impaired groups were combined (n = 95), the two subtests of the AMI correlated highly (r = .771, p < .001). According to Kopelman and his colleagues, this finding casts some doubt on the usefulness of a simple episodic/semantic distinction in characterizing the effects of organic amnesia. However, Paul, Blanco, Hames, and Beatty (1997) found that multiple sclerosis patients were significantly impaired on recall of personal semantic memories but not autobiographical incident memories on the AMI. Additionally, while these authors did not report specific correlations, they did report that none of the correlations computed on measures of cognitive performance were statistically significant (absolute value of r ranged from .00 to .35). This study lends some support to the distinction between personal semantic memory and autobiographical incident memory. Further support for this distinction comes from relatively selective deficits of incident...
memory (Hodges & McCarthy, 1993) and personal semantic memory (Hodges, Patterson, Oxbury, & Funnell, 1992).
Present Study

Personal memories are fundamentally important in many everyday cognitive activities (Webster & Cappeliez, 1993). Self knowledge acquired from past experience is used to sustain a coherent sense of self, integrate and comprehend new information, solve current problems, and guide planning for future actions. Assessment of autobiographical memory can be valuable in order to understand the nature of a memory deficit, to enable more adequate advice and counseling, and to provide an individual focus for ensuing management (Kopelman et al., 1990).

Temporal Gradients

It is evident from a review of the literature on remote memory in AD and more specifically autobiographical memory that there is considerable variation in the pattern of deficits. Some studies have found a steep temporal gradient with early memories being much greater than more recent memories while others have found a “flat” curve with equal memories across the life span. Most of these studies compared AD patients as a whole to normal control subjects and other neurological patients. AD patients were grouped together regardless of severity of illness, or attempts were made to use only patients in the early course of the disease. Only one study has divided the AD patients into subgroups, minimal and mild, based on the severity of their illness to examine the possible differences in temporal gradient of autobiographical memories (Greene et al., 1995). This study did find a temporal gradient for autobiographical incidents which was significant in the mild group but not in the minimal group. However, they did not find a temporal gradient for personal semantic memories. The present study was designed to examine the effects of the next stage of AD (moderate)
as well as the first two (minimal and mild) on autobiographical memory across the life span. This could help to elucidate when persons with AD lose their sense of who they are and were.

**Fractionation of Remote Memory**

As discussed above, there is now an appreciation that memory is not a unitary cognitive measure, but comprises several subcomponents. There has been a tendency to address remote memory in general. Less attention has been given to the possible fractionation of remote memory and its subcomponents. To study the relationship between public and autobiographical memory within remote memory, there was a comparison of performance across the life span on the autobiographical tests with that of performance on a more traditional remote memory test, Famous Faces (Albert, 1981). Kopelman (1989) used the famous personalities test which asks subjects whether they recognize names of people prominent in British life at some period from the 1930s on, names which are fictitious, and names of very famous people which do not contribute toward scoring. He found no correlation between the total scores on the famous personalities test and the personal semantic and autobiographical incidents schedules of the AMI. Greene and Hodges (1996) used a famous faces test with photographs of prominent public British figures who were famous sometime between the 1940s and 1980s. They also found no correlation between total scores on this test and the personal semantic and autobiographical incidents components of the AMI.

**Anterograde and Autobiographical Memory**

There is also the issue of how early in the course of the disease deficits in autobiographical memory can be detected, and hence the relationship of the
autobiographical memory impairment to anterograde memory impairment. As mentioned earlier, it is now established that the vast majority of AD patients present with episodic memory deficits. Impairment in delayed recall of verbal information is almost a universal manifestation of AD patients (Welsh et al., 1992). This impairment has been attributed to pathological changes in the transentorhinal region of the brain (Braak & Braak, 1991). The transentorhinal region is found between the entorhinal region and the adjoining temporal neocortex. Current evidence implicates the temporal neocortex as a crucial sight for the storage of our knowledge of the world and our past autobiographical experiences (Patterson & Hodges, 1995). It is unlikely that lesions limited to the transentorhinal region would disrupt autobiographical memory. When the disease progresses to involve the temporal neocortex, deficits in autobiographical memory should occur. The Kopelman study (1989) reported a significant correlation between an index of anterograde memory and personal semantic memory and autobiographical incidents. The present study compared performance on the two subtests of the Autobiographical Memory Interview to a test of anterograde memory, story recall, to examine the relationship between anterograde memory and autobiographical memory at the different stages of AD.

Semantic and Autobiographical Memory

Patients with AD show progressive disruption of semantic memory (Hodges & Patterson, 1995). Most researchers attribute this to a breakdown of semantic memory structure as illustrated by their marked impairment in category fluency tests (Chan et al, 1993; Hodges, Salmon, & Butters, 1992; Martin & Fedio, 1983; Mickanin et al., 1994). Greene et al. (1995) found a significant correlation between letter fluency
(FAS) and both the personal semantic subtest of the AMI ($r = .44, p < .05$) and the autobiographical incidents subtest ($r = .42, p < .05$). Retrieval of autobiographical memories involves active search mechanisms to locate, retrieve, and verify items (Greene et al.). Similarly, category fluency tasks call for the systematic retrieval of hierarchically organized information from semantic memory, but letter fluency can be accomplished by utilizing phonemic or lexical cues to direct the retrieval process (Hodges, Salmon, et al., 1992). Because of these more complex retrieval processes, the current study hypothesized that the correlation between category fluency and the components of the AMI would be even greater than that previously found with letter fluency. As general semantic memory is disrupted, autobiographical memory will be similarly disrupted. In order to explore the association between more general semantic memory and autobiographical memory, the present study examined the relationship between a semantic category verbal fluency test (animals) and the two components of the AMI.

**Autobiographical Incidents and Personal Semantic Memory**

The current study also looked at the relationship between personal semantic memory and autobiographical incidents in AD patients. As mentioned earlier, Kopelman and his colleagues found the two components were significantly correlated for a group of amnesic patients, while Paul and his colleagues found that they were not significantly correlated for a group of multiple sclerosis patients.

To examine the proportion of individual differences in one variable that can be associated with the individual differences in another variable, the size of the correlation coefficients were interpreted according to the recommendations of Hinkle,
Wiersma, and Jurs (1994) They suggested .90 to 1.00 be interpreted as a very high correlation, .70 to .90 as high, .50 to .70 moderate, .30 to .50 low, and .00 to .30 little if any correlation.

The present study looked at autobiographical incidents and personal semantic memory on the AMI as well as Famous Faces (dependent variables) across the three life periods: childhood, early adult life, and recent life. There were three AD groups and a normal control group (independent variables). The AD groups were classified by AD stages: minimal, mild, and moderate.

**Hypotheses**

1. Autobiographical incidents, personal semantic memory, and public remote memory (Famous Faces) performance of AD participants will be impaired compared to normal controls over the three life periods measured. Participants with minimal and mild AD will show a temporal gradient for autobiographical incidents, personal semantic memory, and Famous Faces with better retrieval of childhood memories than more recent memories. Those with moderate AD will show relatively equal impairment across time for autobiographical incidents as well as personal semantic memory and Famous Faces. Normal controls will show a temporal gradient with better retrieval for more recent information on all three measures.

2. Scores for the three life periods on the personal semantic memory and autobiographical incidents of the AMI will show little if any correlation with the Famous Faces test in AD participants.
3. There will not be a significant correlation between the anterograde memory test, Babcock story delayed recall, and the personal semantic memory or autobiographical incidents tests for AD patients in the minimal stage. However, there will be a significant correlation between the Babcock and the tests of the AMI for AD patients in the mild stage and an even stronger correlation for AD patients in the moderate stage.

4. Semantic category fluency will correlate significantly with personal semantic memory and autobiographical incidents in the three groups of AD participants.

5. Autobiographical incidents will correlate significantly with personal semantic memory in the three groups of AD participants.
Method

Subjects

A total of 60 individuals diagnosed with Alzheimer’s disease were participants in this study. Twenty of these persons were assessed to be in the minimal stage of AD, 20 were classified as mild stage AD, and 20 were in the moderate stage of AD. In order to ensure that there was sufficient statistical power to detect significant effects, a power analysis was conducted (Cohen, 1992). For the present study, with a large effect size (.40), power set at .80, and alpha level at .05, 18 subjects per group were required.

Thirty-three of the participants were recruited from NeuroMedical Center and one from Family Therapy in Baton Rouge, Louisiana. All patients referred to the Neuropsychology Department at NeuroMedical for a dementia evaluation between February, 1997, and February, 1998, were evaluated and included in the study if they met criteria. Subsequent to neuropsychological evaluation, the patients who were diagnosed with probable AD were included in this study. Most patients received physical, neurological, CSF serology and blood tests, and a CT or MRI scan to rule out other possible causes of dementia. Other participants had been previously diagnosed with probable AD by their physician and were recruited from Ollie Steele Burden Manor (n = 11) and St. James Place (n = 4) in Baton Rouge, Louisiana, Chateau D’Arbonne Nursing Home (n = 3) in Farmerville, Louisiana, and through the Alzheimer’s Association (n = 7). Individuals with additional diagnoses of Vascular Dementia, alcohol abuse, metabolic disorder, schizophrenia, or Parkinson’s disease were excluded. All AD participants had a reliable collateral available for interview,
including a spouse to whom the patient had been married for at least 10 years, a sibling or other close relative, a lifelong friend, or a child at least 21 years old. Because one section of the AMI has questions regarding high school, all participants were required to have some high school education.

In the group whose diagnosis might be most difficult to differentiate, the minimal group, 16 (80%) were evaluated at NeuroMedical Center where their assessment included neuropsychological testing. Of the remaining four participants in this group, one had previously been evaluated and diagnosed at NeuroMedical Center, one had been evaluated and diagnosed at Tulane Medical Center, one had been evaluated and diagnosed at another local neurology clinic, and one had been evaluated and diagnosed by a local gerontologist. Likewise 15 of the 20 participants in the mild AD group (75%) were evaluated at NeuroMedical Center during the course of this study, and their evaluation also included neuropsychological testing.

In addition, 20 normal elderly control subjects who agreed to participate were also assessed. The control participants were recruited from the relatives and friends of nursing students at Our Lady of the Lake Nursing College and from the community in the Baton Rouge, New Orleans, Shreveport, and Monroe, Louisiana, metropolitan areas. The controls were in good health and had no history of progressive memory or cognitive impairment. AD participants and controls were matched as closely as possible for age, education, and premorbid intelligence.

Prior to participation in this study, a letter of consent was read by or read to, agreed to, and signed by each participant and a family member or other responsible party (Appendix C).
Materials

In an attempt to minimize the mental and physical fatigue of the research participants, the tests were selected to maximize the amount of information obtained in as short a time as possible.

Mini-Mental State Examination. The Mini-Mental State Exam (MMSE; Folstein et al., 1975) is probably the most widely used brief screening instrument for dementia. This cognitive mental status examination includes 11 questions and requires approximately five to ten minutes to administer. Basic functions assessed include attention, memory, verbal functions, and construction. Scores below 24 are considered abnormal when screening for dementia (Folstein et al.), although it is now accepted that patients in the earliest stages of AD score higher than this (Welsh et al., 1992). High twenty-four hour test-retest reliability was found in the original study, .89 for the same examiner and .83 for different examiners (Folstein et al.).

The MMSE was used to determine the stage of dementia for this study. Welsh and colleagues (1992) used MMSE scores of 24 or greater for their “mild” AD group and scores between 19 and 23 for their “moderate” group. Greene et al. (1995) divided their AD subjects into two subgroups based on their MMSE scores. Since none of their subjects were considered severely demented, the two subgroups were designated minimal and mild, and the score ranges were 24 to 30 for minimal and 17 to 23 for mild. They chose the upper cut-off of 24 because this is conventionally regarded as the lower limit of normality. In another study, Hodges and Patterson (1995) divided their AD patients into three subgroups also on the basis of their scores on the MMSE. The score ranges for the three groups were 24 to 30 for “minimal,”
to 23 for “mild,” and 2 to 16 for “moderate.” The current study utilized a combination of these three studies for dividing subjects into subgroups. The “minimal” AD group consists of those with MMSE scores of 24 through 27, the “mild” group has scores between 19 and 23, and the “moderate” group has scores between 13 and 18. To assure no overlap between controls and the minimal AD group, controls had to score 28 or greater to be included.

**Autobiographical Memory Interview.** The development of this questionnaire (Kopelman et al., 1990) was in response to a need for standardization of the collection of autobiographical data and to render a range of time spans and item types (Lezak, 1995). The authors report that the test is simple and fairly rapid to administer, and patients typically find the test enjoyable and interesting. There are two sections, an autobiographical incidents schedule and a personal semantic memory schedule. Each one includes three questions from three time blocks: childhood (e.g., preschool, elementary school), early adult life (e.g., first job; marriage in 20s), and recent events (e.g., a recent visitor, a recent holiday). When patients cannot respond to a question, prompts are given. On the autobiographical incidents schedule, responses are scored on a scale of zero to three which takes into account the clarity and specificity of the response so that the maximum score for each time block is nine. Each of the three sections of the personal semantic memory schedule has a maximum score of 21 points.

Interrater reliability has been reported as high (Kopelman et al., 1990). Three independent raters scored written descriptions of memories recalled. Correlations between pairs of raters ranged from .83 to .86.
Information on test-retest reliability is not currently available (Spreen & Strauss, 1998). Since there was no published reliability data for the AMI, 14 participants were interviewed twice. Four subjects were from the control group and four were from the minimal patient group, while there were three subjects from the mild AD group and three from the moderate AD group. The time between interviews ranged from two weeks to four weeks. The reliability coefficients for the two components of the AMI, autobiographical incidents and personal semantic memory, for the three time periods and the total score were high ranging from .863 to .989 (see Table 1). This lends support to the stability of the AMI.

**Controlled Oral Word Association.** The Controlled Oral Word Association (COWA) was used to test word fluency for a semantic category. Participants were asked to name as many animals as they could in one minute. Psychometrics of word fluency tests are generally good. Spreen and Strauss (1998) report that interrater reliability is near perfect, and one year test-retest reliability in older individuals is approximately .70.

**Famous Faces.** The Famous Faces test from the Boston Remote Memory Battery (Albert et al., 1979) revised and updated version was given as a measure of remote memory. The test consists of black and white portrait photographs of persons who were best known during the 1920s, 30s, 40s, 50s, 60s, 70s, and 80s. The photographs include movie, stage, and television personalities, politicians and statesmen, and athletes. There are eight photographs from each decade with a total of 56 photographs. The participants were asked to name the person pictured first. If they were incorrect or could not name the person, a standard set of semantic cues was read.
Table 1

**Reliability Coefficients for the Autobiographical Memory Interview**

<table>
<thead>
<tr>
<th>Autobiographical Incidents</th>
<th>Childhood</th>
<th>0.941</th>
<th>p &lt; .001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Adult Life</td>
<td>0.863</td>
<td>p &lt; .001</td>
<td></td>
</tr>
<tr>
<td>Recent Life</td>
<td>0.979</td>
<td>p &lt; .001</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.972</td>
<td>p &lt; .001</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal Semantic Memory</th>
<th>Childhood</th>
<th>0.969</th>
<th>p &lt; .001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Adult Life</td>
<td>0.937</td>
<td>p &lt; .001</td>
<td></td>
</tr>
<tr>
<td>Recent Life</td>
<td>0.953</td>
<td>p &lt; .001</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.989</td>
<td>p &lt; .001</td>
<td></td>
</tr>
</tbody>
</table>
According to Beatty et al. (1988), the cueing procedure raises overall performance to avoid floor effects. Performance under the cued recall condition was the percentage of correct responses without cues and with cues combined. In order to compare the results with those of the Autobiographical Memory Interview, the decades were matched as closely as possible to the three time periods of the AMI for each participant. Childhood is matched to approximately 20 years old, adult is from roughly 20 years to 50 years old, and recent includes the 1980s decade. Because the time periods often had an unequal number of decades, a percentage correct score was calculated for each time period.

**Babcock Story Recall Test.** This test (Rapaport, Gill, & Schafer, 1968) was used to measure anterograde memory. A 21-unit story was read to the participants with an immediate recall afterwards. The story was then read to the participants again, and they were told they would be asked to remember the story again in a little while. Delayed recall was assessed after approximately 20 minutes. A reliability study used three raters and found interrater reliabilities for each combination of rater pairs were .79, .85, and .92 with the average score difference between raters being 0.97 ± 0.83 (Lezak, 1995).

Babcock’s story was used instead of the Logical Memory subtest from the Wechsler Memory Scale Revised (Wechsler, 1987) because, with its single reading of the story, the Wechsler format provides less of a learning test than does the Babcock (Lezak, 1995). Patients with a limited auditory span, or whose grasp of information as it is presented to them is restricted by slow processing, will register only a small portion of the story on hearing it read once. Immediate recall can assess for these
problems which then can be distinguished from defective learning by providing a second reading. Delayed recall will then give a better picture of learning capacity. Patients whose delayed recall drops significantly even with a second reading show an impaired recall capacity (Lezak, 1995). It may be noted that the Logical Memory subtest of the Wechsler Memory Scale-III (Wechsler, 1997) now includes a second reading of the stories.

**WRAT3 Reading Subtest.** The reading subtest from the Wide Range Achievement Test 3 (WRAT3; Wilkinson, 1993) was used to match participants on premorbid intelligence. Reading tests are sometimes used as estimates of premorbid intelligence because it is believed that reading remains relatively stable following cerebral injury or disease. Johnstone and Wilhelm (1996) recently evaluated the longitudinal stability of reading using the WRAT-R/3 for a mixed group of neurological and psychiatric patients. The average time from test to retest was approximately 28 months. They found that reading scores may be appropriate estimates of premorbid intelligence for individuals demonstrating intellectual decline or stability.

Reliability estimates are reported to be high with coefficient alphas ranging from .85 to .95 over the WRAT3 tests. Test-retest correlations with the second test administered about one month later range from .91 to .98.

**Procedure**

The majority of participants were tested beginning at 1:00 p.m. with a few others being tested in the afternoon from approximately 2:00 to 3:30. The remaining participants were tested in the morning beginning between 9:00 and 10:30. All
participants were administered the MMSE first to see if they met inclusion criteria. If they did not, testing was discontinued at this time. If they did meet criteria, the Autobiographical Memory Interview was conducted followed by the Babcock story initial reading, immediate recall, and second reading. The Famous Faces Test was given next with the delayed recall of the Babcock story being assessed after a 20 minute delay. Finally subjects were given the Category Fluency test (animals) and the WRAT3 reading subtest. Collaterals for the AD participants were asked to verify the information given during the Autobiographical Memory Interview.
Results

Initial analyses were conducted to obtain a description of the sample characteristics. A summary of demographic data and test scores is shown in Table 2. Comparisons of the four groups’ demographic data were performed using a one-way ANOVA to determine if there were significant differences between experimental groups. Experimental groups were equivalent in education and premorbid intelligence as measured by the WRAT3 Reading subtest. There were no significant differences between the minimal AD, mild AD, and normal control groups for age, however the moderate AD group was significantly older than the other three groups ($F = 11.255, p < .001$). Since AD is a progressive disease, it is not surprising that the moderate group would be older. Overall performance of the controls and AD participants on autobiographical and remote memory are shown in Table 3.

Tests of Hypotheses

Hypothesis 1 had two parts. The first stated that the three AD groups would be significantly impaired compared to the normal control group on personal semantic memory, autobiographical incident memory, and Famous Faces memory. The second part postulated that the minimal and mild AD groups would show better retrieval of more remote information than more recent information and that the moderate AD group would show equal impairment across the three time periods for all three measures. Normal controls were expected to show better retrieval for more recent information than more remote information. Because the moderate AD group was significantly older than the other three groups, repeated measures multivariate analysis
Table 2

Demographic Information and Test Scores

<table>
<thead>
<tr>
<th></th>
<th>Control Participants</th>
<th>Minimal AD Participants</th>
<th>Mild AD Participants</th>
<th>Moderate AD Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>20 (6 males)</td>
<td>20 (8 males)</td>
<td>20 (10 males)</td>
<td>20 (5 males)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>74.90 (6.67)</td>
<td>78.15 (8.34)</td>
<td>86.25 (6.93)</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>68-91</td>
<td>59-92</td>
<td>71-97</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>13.10 (2.25)</td>
<td>12.78 (1.82)</td>
<td>13.00 (3.03)</td>
<td>p &lt; .91</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WRAT3</strong></td>
<td>47.90 (5.05)</td>
<td>43.39* (5.71)</td>
<td>43.47* (5.75)</td>
<td>p &lt; .06</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(6.46)</td>
<td>(5.71)</td>
<td>(5.75)</td>
<td></td>
</tr>
<tr>
<td><strong>MMSE</strong></td>
<td>29.20 (0.77)</td>
<td>20.80 (1.24)</td>
<td>15.00 (2.36)</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Animals</strong></td>
<td>18.40 (3.72)</td>
<td>9.00 (3.83)</td>
<td>5.65 (5.43)</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Babcock Story</strong></td>
<td>8.15 (3.30)</td>
<td>3.65 (2.48)</td>
<td>1.60 (1.82)</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td><strong>Immediate</strong></td>
<td>3.60 (2.58)</td>
<td>1.15 (2.50)</td>
<td>0.50 (1.67)</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Delayed</strong></td>
<td>10.70 (3.91)</td>
<td>1.75 (2.40)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Mean based on n = 18 for the mild group and n = 19 for the moderate group due to visual difficulty.
Table 3

Overall Performance on Autobiographical and Remote Memory Tests

<table>
<thead>
<tr>
<th>AMI</th>
<th>Controls</th>
<th>Minimal</th>
<th>Mild</th>
<th>Moderate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autobiographical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidents</td>
<td>25.60</td>
<td>16.90</td>
<td>12.20</td>
<td>4.30</td>
</tr>
<tr>
<td>SD</td>
<td>(1.67)</td>
<td>(5.82)</td>
<td>(5.12)</td>
<td>(3.63)</td>
</tr>
<tr>
<td>Personal Semantic</td>
<td>60.18</td>
<td>50.30</td>
<td>39.68</td>
<td>24.40</td>
</tr>
<tr>
<td>SD</td>
<td>(3.33)</td>
<td>(5.80)</td>
<td>(11.10)</td>
<td>(10.99)</td>
</tr>
<tr>
<td>Famous Faces</td>
<td>57.25</td>
<td>26.00</td>
<td>20.87</td>
<td>5.21</td>
</tr>
<tr>
<td>SD</td>
<td>(19.90)</td>
<td>(13.94)</td>
<td>(17.21)</td>
<td>(9.65)</td>
</tr>
</tbody>
</table>
of covariance, using age as a covariate, was conducted. A 4 (group) by 3 (life periods) MANCOVA was conducted for each of the three measures.

For the autobiographical incident component of the AMI (see Table 4), the group effect was significant \([F (3,75) = 57.19, p < .001]\) but the life period effect was not significant \([F (2,74) = 0.72, \text{ ns}]\). However, there was a significant group by life period interaction \([F (6, 148) = 6.63, p < .001]\) indicating that temporal gradients differed between groups. For the between group differences, Sidak post hoc analyses showed that controls performed better than all three AD groups across all life periods with one exception. There was not a significant difference between the controls \((M_{\text{adj}} = 8.3)\) and the minimal group \((M_{\text{adj}} = 6.8)\) on the childhood life period. The minimal and mild AD groups differed significantly only on the recent life period. The moderate AD group performed significantly worse than all other groups across all life periods with one exception: there was not a significant difference between the moderate group and the mild group on the recent life period.

Trend analysis supported a linear trend with differing slopes for the group by life period interaction (see Figure 1). Sidak post hoc analyses were performed for each group. There were no differences across time for the control group. The minimal and mild AD groups showed a temporal gradient with performance significantly better on childhood events compared to recent events. For the minimal and mild groups, there was also a significantly better performance on childhood events \((\text{minimal } M_{\text{adj}} = 6.8, \text{ mild } M_{\text{adj}} = 5.5)\) compared to early adult life \((\text{minimal } M_{\text{adj}} = 5.2, \text{ mild } M_{\text{adj}} = 4.5)\) and early adult compared to recent \((\text{minimal } M_{\text{adj}} = 4.2, \text{ mild } M_{\text{adj}} = 2.1)\). The moderate group showed no significant differences across time.
Table 4a

*Age Adjusted Scores for Autobiographical Incidents of the AMI*

<table>
<thead>
<tr>
<th></th>
<th>Childhood</th>
<th>Early Adulthood</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Controls</td>
<td>8.30</td>
<td>8.39</td>
<td>8.27</td>
</tr>
<tr>
<td>SD</td>
<td>(1.27)</td>
<td>(1.06)</td>
<td>(1.17)</td>
</tr>
<tr>
<td>Minimal AD</td>
<td>6.80</td>
<td>5.24</td>
<td>4.22</td>
</tr>
<tr>
<td>SD</td>
<td>(1.15)</td>
<td>(0.84)</td>
<td>(0.83)</td>
</tr>
<tr>
<td>Mild AD</td>
<td>5.54</td>
<td>4.52</td>
<td>2.07</td>
</tr>
<tr>
<td>SD</td>
<td>(1.00)</td>
<td>(0.75)</td>
<td>(0.57)</td>
</tr>
<tr>
<td>Moderate AD</td>
<td>2.26</td>
<td>1.91</td>
<td>1.49</td>
</tr>
<tr>
<td>SD</td>
<td>(0.73)</td>
<td>(0.56)</td>
<td>(0.55)</td>
</tr>
</tbody>
</table>

Table 4b

*Scores for Autobiographical Incidents of the AMI*

<table>
<thead>
<tr>
<th></th>
<th>Childhood</th>
<th>Early Adulthood</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Controls</td>
<td>8.40</td>
<td>8.65</td>
<td>8.55</td>
</tr>
<tr>
<td>SD</td>
<td>(0.82)</td>
<td>(0.67)</td>
<td>(0.60)</td>
</tr>
<tr>
<td>Minimal AD</td>
<td>6.90</td>
<td>5.50</td>
<td>4.50</td>
</tr>
<tr>
<td>SD</td>
<td>(1.77)</td>
<td>(2.28)</td>
<td>(2.87)</td>
</tr>
<tr>
<td>Mild AD</td>
<td>5.55</td>
<td>4.55</td>
<td>2.10</td>
</tr>
<tr>
<td>SD</td>
<td>(2.61)</td>
<td>(1.96)</td>
<td>(1.77)</td>
</tr>
<tr>
<td>Moderate AD</td>
<td>2.05</td>
<td>1.35</td>
<td>0.90</td>
</tr>
<tr>
<td>SD</td>
<td>(1.99)</td>
<td>(1.23)</td>
<td>(1.25)</td>
</tr>
</tbody>
</table>
Figure 1

Autobiographical Incidents
Table 5 gives the age adjusted and unadjusted scores of the four groups on the personal semantic component of the AMI. Again there was a significant group effect \[ F (3,75) = 39.37, \ p < .001 \] but not a significant life period effect \[ F (2,74) = 0.61, \ ns \]. Once more there was a significant life period by group interaction \[ F (6,148) = 3.64, \ p < .002 \], again indicating that temporal gradients differed between groups. Post hoc analyses for between group interaction differences revealed the same pattern between the controls and the AD groups as with the autobiographical incidents; controls performed significantly better than the mild and moderate AD groups across all three life periods. The controls' scores were significantly higher than the minimal AD group on the adult and recent life spans but not on the childhood life span. The pattern between the minimal and mild AD groups was also the same as with the autobiographical incidents; there was a significant difference only for the recent life span. The moderate AD group performed significantly worse than all other groups across all life periods.

For the interaction within groups, trend analysis once again showed a linear trend with different slopes (see Figure 2). Sidak post hoc analyses showed that the controls had no temporal gradient for the personal semantic component with no significant differences for recall across the three life periods. The minimal AD group did not show an overall temporal gradient (childhood vs. recent) but did perform significantly better on childhood memories (\(M_{adj} = 17.27\)) than on early adult memories (\(M_{adj} = 15.15\)). There was an overall temporal gradient for the mild group with scores being significantly higher on the childhood life period (\(M_{adj} = 14.99\)) than on the recent life period (\(M_{adj} = 11.44\)). Scores on the childhood segment were also
Table 5a

**Age Adjusted Scores for Personal Semantic Memory of the AMI**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Childhood</th>
<th>Early Adulthood</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Controls</td>
<td>19.27</td>
<td>19.53</td>
<td>20.17</td>
</tr>
<tr>
<td>SD</td>
<td>(3.79)</td>
<td>(3.09)</td>
<td>(3.84)</td>
</tr>
<tr>
<td>Minimal AD</td>
<td>17.27</td>
<td>15.15</td>
<td>15.87</td>
</tr>
<tr>
<td>SD</td>
<td>(3.59)</td>
<td>(2.72)</td>
<td>(3.41)</td>
</tr>
<tr>
<td>Mild AD</td>
<td>14.99</td>
<td>13.12</td>
<td>11.44</td>
</tr>
<tr>
<td>SD</td>
<td>(3.23)</td>
<td>(2.45)</td>
<td>(2.80)</td>
</tr>
<tr>
<td>Moderate AD</td>
<td>10.36</td>
<td>10.05</td>
<td>6.60</td>
</tr>
<tr>
<td>SD</td>
<td>(3.07)</td>
<td>(2.45)</td>
<td>(2.43)</td>
</tr>
</tbody>
</table>

Table 5b

**Scores for Personal Semantic Memory of the AMI**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Childhood</th>
<th>Early Adulthood</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Controls</td>
<td>19.63</td>
<td>19.83</td>
<td>20.75</td>
</tr>
<tr>
<td>SD</td>
<td>(2.61)</td>
<td>(1.26)</td>
<td>(0.79)</td>
</tr>
<tr>
<td>Minimal AD</td>
<td>17.63</td>
<td>15.45</td>
<td>16.45</td>
</tr>
<tr>
<td>SD</td>
<td>(4.20)</td>
<td>(2.47)</td>
<td>(2.81)</td>
</tr>
<tr>
<td>Mild AD</td>
<td>15.03</td>
<td>13.15</td>
<td>11.50</td>
</tr>
<tr>
<td>SD</td>
<td>(4.25)</td>
<td>(3.80)</td>
<td>(4.84)</td>
</tr>
<tr>
<td>Moderate AD</td>
<td>9.60</td>
<td>9.43</td>
<td>5.38</td>
</tr>
<tr>
<td>SD</td>
<td>(3.80)</td>
<td>(3.92)</td>
<td>(5.23)</td>
</tr>
</tbody>
</table>

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Figure 2

Personal Semantic Memory
higher than on the early adult life period but this difference only approached significance ($M_{adj} = 13.12; p < .057$). The moderate group also had an overall temporal gradient performing significantly better on the childhood portion ($M_{adj} = 10.36$) than on the recent life portion ($M_{adj} = 6.60$). They also scored significantly better on the early adult life period ($M_{adj} = 10.05$) than on the recent life period.

The age adjusted and unadjusted scores of the four groups on the Famous Faces test of remote memory are given in Table 6. This measure showed a significant group effect ($F(3,75) = 35.27, p < .001$) and a significant life period effect ($F(2,74) = 3.43, p < .038$). (See Figure 3.) The group by life period interaction was not significant for this instrument ($F(6,148) = 0.85, ns$). Using age adjusted marginal means, post hoc analyses showed that controls ($M_{adj} = 51.45$) performed significantly better than all three AD groups (minimal $M_{adj} = 19.71$, mild $M_{adj} = 17.65$, moderate $M_{adj} = 11.88$). There were no differences between the minimal, mild, and moderate groups. Post hoc analyses for the life period effect showed significant differences between the childhood ($M_{adj} = 30.24$) and the recent life periods ($M_{adj} = 16.41$) and the adult ($M_{adj} = 28.87$) and recent life periods. The difference between the childhood and adult periods was not significant. Trend analysis showed that the Famous Faces means fit a quadratic trend rather than a linear trend.

Overall the first part of hypothesis one was supported with the normal controls performing significantly better than the three Alzheimer’s groups on eight of nine comparisons on both the autobiographical incidents and the personal semantic memory components. The hypothesis was not supported for the Famous Faces test since there was no group by life period interaction. The second part of the first
Table 6a

**Age Adjusted Scores of Percentage Correct for Life Periods of the Famous Faces Test**

<table>
<thead>
<tr>
<th></th>
<th>Childhood</th>
<th>Early Adulthood</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal Controls</strong></td>
<td>56.84</td>
<td>55.54</td>
<td>41.95</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(31.79)</td>
<td>(25.29)</td>
<td>(21.26)</td>
</tr>
<tr>
<td><strong>Minimal AD</strong></td>
<td>28.71</td>
<td>23.46</td>
<td>6.95</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(22.60)</td>
<td>(16.44)</td>
<td>(8.65)</td>
</tr>
<tr>
<td><strong>Mild AD</strong></td>
<td>21.93</td>
<td>21.91</td>
<td>9.11</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(19.11)</td>
<td>(15.38)</td>
<td>(9.59)</td>
</tr>
<tr>
<td><strong>Moderate AD</strong></td>
<td>13.48</td>
<td>14.56</td>
<td>7.61</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(17.11)</td>
<td>(14.32)</td>
<td>(10.01)</td>
</tr>
</tbody>
</table>

Table 6b

**Percentage Correct for Life Periods of the Famous Faces Test**

<table>
<thead>
<tr>
<th></th>
<th>Childhood</th>
<th>Early Adulthood</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal Controls</strong></td>
<td>60.31</td>
<td>59.58</td>
<td>44.38</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(24.52)</td>
<td>(21.03)</td>
<td>(22.02)</td>
</tr>
<tr>
<td><strong>Minimal AD</strong></td>
<td>32.19</td>
<td>27.50</td>
<td>9.38</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(19.16)</td>
<td>(15.26)</td>
<td>(9.83)</td>
</tr>
<tr>
<td><strong>Mild AD</strong></td>
<td>22.31</td>
<td>22.36</td>
<td>9.38</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(20.33)</td>
<td>(16.74)</td>
<td>(15.64)</td>
</tr>
<tr>
<td><strong>Moderate AD</strong></td>
<td>6.15</td>
<td>6.04</td>
<td>2.50</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(10.80)</td>
<td>(12.05)</td>
<td>(7.69)</td>
</tr>
</tbody>
</table>

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Figure 3

Famous Faces
Hypothesis was supported for the autobiographical incidents with both the minimal and mild AD groups having significantly better retrieval of childhood memories than more recent memories. Also, as hypothesized, the moderate AD group showed relatively equal impairment across the life periods. Contrary to the hypothesis, the normal controls did not have better retrieval of more recent life memories than childhood but showed equal retrieval across life periods. For the personal semantic memory, the only component of the second part of the hypothesis that was supported was the significant temporal gradient of the mild AD group.

Hypothesis 2 proposed that different components of remote memory, as measured by the Famous Faces test and the two parts of the AMI, would show little if any correlation for the AD participants. Surprisingly there were significant correlations between the Famous Faces and both the personal semantic memory and the autobiographical incidents (see Table 7). However, five of the six correlations were low, and one was moderate.

Hypothesis 3 stated that there would be a significant correlation between a test of anterograde memory and both components of the AMI for the mild and moderate AD groups but not for the minimal AD group. This hypothesis was partially supported by the results of the correlation test. (See Table 8.) There was a significant correlation between the Babcock story delayed recall and both components of the AMI for the moderate AD group but not for the mild group. As predicted, the correlation for the minimal AD group was nonsignificant. Because of the severe early impairment of anterograde memory, it may be the moderate stage of AD before autobiographical impairment begins to "catch up" with anterograde impairment.
Table 7

**Correlations for Famous Faces with Autobiographical Incidents and Personal Semantic Memory for AD Participants across Life Periods**

<table>
<thead>
<tr>
<th>Famous Faces</th>
<th>Childhood</th>
<th>Early Adult</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autobiographical Incidents</td>
<td>.436*</td>
<td>.617*</td>
<td>.388*</td>
</tr>
<tr>
<td>Personal Semantic</td>
<td>.474*</td>
<td>.349*</td>
<td>.398*</td>
</tr>
</tbody>
</table>

*Correlation is significant at the .01 level.
<table>
<thead>
<tr>
<th>Autobiographical Incidents</th>
<th>Babcock Story Delayed Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Participants</td>
</tr>
<tr>
<td></td>
<td>Babcock Story Delayed Recall</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Participants</td>
</tr>
<tr>
<td>Autobiographical Incidents</td>
<td>.385</td>
</tr>
<tr>
<td>Personal Semantic Memory</td>
<td>.237</td>
</tr>
</tbody>
</table>

*Correlation is significant at the .01 level.
Hypothesis 4 stated that semantic category fluency as measured by animal naming would correlate significantly with personal semantic memory and autobiographical incidents for the AD groups. Correlations between these tests were performed, and there was found to be little if any correlation for the normal controls and minimal AD group but a significant moderate correlation for the mild group and a significant high correlation for the moderate group (see Table 9). This supports the hypothesis that as general semantic memory is progressively disrupted so is autobiographical memory.

To test Hypothesis 5, a correlation was performed between the personal semantic memory and autobiographical incidents schedules of the AMI for the four groups. This hypothesis was supported by the results of the correlation test (see Table 10). There was a significant correlation for each of the AD groups with the correlation becoming greater with each successive stage of disease. The minimal AD group had a low correlation, the mild group showed a moderate correlation, and the moderate group had a high correlation. This finding supports the worsening concurrent breakdown of both components of autobiographical memory in AD.
Table 9

Correlations for Semantic Category Fluency with Autobiographical Incidents and Personal Semantic Memory for the Four Experimental Groups

<table>
<thead>
<tr>
<th>Animals</th>
<th>Control Participants</th>
<th>Minimal AD Participants</th>
<th>Mild AD Participants</th>
<th>Moderate AD Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autobiographical Incidents</td>
<td>.328</td>
<td>.142</td>
<td>.637*</td>
<td>.793*</td>
</tr>
<tr>
<td>Personal Semantic Memory</td>
<td>.030</td>
<td>-.012</td>
<td>.569*</td>
<td>.802*</td>
</tr>
</tbody>
</table>

*Correlation is significant at the .01 level.
Table 10

Correlations for Autobiographical Incidents and Personal Semantic Memory for the Four Experimental Groups

<table>
<thead>
<tr>
<th></th>
<th>Control Participants</th>
<th>Minimal AD Participants</th>
<th>Mild AD Participants</th>
<th>Moderate AD Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autobiographical Incidents</td>
<td>.316</td>
<td>.498*</td>
<td>.611**</td>
<td>.740**</td>
</tr>
</tbody>
</table>

*Correlation is significant at the .05 level.
**Correlations are significant at the .01 level.
Discussion

Specific Findings

Results of this study have confirmed that minimal, mild, and moderate AD patient groups were impaired on autobiographical memory when compared to normal elderly controls. This held for personal semantic and autobiographical incident components of autobiographical memory. Prior studies have also found impaired autobiographical memory in AD (Greene et al., 1995; Kopelman, 1989; Sagar et al., 1988). Greene and his colleagues studied patients in the minimal and mild stages of AD and found impairment in patients in the earlier stage. The present study also found impairment of the minimal AD group compared to the control group; this difference was statistically significant for all but the earliest life period (childhood). This is further verification of impaired remote memory in the early stages of AD.

There was evidence of a temporal gradient for autobiographical memory. For autobiographical incident memory, there was a gradient for both the minimal and mild AD groups. As hypothesized, recall of incidents from childhood was significantly better than from recent life. It was proposed that the moderate group would not show a temporal gradient, and this was supported. Because of the progression of the disease, it was thought that the level of impairment would equal out across the time periods, which is what was demonstrated. It was hypothesized that normal controls would have a temporal gradient in the opposite direction of the AD groups with better recall of recent memories than childhood, but they had no difference in recall across the three time periods. This was probably due to a ceiling effect reflecting excellent recall in all time periods.
This finding of a temporal gradient for autobiographical incidents is in keeping with the results of Kopelman (1989) and Greene et al. (1995). With their two groups, minimal and mild AD, Greene and colleagues found a temporal gradient, but theirs was significant only in the mild patient group with a trend for the minimal group.

For personal semantic memory, there was a temporal gradient for both the mild and moderate AD groups with recall of information from childhood being superior to recall from recent life. This finding in the mild group supports the first hypothesis, but the temporal gradient in the moderate group again does not support the proposed leveling out of memory recall across time. The minimal group had significantly better recall of childhood memories than early adulthood but did not have significantly better recall of childhood than recent memories. As with autobiographical incidents, normal controls did not show any difference in recall across the three life periods. Once more there could have been a ceiling effect.

Again these findings are similar to those of Kopelman (1989) and Greene et al. (1995). Kopelman found a temporal gradient for his AD patients with better recall of childhood than recent memories. Greene et al. found no temporal gradient in either their minimal or mild group, whereas the present study found no temporal gradient in the minimal group but did find one in the mild and moderate groups.

The different patterns for the temporal gradients in autobiographical incident memory and personal semantic memory lends some support to the separability of autobiographical memory into these two components. Personal semantic memory may be similar to general semantic memory whereas autobiographical incident memory is similar to episodic memory. Autobiographical incident memory involves specific
personal incidents that are time-specific and context-specific. They also have to be reconstructed.

Contemplating the possible reason for the temporal gradients found, it could be that the gradient is an artifact because of trouble identifying the onset of AD (Greene et al., 1995). AD pathology may develop for some time before clinical presentation. Therefore, there is the issue of whether the temporal gradient observed in AD patients may be partly due to the insidious onset of anterograde amnesia over a number of years. Recent remote memory impairment could actually be a function of anterograde episodic memory impairment. Greene et al. altered the recent life component of the AMI to shift the timeframe back in an attempt to assess truly remote memory (e.g., an incident occurring on holiday prior to onset of memory problems). If the temporal gradient were an artifact due to difficulty dating onset of pathology, a temporal gradient would be expected in both components of the AMI. These researchers did find a temporal gradient for autobiographical incidents but found no evidence of a temporal gradient for personal semantic memory in their minimal or mild AD patients.

The present study did not attempt to shift the timeframe back and therefore could have assessed anterograde memory, which is impaired early in AD. If this were the case, then a temporal gradient should have been seen for both components of the AMI for the minimal and mild groups. The minimal AD group did not show greater recall of childhood than recent memories on the personal semantic component. If this were an artifact, it would be expected to be present in this case also.

As discussed earlier, Cermak (1984) proposed that more distant memories which have been retrieved repeatedly lose temporal and contextual specificity and
acquire features of semantic knowledge while memories from the most recent decades are truly "episodic" because temporal and contextual cues are still used in their retrieval. Semantic memories or memory for facts can be acquired through repetition of the material. Autobiographical incidents are specific to time and place and can not be repeated. Information that has been repeated often should be easier to remember than something that has happened only once. Also, retrieval of semantic memories may be less dependent on the limbic system (Greene et al., 1995). The pathology found in early AD in the perihippocampal region may impair recent episodic autobiographical memories (autobiographical incidents), but more semantic memories may be relatively spared. This could explain the temporal gradient of the minimal AD group for autobiographical incidents.

As with autobiographical memory, minimal, mild, and moderate AD patient groups were impaired on naming of Famous Faces when compared to controls. On top of this overall deficit, there was an extremely low performance for all three AD groups for the recent life period (1980s). Greene and Hodges (1996a) also found the low performance for the recent life period. It might seem that a possible explanation for this is a gradually developing impaired ability to retain newly acquired information. Since the onset of AD is notoriously insidious, it is possible that some participants may have had sub-clinical disease for several years prior to clinical presentation. However the pictures are from the 1980s, which means the range of years since the time of the photographs could be from eight to eighteen years. It is unlikely that this would account for the poor scores for the minimal group particularly. This implies that the low recall from the most recent life period associated with the
AD participants’ retrograde amnesia reflects a real difference in recall of memories from distant times and not simply progressive anterograde amnesia.

To explain this, Cermak’s episodic/semantic continuum (1984) may once again have to be considered. He suggested that newly acquired knowledge may be episodic in nature, but that with time and continued rehearsal, the memories lose their temporal and spatial contexts, and become more semantic in nature. While the pattern of deficits is similar for the different groups on the AMI and the Famous Faces, the impairment appears greater on the Famous Faces. This could have to do with the nature of the material being tested. Autobiographical memories would have been retrieved repeatedly and would have been personally more relevant than remembering a famous person’s face. With autobiographical memory there is assurance that the person knew the information at one time. With Famous Faces there is not this assurance.

The primary deficit involved in the Famous Faces test appears to be a breakdown in semantic knowledge rather than just a name retrieval deficit. Hodges, Salmon, et al. (1993) found that identification (providing person-specific details about unnamed faces) was not significantly better than spontaneous naming, AD patients named and identified a significantly lower proportion of the faces that they recognized as famous than did the controls, and semantic cueing did not aid naming performance. This adds to the evidence that loss of semantic memory is a fundamental defect in AD.

As far as the fractionation of remote memory is concerned, this study supported the separability of autobiographical and public memory. While there were significant correlations, overall these were low. This suggests that public and
autobiographical memory are different subcomponents of remote memory. The recall of autobiographical memories is an active process with visual and verbal components. The recall of the name of a famous person from their face is a less re-creative process. The British study that used famous faces found little correlation between total scores on their famous faces test and the two components of the AMI (Greene & Hodges, 1996b). The current study divided the Famous Faces test into life periods comparable to those of the AMI for each AD participant and found low correlations across the three life spans measured.

It is now well established that the vast majority of AD patients present with memory problems. Impairment on delayed recall of verbal material is an indication of their deficient episodic memory. In the present study, deficits in autobiographical memory were significantly correlated with anterograde memory deficits when AD patients reached the moderate stage of disease. Even though there was impairment of autobiographical memory in the minimal and mild stages of AD, this impairment was apparently not as severe as the impairment of anterograde memory. Family members often remark that the Alzheimer patient can remember the distant past but cannot remember recent experiences (Zec, 1993). This seeming preservation of remote memories in the earlier stages is obviously relative and diminishes as the disease progresses. This holds with Squire’s postulate (1992) that a pure hippocampal pathology causes an isolated anterograde amnesia, but when other surrounding structures become involved, there is a combined anterograde-retrograde amnesia. In the development of retrograde amnesia, it appears that the key structures may be the temporal neocortex, which is important for memory storage, and, possibly, the frontal...
systems acting through the diencephalon, which play a key role in remote memory retrieval (Greene & Hodges, 1996a). The more severe anterograde impairment in the early stages suggests that these patients have more extensive perihippocampal pathology and the less severe retrograde deficits implies that other anatomical structures are involved but not as extensively at this point. When patients reach the moderate stage, the pathological involvement of the structures responsible for retrograde amnesia has become more extensive.

The relationship between semantic and autobiographical memory continues to be debated. The correlation found in this study between category fluency (animals) and both components of the AMI was greater than that found previously with letter fluency by Greene et al. (1995). This is possibly because retrieval of autobiographical memories and category fluency tasks require similar active search mechanisms to locate, retrieve, and verify items while letter fluency can be achieved by using phonemic or lexical cues. This suggests an interactive model of semantic and autobiographical memory rather than two strictly independent memory systems (Graham & Hodges, 1997). Looking at the increasing correlation across groups from the minimal AD group to the moderate AD group, there appears to be an increasing concurrent deterioration of both semantic and autobiographical memory as the disease progresses.

The progressively higher correlation across groups found between the personal semantic and autobiographical incident components of the AMI demonstrates the concurrent progression of impairment of both components in AD. This is in keeping with the high correlation found by Kopelman et al. (1990) for amnesic patients.
Kopelman interpreted this as evidence against an episodic/semantic distinction in autobiographical memory. In light of evidence from other patient groups (i.e., multiple sclerosis, encephalitis), current findings could be interpreted as a contemporary breakdown of both personal semantic and autobiographical incident memory in AD instead of being interpreted as a lack of distinct subtypes of autobiographical memory. For example, O'Connor, Butters, Miliotis, Eslinger, and Cermak (1992) described a post-encephalitis patient who exhibited moderate impairment on tests of personal semantic information and public events but seemed to have a total, absolute loss of episodic autobiographical memories.

There are limitations of the AMI when assessing autobiographical memory. The recent time period is relatively ill defined and autobiographical memory for the period between early adulthood and recent life is not assessed. In spite of these limitations, the present findings indicate that the AMI in conjunction with other tests may be useful in the clinical assessment of patients with AD. Whereas the Famous Faces test requires recall of information that may never have been known to the patients, the AMI requires recall of information that must have been known to patients at one time. Therefore deficits that are found must be impairments of remote memory.

A limitation of this study was that the moderate AD group was significantly older than the other two AD groups and the normal controls. Future studies should attempt to match all groups for age because of possible differences due to age rather than the disease process.
General Observations

Overall AD patients showed the pattern of relatively impaired recent memories and more preserved distant memories. In a study by Graham and Hodges (1997), semantic dementia patients with focal lesions in the left temporal neocortex with sparing of the hippocampus and parahippocampal region show a reverse of this pattern with preservation of recent memories and impairment of more distant memories. The preservation of autobiographical memory for recent life in semantic dementia patients strengthens the conception that autobiographical and semantic knowledge are consolidated in the neocortex initially through plastic interactions with the hippocampal system (McClelland, McNaughton, & O'Reilly, 1995). Comparison of deficits in semantic dementia and AD provides support for the distinct roles played by the hippocampal system and the neocortex. The patterns of decline in the autobiographical memory of AD patients in the present study demonstrate the great involvement of the hippocampal system but the involvement of the neocortex as well and the continued deterioration of these areas.

In summary, it is apparent that AD patients show impairment of autobiographical memory. The cause of the autobiographical memory deficit in AD might be attributed to the known deficits in both episodic and semantic memory. In the very earliest stages episodic memory alone may be affected due to the selective involvement of parahippocampal structures, primarily the transentorhinal area (Braak & Braak, 1991). Hodges (1995) says that at this early stage, it might be predicted that remote memory impairment should affect episodic aspects preferentially and be limited to the most recent few years. As the disease progresses, there is breakdown in
semantic memory. Examining the data in the present study, this could be partially true. The deficit shown by the minimal AD group compared to the controls for recent autobiographical incidents was greater than their impairment for recent personal semantic memory compared to the controls. Also there was no significant difference between the recent life period and childhood for the minimal group on personal semantic memory, but there was a significant difference for autobiographical incidents between these two life periods. It is clear from inspecting the data that impairment of episodic memory was not restricted to the most recent few years, but the impairment was greater for this time period. Therefore at this early stage (minimal, MMSE ≥ 24), the disease process is probably more advanced in the transentorhinal area, but appears to have spread beyond this area (i.e., the deficits in autobiographical memory for childhood and early adulthood). The results of this study wait for confirmation by longitudinal study of AD patients in the minimal stage initially. Additionally, further study using neuroimaging techniques to correlate the pattern of remote memory deficits with neuropathological changes may help clarify which anatomical structures are involved in the development of retrograde amnesia.

Because it is commonly believed that “old” memories are intact in AD, family members should be educated concerning the pattern of deterioration of autobiographical memories. This knowledge could help decrease the frustration that is sometimes exhibited by family members concerning the AD patient’s inability to recall information about his own life and his family. Some families wish to plan gatherings for family and friends to reminisce before the patient’s autobiographical memories become too impaired. Also, some families wish to record memories of the
AD patient before they are lost. The information gained can be used later to remind
the patient of events in his life to help him keep individual memories longer and
maintain a sense of self as long as possible after his own autobiographical memory
continues to deteriorate.
References


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Appendix A

NINCDS-ADRDA Criteria for Clinical Diagnosis of Alzheimer’s Disease

I. The criteria for the clinical diagnosis of PROBABILE Alzheimer’s disease include:

A. dementia established by clinical examination and documented by the Mini-Mental Test (Folstein, Folstein, & McHugh, 1975), Blessed Dementia Scale (Blessed, Tomlinson, & Roth, 1968), or some similar examination, and confirmed by neuropsychological tests;

B. deficits in two or more areas of cognition;

C. progressive worsening of memory and other cognitive functions;

D. no disturbance of consciousness;

E. onset between ages 40 and 90, most often after age 65; and

F. absence of systemic disorders or other brain diseases that in and of themselves could account for the progressive deficits in memory and cognition.

II. The diagnosis of PROBABILE Alzheimer’s disease is supported by:

A. progressive deterioration of specific cognitive functions such as language, motor skills, and perception;

B. impaired activities of daily living and altered patterns of behavior;

C. family history of similar disorders, particularly in confirmed neuropathology; and

D. laboratory results of:

1. normal lumbar puncture as evaluated by standard techniques,

2. normal pattern or nonspecific changes in EEG, such as increased
slow-wave activity, and

3. evidence of cerebral atrophy on CT with progression documented by serial observation.

III. Other clinical features consistent with the diagnosis of PROBABLE Alzheimer’s disease, after exclusion of causes of dementia other than Alzheimer’s disease, include:

A. plateaus in the course of progression of the illness;
B. associated symptoms of depression, insomnia, incontinence, delusions, illusion, hallucinations, catastrophic verbal, emotional, or physical outbursts, sexual disorders, and weight loss;
C. other neurologic abnormalities in some patients, especially with more advanced disease and including motor gaits such as increased muscle tone, myoclonus, or gait disorder;
D. seizures in advanced disease; and
E. CT normal for age.

IV. Features that make the diagnosis of PROBABLE Alzheimer’s disease uncertain or unlikely include:

A. sudden, apoplectic onset;
B. focal neurologic findings such as hemiparesis, sensory loss, visual field deficits, and incoordination early in the course of the illness; and
C. seizures or gait disturbances at the onset or very early in the course of the illness.

V. Clinical diagnosis of POSSIBLE Alzheimer’s disease:

A. may be made on the basis of the dementia syndrome, in the absence of
other neurologic, psychiatric, or systemic disorders sufficient to cause
dementia, and in the presence of variations in the onset, in the presentation or
in the clinical course;
B. may be made in the presence of a second systemic or brain disorder
sufficient to produce dementia, which is not considered to be \textit{the} cause of the
dementia; and
C. should be used in research studies when a single, gradually progressive
severe cognitive deficit is identified in the absence of other identifiable cause.

VI. Criteria for diagnosis of \textbf{DEFINITE} Alzheimer’s disease are:
   A. the clinical criteria for probable Alzheimer’s disease and
   B. histopathologic evidence obtained from a biopsy or autopsy.

VII. Classification of Alzheimer’s disease for research purposes should specify
features that may differentiate subtypes of the disorder, such as:
   A. familial occurrence;
   B. onset before age of 65;
   C. presence of trisomy-21; and
   D. coexistence of other relevant conditions such as Parkinson’s disease.
## Appendix B

**Autobiographical Memory Interview**

**Autobiographical Incidents Schedule**

<table>
<thead>
<tr>
<th>Time period:</th>
<th>Incident to be recalled</th>
<th>Suggested prompts:</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. CHILDHOOD (9 points)</td>
<td>1. Before school</td>
<td>first memory? involving brother or sister?</td>
</tr>
<tr>
<td></td>
<td>2. At primary school (i.e. 5-11 years)</td>
<td>involving friend? involving teacher?</td>
</tr>
<tr>
<td></td>
<td>3. At secondary school (i.e. 11-16/18 years)</td>
<td>involving friend? involving teacher?</td>
</tr>
<tr>
<td>II. EARLY ADULT LIFE: (9 points)</td>
<td>1. First job or at College/University</td>
<td>first day at job/college? episode with friend/girlfriend</td>
</tr>
<tr>
<td></td>
<td>2. Wedding: own or other’s during 20s</td>
<td>the guests? at reception?</td>
</tr>
<tr>
<td></td>
<td>3. Meeting someone during 20s</td>
<td>e.g. and interview? on holiday or at work?</td>
</tr>
<tr>
<td>III. RECENT EVENTS (9 points)</td>
<td>1. A relative or visitor in the last year</td>
<td>visit by/to a relative? news about a relative?</td>
</tr>
<tr>
<td></td>
<td>2. An event in this hospital/institution/place where interviewed</td>
<td>involving other patients/clients? involving staff/doctor/nurses?</td>
</tr>
<tr>
<td></td>
<td>3. A journey in the last year</td>
<td>place visited? someone met?</td>
</tr>
<tr>
<td>Time-period</td>
<td>Item</td>
<td>Examples of individual questions</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>I. CHILDHOOD</strong> (21 points)</td>
<td>1. Before school</td>
<td>address where living, names of friends?</td>
</tr>
<tr>
<td></td>
<td>2. First school</td>
<td>name, where, age at starting, own address, names of teachers/friends?</td>
</tr>
<tr>
<td></td>
<td>3. Secondary school</td>
<td>name, where, level of exams passed, own address, names of teachers/friends?</td>
</tr>
<tr>
<td><strong>II. EARLY ADULT LIFE</strong> (21 points)</td>
<td>1. First job or College/ University</td>
<td>name of firm/college, qualifications, own address, names of boss/colleagues?</td>
</tr>
<tr>
<td></td>
<td>2. Wedding: own or other’s during 20s</td>
<td>whose? where? when? address before/after, names of best man/bridesmaids?</td>
</tr>
<tr>
<td></td>
<td>3. Children (own or niece/ nephew or close friend’s)</td>
<td>names of two children, when and where born?</td>
</tr>
<tr>
<td><strong>III. RECENT INFORMATION</strong> (21 points)</td>
<td>1. Hospital or other institution</td>
<td>current - name and place, when first came, names of staff/clients/patients, current address? When and where last in hospital, where living then?</td>
</tr>
<tr>
<td></td>
<td>2. Christmas and visits</td>
<td>where last Christmas spent? who with? names of other visitors/relatives seen in last year?</td>
</tr>
<tr>
<td></td>
<td>3. Holidays or other journeys in last year (or within last 5 years, if more applicable)</td>
<td>where? when? who with?</td>
</tr>
</tbody>
</table>
Appendix C
Consent Forms

LOUISIANA STATE UNIVERSITY

(1) Consent form for the patient group:

Participant number

Study Title: Autobiographical Memory in Mild and Moderate Dementia of the Alzheimer's Type

Performance Sites: Participants' home or NeuroMedical Center

Investigators: The following researchers are available for questions:
Dr. Drew Gouvier or Ms. Judith Levy
Louisiana State University Psychology Department
Telephone: 388-8745

Dr. John Bolter or Dr. Paul Dammers
NeuroMedical Center
Telephone: 769-2200

Purpose of the Study: The purpose of the study is to examine the effect of stage of Alzheimer's disease on autobiographical memory and its relationship to other forms of memory and language.

Patient Inclusion: The study includes patients of NeuroMedical Center diagnosed with minimal to moderate Alzheimer's disease. To be included in the study patients must achieve a score on the Mini Mental State Examination of 24 or greater to be the minimal group, 19-23 to be in the mild group, or 12-18 to be in the moderate group.

Patient Exclusions: Patients with additional diagnoses of Vascular Dementia, alcohol abuse, metabolic disorder, schizophrenia, or Parkinson's disease will be excluded.
Description of the Study: The study will consist of a brief mental status exam, three brief neuropsychological tests, and an autobiographical interview. The session will last approximately one and one-half hours. Information from the interview will be confirmed with a spouse, relative, or friend.

Potential Benefits: The study will not benefit the patient directly, but may increase knowledge about the progression of Alzheimer’s disease.

Potential Risks: There are no recognizable risks involved with participation in this clinical research project.

Right to Refuse: Individuals who agree to participate in this project will not be treated in any way that is different from other patients at NeuroMedical Center. Participation will not in any way affect or otherwise alter medical care received at this clinic. You may refuse to participate or withdraw your consent at any time without jeopardizing, in any way, your medical treatment at this clinic in the present or future.

Privacy: The results of this study may be published. All medical information and test scores, names and addresses will be kept strictly confidential. The participant number listed above will be the only identifier listed on record forms.

Release of Information: Medical records at NeuroMedical Center

7777 Hennessy Boulevard
Baton Rouge, LA
(504) 769-2200

may be reviewed by investigators, but patient identity will be kept secret.

The study has been discussed with me and all my questions have been answered. I understand that additional questions regarding the study should be directed to investigators listed above. I understand that if I have questions about subject
rights, or other concerns, I can contact the Vice Chancellor of the LSU Office of Research and Economic Development at 388-5833. I agree with the terms above and acknowledge I have been given a copy of the consent form.

______________________________  ______________________
Signature                        Date

______________________________  ______________________
Witness                          Date

______________________________  ______________________
Investigator                     Date

The study subject has indicated to me that the subject is unable to read. I certify that I have read this consent form to the subject and explained that by completing the signature line above the subject has agreed to participate.

______________________________  ______________________
Signature of Reader               Date
(2) Consent form for the normal control group:

Participant number

Study Title: Autobiographical Memory in Mild and Moderate Dementia of the Alzheimer's Type

Performance Sites: Participants' home or NeuroMedical Center

Investigators: The following researchers are available for questions:
Dr. Drew Gouvier or Ms. Judith Levy
Louisiana State University Psychology Department
Telephone: 388-8745
Dr. John Bolter or Dr. Paul Dammers
NeuroMedical Center
Telephone: 769-2200

Purpose of the Study: The purpose of the study is to examine the effect of stage of Alzheimer's disease on autobiographical memory and its relationship to other forms of memory and language.

Control Inclusion: To be included in the study control subjects must achieve a score on the Mini Mental State Examination of 28 or greater.

Description of the Study: The study will consist of a brief mental status exam, three brief neuropsychological tests, and an autobiographical interview. The session will last approximately one and one-half hours.

Potential Benefits: The study will not benefit the subject directly, but may increase knowledge about the progression of Alzheimer's disease.

Potential Risks: There are no recognizable risks involved with participation in this clinical research project.

Right to Refuse: You may refuse to participate or withdraw your consent at any time.

Privacy: The results of this study may be published. All medical
information and test scores, names and addresses will be kept strictly confidential. The participant number listed above will be the only identifier listed on record forms.

The study has been discussed with me and all my questions have been answered. I understand that additional questions regarding the study should be directed to investigators listed above. I understand that if I have questions about subject rights, or other concerns, I can contact the Vice Chancellor of the LSU Office of Research and Economic Development at 388-5833. I agree with the terms above and acknowledge I have been given a copy of the consent form.

__________________________________________  ________________
Signature                                      Date

__________________________________________  ________________
Witness                                        Date

__________________________________________  ________________
Investigator                                   Date

The study subject has indicated to me that the subject is unable to read. I certify that I have read this consent form to the subject and explained that by completing the signature line above the subject has agreed to participate.

__________________________________________  ________________
Signature of Reader                            Date
Vita

Judith Parks Levy was born on September 15, 1951, in Monroe, Louisiana. She received a Bachelor of Science degree in Math Education from Louisiana Tech University in May 1972. She taught math at Jesuit High School/Loyola College Prep in Shreveport, Louisiana until 1989. In 1989 she received a master of arts in general counseling from Louisiana Tech University.

Judith received a master of arts in psychology from Louisiana State University in May, 1994, and will be awarded the Doctor of Philosophy degree in psychology from Louisiana State University on December 18, 1998. Her area of special interest is clinical neuropsychology.
Candidate: Judith Parks Levy

Major Field: Psychology

Title of Dissertation: Autobiographical Memory in Mild and Moderate Dementia of the Alzheimer's Type

Approved:

[Signatures]

Major Professor and Chairman
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination: 10/27/98

[Signatures]