AWARENESS OF MEMORY DEFICIT IN ALZHEIMER'S DISEASE PATIENTS AND MEMORY-IMPAIRED OLDER ADULTS

by

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ABSTRACT

Disturbances in awareness of memory deficit have been observed in Alzheimer's disease (AD), yet few studies have systematically investigated the phenomena in this population. The present study has applied the concepts and instruments used in the metamemory literature to the study of awareness of memory deficit in twenty mild AD patients, eighteen individuals with memory impairment, and eighteen normal elderly controls. Specifically, a multidimensional approach to metamemory was selected including an evaluation of perception of memory change, knowledge about memory functioning, and self-monitoring of memory performance. Consistent with previous research, AD patients reported less change in memory functioning than did their informants, suggesting that these patients have diminished awareness of the extent of the decline in their memory abilities. No differences among the three groups were observed in self-report measures addressing the use of strategies, perception of control over memory functioning, and presence of anxiety in memory-related activities. Diminished self-monitoring abilities were observed in the AD patients' tendency to make a high number of intrusion errors with few self-corrections, and

to overestimate their performance on memory tests. The results also suggest that relatives' evaluation of memory functioning may be particularly useful in differentiating AD patients from older adults displaying memory impairment and from normal elderly.

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DEDICATION

This dissertation is dedicated to a very special person, my uncle Renato, who left me with the happiest and most beautiful memories of my childhood.

INTRODUCTION

Disturbances in awareness of deficit (i.e., anosognosia) have been observed in several neuropsychological syndromes like hemiplegia (Weinstein & Kahn, 1955), Anton's syndrome (Bisiach, Vallar, Perani, Papagno, & Berti, 1986), hemianopsia (Koehler, Endtz, Tevelde, and Hekster, 1986), head injury (Prigatano, 1986), aphasia (Weinstein, Lyerly, Cole, & Ozer, 1966), amnesia (Victor, Adams & Collins, 1977), and dementia (Frederiks, 1985). The term anosognosia was introduced by Babinski (1914) to describe lack of knowledge, awareness or recognition of disease. The terms unawareness of deficit, anosognosia, and lack of insight are used interchangeably in this study to describe patients who lack awareness of a neuropsychological deficit.

Although the study of these neuropsychological syndromes has provided relevant information concerning the nature of awareness, systematic neuropsychological investigations of phenomenal awareness are few (Schacter, 1990). Additionally, many of the existing studies are based on clinical observations with little information regarding both the definition of concepts

and the criteria used to assess unawareness (McGlynn & Schacter, 1989).

The fact that brain damaged patients may be unaware of their deficits is important for both theoretical and clinical reasons. The study of unawareness can provide information about the mechanisms that normally allow individuals to be aware and to monitor their cognitive functioning. Clinically, unawareness of deficit can be a considerable obstacle for the achievement of successful rehabilitation of function. Patients who are unaware of their deficits are less likely to benefit from or participate in remedial interventions, or to function efficiently in everyday life. Similarly, these patients may insist on performing activities that they are no longer capable of. Understanding the awareness disturbance may also help caregivers to prepare for and to deal with the patient in a more efficient manner.

The present research focuses on the study of awareness of deficit in patients with Alzheimer's disease (AD) as well as in individuals experiencing age-related memory deficits. Specifically, it addresses issues concerning degree of awareness of memory impairment in these populations. A description

of AD, recent research addressing "normal aging" and age-related cognitive impairments, as well as the most relevant memory deficits displayed by these individuals is followed by a discussion of current findings regarding awareness of memory functioning in clinical and normal populations. Finally, a systematic approach for investigating awareness of memory deficit is proposed.

Alzheimer's disease

Dementia is generally defined as a decline in intellectual functioning of sufficient severity to cause a restriction in normal activities. At least three of the following areas are affected: memory, visuospatial skills, language, judgement, abstraction, and personality (Cummings & Benson, 1983). The diagnostic criteria proposed by the Diagnostic and Statistical Manual of Mental Disorders - Revised (DSM III-R; 1987), although consistent with the above mentioned definition, give particular emphasis to memory decline and require the presence of an etiological factor.

Among the dementias, AD is the most well studied and accounts for the plurality of the dementia cases (Cummings & Benson, 1983; Frederiks, 1985). In a

review of studies (Cummings & Benson, 1983) addressing the relative prevalence of dementia among patients referred for evaluation of progressive intellectual deterioration the most frequent diagnoses were: (1) AD (39%), (2) multi-infarct dementia (13%), (3) miscellaneous or non-specific dementia (11%), (4) alcoholic dementia (8%), and (5) dementia associated with psychiatric disorder (7%).

The diagnosis of AD is based on clinical and neuropsychological examination and currently cannot be determined by the use of routine non-invasive laboratory tests (e.g., CT Scan, EEG). The syndrome is characterized by an insidious onset with progressive memory and other cognitive deficits (e.g., language, praxis, problem solving, social functioning) most often after age 65. The diagnosis excludes disturbances of consciousness and other systemic or brain diseases that could account for the progressive intellectual deterioration. The National Institute of Neurological and
Communicative Disorders and Stroke (NINCDS) and the Alzheimer's Disease and Related Disorders Association (ADRDA) have specified the diagnostic criteria by subdividing it into Probable, Possible and Definite AD (McKhann, Drachman, Folstein, Katzman, Price, &

Stadlan, 1984). The criteria for Probable AD is consistent with the above mentioned description. Possible AD may be diagnosed in the presence of variations in the onset, presentation, or clinical course. Additionally, systemic or brain diseases may be evident as long as they are not considered the cause of the dementia. Criteria for the diagnosis of definite AD includes diagnosis of Probable AD accompanied by histopathologic evidence from biopsy or autopsy.

The progressive intellectual deterioration that occurs in AD can be divided in three stages (Cummings & Benson, 1983). Memory impairment is among the earliest and most prominent features. The deficits are characterized by reduced ability to learn new material and difficulty recalling remote information which become increasingly more severe as the disease progresses. Visuospatial skills are also impaired early in the course of AD with evidence of topographic disorientation, poor constructions and spatial disorientation. The first signs of language abnormalities are impaired word-finding and emptiness of spontaneous speech (e.g., circumlocution). These deficits usually develop into anomia, paraphasia and impaired comprehension in the later stages.

Acalculia, apraxia, agnosia and motor restlessness are usually observed in the second stage. Although personality and social behavior remain intact during the early phases, there is some evidence of apathy and lack of insight. Depression may occur early in the course of the illness but it is usually not severe and it often recedes as the intellectual deterioration worsens. The later stages of the illness are characterized by severe deterioration of intellectual functions associated with motor and neurological abnormalities. However, AD is not a homogeneous disorder with a single set of stages or patterns that describe it, since considerable variability in the presentation of cognitive deficits is often reported.

The diagnosis of AD can be confirmed only by histopathologic evidence of excessive numbers of neurofibrillary tangles and senile plaques in the cerebral cortex (e.g., temporal, parietal and frontal areas) and granuovacular degeneration in the hippocampus (Blessed, Tomlinson, & Roth, 1968; Chui, 1989). Although decreased brain weight, loss of neurons, gyral atrophy, ventricular dilation, and neurofibrillary tangles are prominent age-related changes, there is a marked increase in these changes, particularly in the density and extent of distribution

of tangles, in dementia patients (Kemper, 1984). Specifically, the development of neuritic plaques and neurofibrillary tangles in the limbic system (i.e., amygdala and hippocampus) have been suggested to be responsible for some of the memory deficits observed in the early stages of AD (Hyman, Van Hoesen, & Damasio, 1985; Hyman, Kramer, & Van Hoesen, 1987). Similarly, neurofibrillary degeneration in multimodal association cortex (temporo-parietal-occipital) appears to be related to aphasia, apraxia and agnosia.

Subcortical areas like the cholinergic basal forebrain, noradrenergic locus ceruleus and serotonergic raphe nucleus are also affected but their specific contributions are still unclear. There has been, however, some indication that the memory deficits in AD (Rossor, Emson, Mountjoy, Roth, & Iversen, 1982; Huppert & Kopelman, 1989) and in "normal" aging (Bartus, Dean, Beer, & Lippa, 1982; Mann, Yates, & Marcyniuk, 1984) are related to the cholinergic deficiency often observed in these individuals. Specifically, cholinergic deficiency in AD has been linked to cell loss and tangles in the nucleus basalis which has diffuse cholinergic projection to the cerebral cortex (including the basal

forebrain) and the hippocampus (Whitehouse, Price, Struble, Clark, Coyle, & DeLong, 1982).

Most studies examining patterns of cerebral glucose metabolism (e.g., Grady et al., 1990) and cerebral blood flow (e.g., Prohovnik, Mayeux, & Sackeim, 1985) in AD have reported glucose hypometabolism and reduced blood flow mostly in the parietal and temporal areas. There appear to be, however, a significant number of patients showing predominantly frontal or posterior metabolic abnormalities (Haxby, et al., 1988). The behavioral correlates of frontal involvement in AD have not been the focus of systematic research. The most common findings appear to be apathy, impaired insight, lack of judgement, perseveration and inefficient problem-solving (Cummings & Benson, 1983).

There has been an increasing interest in understanding the information processing deficits underlying the reduced ability to acquire verbal and nonverbal information frequently observed in AD patients. Investigations using the concepts of cognitive neuropsychology have demonstrated important differences in superficially similar memory dysfunctions. Additionally, a qualitative analysis of error patterns combined with standardized quantitative

measures can add substantially to the understanding of the cognitive factors involved in the observed learning impairments (Heindel, Salmon, & Butters, 1989).

Short-term memory (or working memory) abilities appear to be impaired in AD patients (Butters et al., 1988; Kopelman, 1985; Morris & Baddeley, 1988). A moderate reduction in immediate memory span (e.g., digit span, visual span), a recency effect on the recall of words and susceptibility to distraction (e.g., Brown-Peterson task) have been observed. Although there has been some suggestion that these difficulties are secondary to impaired attention to incoming stimuli (Wilson et al. 1983), alternate views have been proposed. Recent studies addressing attentional processes in AD (Gallie, Tuokko & Graf, 1991; Kaszniak & Davis, 1986; Storandt, Botwinick, & Danziger, 1986) reported that attention decline is not detectable until the dementia has reached moderate to severe levels. Morris and Kopelman (1986) have suggested that the short-term memory deficits observed in AD might be related to a generalized information processing deficit.

Recent investigations (Butters, Granholm, Salmon, Grant, & Wolf, 1987; Granholm & Butters, 1988; Heindel

et al. 1989) have supported the notion that episodic and semantic memory are disturbed in AD. Tulving (1983) has described episodic memory as requiring conscious recollection of the temporal-spatial context in which the event occurred. Semantic memory, on the other hand, requires the retrieval of information (i.e., general knowledge) without its temporal-spatial context. It has been proposed that through repetition and overlearning, memories that are initially episodic may become context free and part of the individual's semantic knowledge (Heindel et al. 1989).

Several studies (Butters, 1985; Cushman, Como, Booth, & Caine, 1988; Martin & Fedio, 1983; Weingartner et al. 1983) have demonstrated that in dementia both the ability to acquire information associated with temporal-spatial cues and to recall previously acquired general knowledge are impaired. On tests that require the recall of short passages or word lists (i.e., measures of episodic memory) AD patients display considerable impairment (Butters, Granholm, Salmon, Grant, & Wolf, 1987; Delis, Massman, Butters, Salmon, Cermak, & Kramer, 1991). Furthermore, the observation that these patients' recognition memory is also impaired provided evidence that there is a deficit in learning or encoding

information as opposed to a deficit in retrieving information (Delis et al., 1991; Kaszniak, 1986). Memory impairment is seen for both verbal and nonverbal material (Wilson, Kaszniak, Bacon, Fox, & Kelly, 1982). Furthermore, mild deficits in the ability to recall remote information with no temporal gradient (Wilson, Kaszniak, & Fox, 1981), and with less involvement of remote than of recent information (Cummings & Benson, 1992).

Although AD patients display impairment in both the immediate and the delayed recall of information, there have been some discrepant findings regarding which of these two measures differentiates these patients more accurately. For instance, Welsh, Butters, Hughes, Mohs, & Heyman (1991) reported that delayed recall measures were particularly sensitive in discriminating early AD patients from elderly normal controls, even though immediate recall and recognition were also impaired in AD. Recognition memory and intrusion errors had the greatest value in discriminating between more severely demented groups. Conversely, Tuokko and colleagues (1989, 1991) observed that free recall measures were more useful than delayed recall measures in the early detection of AD. Finally, Robinson-Whelen & Storandt (1992)

reported that mild AD patients recalled significantly less information than normal elderly both in immediate and delayed recall measures suggesting a disruption of encoding processes. In a meta-analytic study addressing the differentiation of dementia from normal aging, Christensen, Hadzi-Pavlovic, & Jacomb (1991) argued that a test's ability to discriminate these two populations might vary according to stage of the dementing illness.

It has also been suggested that AD patients' deficits in the recall of information are closely associated with impairments in utilizing semantic information (i.e., cues) at encoding and retrieval (Cushman, et al., 1988). Further evidence for impaired semantic processing comes from tests of verbal fluency in which AD patients often display a reduction in the ability to verbally produce exemplars comprising abstract categories (e.g., category fluency task) while their ability to produce words that begin with a certain letter (e.g., letter fluency task) is less impaired. These findings indicated that the category fluency task is a highly sensitive measure of deficiencies in semantic memory. On the other hand, since the letter fluency tasks can be performed using phonemic cues to search for words impairments on this

task may only be apparent in later stages of the disease.

AD patients display, therefore, a pattern of deficits in episodic and semantic memory that differentiates them from patients with other neuropsychological syndromes. Additionally, their performance is characterized by sensitivity to proactive interference, perseverations and intrusion errors (Butters, 1985; Butters et al. 1987).

There is some controversy in the literature regarding the definition of intrusions. Intrusion errors have been generally defined as introduction of unrelated items while performing a given task (e.g., recalling a list of words). Intrusion errors have also been described as "inappropriate recurrence of responses from a preceding test item, test or procedure" (Fuld, Katzman, Davies, & Terry, 1982) which is also consistent with some definitions of perseverative responses (Sandson & Albert, 1984). Butters and colleagues (1987) described perseverations as repetition of a correct word within a given trial. Several studies (Brinkman, Largen, Cushman, Braun, & Block, 1986; Fuld et al. 1982; Fuld, 1983; Kramer, Delis, Blusewicz, Brandt, Ober, & Strauss, 1988) have documented the occurrence of intrusion errors in AD

and have suggested that these errors are an important characteristic of the syndrome.

Fuld and colleagues (1982) found an association between the occurrence of intrusion errors and the cholinergic deficiency observed in AD. Additionally, Wilson and colleagues (1983) distinguished between prior-list errors (items from previously presented tests) and extra-list intrusions (items not presented in the test situation). The authors observed that AD patients made predominantly extra-list intrusions. This distinction has been suggested to be relevant since the presence of prior-list intrusions may be indicative of some ability to register and encode information associated with a retrieval deficit while extra-list intrusions may indicate an encoding deficit (Hart, Smith, & Swash, 1986).

Other studies (Gordon, Whitehouse, Cockrell, Mroz, & Steele, 1984; Ober, Dronkers, Koss, Delis, & Friedland, 1986; Shindler et al. 1984), however, did not find higher intrusion rates in AD patients when compared to other diagnostic groups (e.g., cerebral vascular accidents, aphasia, other dementias). Lowenstein and colleagues (1989, 1991) also reported that test intrusions did not distinguish AD from other neurological disorders. The authors observed,

however, that the groups could be discriminated according to specific types of intrusion errors. Patients with mild AD made significantly more unrelated intrusions (i.e., responses unrelated either to the to-be-remembered targets or to the distractor items) than patients with cerebral infarctions or with depression. The occurrence of unrelated intrusions were interpreted as evidence for (a) a failure in the storage/consolidation of information since patients performed poorly on free-recall and recognition measures, or (b) difficulties in self-monitoring.

Although it has been suggested that the mechanism underlying intrusion errors in AD may be related mainly to deficits in short-term memory (Gordon et al., 1984; Lee, Loring, Flanigin, Smith, & Meador, 1988), there is some evidence against this view. First, low correlations between intrusions and either verbal memory tests or dementia severity have been reported (Shindler, Caplar, & Hier, 1984). Second, patients with Huntington's disease make few intrusion errors despite their memory deficit (Butters et al., 1987). Furthermore, research involving patients with Wernicke's aphasia indicates the occurrence of a high number of intrusions in this population (Marshall & Tompkins, 1982).

Shindler and colleagues (1984) suggested that intrusion errors observed in AD and Wernicke's aphasia may be a consequence of defective self-monitoring abilities since there is little insight into the illness in both of these conditions. Additionally, the observation that intrusion errors are frequently reported in Korsakoff's disease (Butters, 1985) suggests that these errors cannot be accounted for by the presence of language disturbances.

Self-monitoring abilities have been investigated in aphasic subjects through an evaluation of their verbal self-corrective behavior (i.e., ability to recognize and correct language production errors). Marshall and Tompkins (1982) reported that successful self-corrective abilities were related to severity of aphasia and suggested that self-corrections may be indicative of intactness of the individual's self-monitoring system. Self-corrective behavior has not been, however, systematically investigated in dementia patients.

The majority of studies investigating intrusions report that these errors are rare among healthy elderly controls (e.g., Fuld, 1983; Shindler et al. 1984) and, therefore helpful in distinguishing normal subjects from demented subjects. The occurrence of

intrusions in individuals with cognitive impairment of insufficient severity to be diagnosed as having dementia has not been systematically investigated.

"Normal" Aging

The majority of neuropsychological studies addressing age-related changes in cognitive abilities report some level of impairment (e.g., Rimm, [illegible]88). The amount of loss that occurs from individual to individual appears to be, however, highly variable (Drachman, 1986). Education, presence of chronic disease, and advanced age are among the most common factors influencing level of cognitive functioning in this population. Specifically, decrements in neuropsychological performance appear to be particularly evident after the eight decade (Back & Greene, 1980; Benton, Eslinger, & Damasio, 1981; Mitrushina & Satz, 1991).

The literature on "normal" aging consistently indicates that the most evident neuropsychological deficits observed in this population involve (1) diminished ability to encode and retrieve newly learned information, particularly nonverbal materials (e.g., Christensen et al., 1991; Poon, 1985), (2) psychomotor slowing (e.g., Strayer, Wilkins, & Braune,

1987), and (3) difficulties in concept formation and mental flexibility (e.g., Reese, & Rodeheaver, 1985).

Poon (1985) reviewed findings of small age-related deficits in recognition and large age-related deficits in recall suggesting that retrieval rather than storage of information is impaired in the elderly. Similarly, procedures involving comparisons between free- and cued-recall tasks show improvement in performance after presentation of cues, which contrasts with AD patients inability to benefit from cues (Cushman et al., 1988). The view that retrieval is impaired in the elderly receives further support from studies reporting that the memory performance of these individuals is enhanced by the provision of elaborative or orienting instructions (Smith, 1980). There have been, however, some contradictory findings showing deficient encoding (i.e., recognition memory) in "normal" elderly (Flicker et al. 1986).

In contrast to the findings of impaired learning and/or retrieval of information, minimal or no age differences in immediate memory (e.g., digit span) or in remote memory (i.e., well learned familiar information) were reported in the majority of the studies in the literature (Poon, 1985; Drachman, 1986). Similarly, general intellectual abilities

(i.e., manipulation of knowledge) and language functions appear to be relatively insensitive to the aging process (Cummings & Benson, 1983; Flicker et al., 1986).

Two neuropsychological models have been proposed to explain the pattern of changes associated with normal aging (Van Gorp, & Mahler, 1990). One model is based on the observations that there is a disproportionate decline on the performance of nonverbal relative to verbal tasks in the elderly, suggesting a right hemisphere involvement in the cognitive deterioration that occurs in this population. This view is supported by the "classic aging pattern" described by Albert & Kaplan (1980) who observed decreased Performance IQ and relatively stable Verbal IQ with age. This model has been criticized, however, since the nonverbal measures used in most studies are also novel and time-dependent which does not provide specific evidence for a right/left discrimination.

The second model proposes that the basal ganglia, with connections to frontal cortical structures, may be particularly affected by the aging process. These structures are involved in the speed of initiating and executing actions, a function that is affected in the

elderly (Van Gorp & Mahler, 1990). Additionally, several studies have reported positive correlations between age and measures indicative of frontal lobe dysfunction (Van Gorp, Mitrushina, Cummings, Satz, & Modessit, 1989; Whelihan & Lesher, 1985). In a recent review, Craik (1991) argued that age decrements are observed whenever non-routinized mental operations involving initiation, organization and execution, i.e., operations requiring frontal lobe involvement, are performed. Although Goldberg (1986) argued that any diffuse brain damage disrupts frontal executive functions first, neurobiological data appear to suggest that frontal-subcortical systems are most vulnerable to aging and are responsible for several age-related deficits.

In sum, a brief review of the neuropsychology of aging literature suggests that difficulties in the recall of newly learned information is one of the most prominent age-related changes in this population. Furthermore, cognitive abilities involving the participation of the frontal lobes also appear to be affected by the aging process.

Age-Related Memory Deficits

The observation that memory decline is one of the earliest markers of AD and is also associated with "normal" aging makes the differentiation between very mild AD and age-related memory deficit problematic. The relevance of accurately characterizing individuals displaying memory impairment has been emphasized by epidemiological reports estimating that while between 5 and 20 percent of the population over 65 years of age suffer from mild to severe dementia (e.g., Mortimer, Schuman, & French, 1981), many of the remaining members of the geriatric population also display some degree of cognitive deterioration (Cummings & Benson, 1983). Furthermore, a recent epidemiological study (Lane & Snowdown, 1989) reported relatively high prevalence and incidence rates for age-associated memory impairment (Prevalence: 34.93% (SE 4.54); Incidence: 6.63% (SE 9.41) per annum) as compared to AD (Prevalence: 13.01% (SE 7.11); Incidence: 3.06% (SE 9.79) per annum).

Kral (1978) was the first to describe benign senescent forgetfulness (BSF) as a circumscribed memory deficit that is largely independent of impairment in other cognitive abilities. BSF has been largely recognized in the literature of clinical

aging, but it has been criticized as being poorly operationalized and insufficiently validated for research purposes (Crook, Bartus, Ferris, Whitehouse, Cohen, & Gerson, 1986).

Recently, a National Institute of Mental Health (NIMH) work group (Crook et al. 1986) proposed specific diagnostic criteria to describe the memory loss that may occur in healthy, elderly individuals in the later decades of life. The term age-associated memory impairment (AAMI) has been selected to characterize individuals who complain of memory impairment in tasks of daily living and display evidence of such impairment on psychological performance tests with adequate normative data. Briefly, the criteria include (1) persons over 50 years of age, (2) complaints of memory loss that are evident in everyday activities, (3) performance on a standardized test of secondary memory that is at least one standard deviation below the mean (4) evidence of preserved intellectual function, and (5) absence of dementia (i.e., a score of 24 or higher on the Mini Mental State Exam). Some of the exclusion criteria are (1) neurologic disorders that could produce cognitive deterioration, (2) history of head injury,

(3) current diagnosis of psychiatric disorder, history of alcoholism or drug dependence.

Youngjohn and colleagues (1991) reported positive results in discriminating persons with AAMI from AD patients based on the NIMH criteria, objective measures of memory function, as well as on self and family ratings of everyday memory function. Reisberg and colleagues (1986) reported a longitudinal follow-up study of patients with degree of memory impairment ranging from very mild to severe. The authors combined a cutting score of 23 or less on the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975) with a cutting score of 4 or less on the Global Deterioration Scale (GDS; Reisberg, Ferris, deLeon, & Crook, 1982) in order to identify individuals with AD. The results suggested that persons displaying very mild or mild cognitive decline (i.e., above cutoff scores and meeting the criteria for AAMI) tended to remain stable over time. On the other hand, individuals showing at least moderate cognitive decline (i.e., at or below cutoff scores) had poor prognosis.

Blackford and La Rue (1989) revised the criteria for diagnosing AAMI and proposed guidelines for identifying more selected subgroups of individuals

with memory deficit. Briefly, the authors argued that since there is a lack of normative data for very old samples, individuals 80 years of age or older should not be identified as having AAMI. Furthermore, they suggested the differentiation of three subtypes of objective memory impairment. The term AAMI is retained as proposed by the NIMH group. Two additional categories are used to describe (a) age-consistent memory impairment (ACMI) which includes persons within the AAMI group whose memory is in accord with normative data (i.e., performance within + or - 1 standard deviation of the mean on 75% or more of the tests), and (b) late-life forgetfulness (LLF) which includes individuals who consistently score below average on memory measures (i.e., performance between 1 and 2 standard deviations below the mean on 50% or more of the tests).

Although the literature suggests that some progress has been achieved in delineating specific guidelines for the evaluation of cognitive decline in "normal" aging, these guidelines are not widely used, and there is some controversy regarding the diagnostic terminology and criteria. Future research is, therefore, warranted in order to verify the accuracy

and relevance of both the NIMH criteria and Blackford and La Rue's (1989) revisions.

The importance of diagnosing memory impairment in "normal" aging has been further emphasized in recent studies that attempted to differentiate groups of elderly according to level of cognitive impairment and/or its progression over a period of time. Storandt and Hill (1989) compared individuals with very mild or questionable dementia, mild dementia, and healthy controls on various psychometric tests. The Logical Memory subtest of the Wechsler Memory Scale made the largest contribution to the discrimination among groups. There was, however, significant overlap between performances of the questionable group with both the healthy and mildly demented groups.

Another study by Morris and colleagues (1991) also attempted to examine the issue of cognitive performance overlap between healthy elderly and patients with questionable dementia. Similar to previous studies, the questionable group's performance on the Logical Memory, Paired Associate Learning (i.e., hard associates) subtests of the Wechsler Memory Scale-Revised (Wechsler, 1987), and on the Information subtest of the Wechsler Adult Intelligence

Scale-Revised (Wechsler, 1981) was significantly worse than that of the control group.

Other studies have examined the longitudinal follow-up of cognitively impaired individuals. Rubin and colleagues (1989) studied 16 patients with questionable dementia of the Alzheimer type, 44 subjects with mild AD and 58 controls. Eleven of the patients with questionable AD (i.e., mild cognitive impairment insufficient in degree to diagnose dementia) either progressed to a dementia stage over an 84-month follow-up period or had AD verified at autopsy. Interestingly, all subjects who displayed evidence of moderate memory loss at entry progressed in global dementia severity.

Tuokko and colleagues (1991) reported that among 45 subjects who did not meet the criteria for dementia at initial assessment, 18 were diagnosed as having possible or probable AD upon reassessment (i.e., 12-18 months later), while 27 subjects remained unchanged. The authors observed that the differences between the "change" and "no change" groups were most evident on a measure of retrieval of information (i.e., free recall). Finally, Katzman (1986) commented on a study in which normal 80-year-old individuals who displayed evidence of memory deficit on mental status

tests were at a significantly increased risk for developing (or being in an early stage of) dementia than their cohorts who made no errors on these tests. The author emphasized that since there is no clear evidence that all such persons will develop dementia, re-evaluation at regular intervals is recommended.

The foregoing studies suggest, therefore, that the distinction between individuals who display mild cognitive impairment and persons in the early stages of a dementing process is particularly evident on memory-related tasks, even though considerable overlap between groups exists. Some of the persons identified as having memory impairment either may be at risk for developing AD or may in fact be in a very mild stage of the disease. Continued longitudinal evaluations of these cases would be necessary in order to address the natural history of memory changes in the elderly. Finally, although some specific guidelines for the classification of memory impaired individuals have been recently proposed (e.g., AAMI), further research is necessary to determine the adequacy of such criteria.

Overall, the literature indicates that although impairment in recalling newly learned information is prominent in the elderly, there appear to be a

significant number of individuals who display a more severe and/or circumscribed deficit in memory-related activities. The characterization of these persons as a separate group (i.e., AAMI) is at present problematic since the degree and pattern of impairment is highly variable, and it may actually represent the early stages of a progressive degenerative disorder.

Awareness/Unawareness of Memory Functioning

Most studies documenting the characteristic memory deficits in dementia patients have not addressed the issue of the degree of awareness of memory impairment displayed by these patients. Very few researchers attempted to investigate the awareness phenomena systematically. Most of the research in the area is based on clinical descriptions.

Overall, the literature on awareness of deficit in dementia suggests that the unawareness phenomena do occur in this syndrome. Lack of awareness is most frequently reported in dementias such as AD and Pick's disease (Benson, 1983; Gustafson & Nilsson, 1982; Neary et al. 1986).

Reisberg and colleagues (1985) examined the relationship between anosognosia and severity of dementia using clinical interviews of patients and

relatives. Subjects included elderly normal controls, subjects with cognitive deficits (i.e., mainly memory impairment) and Alzheimer patients of varying dementia severity (mild to severe). The results revealed a strong relationship between self-awareness of deficits and degree of cognitive deterioration. The subjects with cognitive deficits and mild AD patients rated their memory problems as somewhat worse than did the controls showing awareness of their skills. In contrast, moderately demented patients admitted some cognitive deficits but tended to minimize the extent of their impairment while more severely demented patients tended to deny problems entirely. Additionally, the discrepancy between relatives' and self-descriptions became significantly larger (i.e., with relatives reporting more impairment) as dementia severity increased.

Conversely, several studies (Frederiks, 1985; Joynt & Shoulson, 1985: McGlynn & Kaszniak, 1991a) reported loss of insight in early stages of AD. Mahendra (1984) observed early loss of insight in both AD and Pick's disease and associated this finding with the frontal lobe involvement typically reported in these syndromes. Furthermore, a weak relationship between severity of dementia and unawareness of memory

impairment in AD patients has been recently reported (Feher, Mahurin, Inbody, Crook, & Pirozzolo, 1991; DeBettignies, Mahurin, & Pirozzolo, 1990).

Neary and colleagues (1986) observed that different subgroups of AD patients exhibited different levels of insight. Some patients displayed signs of anxiety when performing demanding tasks, indicating some degree of awareness. Others tended to minimize their difficulties while retaining some awareness of their disability. Still others admitted to memory impairment but had no appreciation for the severity of the deficit and displayed no anxiety. Overall, the literature indicates that there may be considerable variability in awareness among dementia patients.

Reports of unawareness in dementia have primarily examined diminished insight into one's condition rather than unawareness of a specific deficit. In most of the neuropsychological syndromes there is, however, high specificity with preserved awareness for some deficits and lack of insight for others (McGlynn & Kaszniak, 1991b).

Some recent studies that have systematically investigated awareness of memory deficit in dementia have examined metamemorial processes. Metamemory has been defined as knowledge, perceptions and beliefs

about one's memory abilities (Brown, 1975; Flavel, 1981). It has been proposed that metamemory is not a single factor but a combination of several dimensions involving different abilities, attitudes and beliefs. Hultsch and colleagues (1988) described four dimensions of metamemory that appear to be relevant. The first dimension involves knowledge about memory tasks and memory processes. The second dimension involves self-knowledge about how one uses one's memory as well as the current state of one's memory (e.g., reports of strategy use, feeling of knowing judgements, and assessment of the accuracy of one's responses). The third dimension reflects one's sense of competence in memory-related activities (e.g., beliefs about memory capacity, perceived change in memory functioning, and degree to which memory abilities can be self-controlled). The fourth dimension involves mood states that may be related to memory demanding situations (e.g., anxiety, depression, etc.).

A similar view of memory awareness has been proposed by Klatzky (1984) and Cavanaugh (1989). According to these authors memory awareness is composed of three different categories: (1) systemic awareness, which is awareness of the memory system and

how it works; (2) epistemic awareness, which reflects the ability to know the extent and soundness of one's memory (this involves the feeling of knowing, awareness of reliability of memory, and awareness of changes in memory capacity), and (3) on-line awareness or self-monitoring, which refers to the awareness of ongoing memory processes.

Metamemory has been experimentally investigated mostly in developmental research (i.e., age changes in childhood and adulthood). Studies of metamemory involving clinical populations are very few. Some of these studies have used a variety of rating scales or have developed their own quantitative measures (Crook & Larrabee, 1990; Green, Goldstein, Sirockman, & Green, 1991; McGlone, 1991). Most of this research has examined prediction of performance or the feeling of knowing judgement.

The feeling of knowing phenomenon involves the ability to judge the probability of future success in a memory test and appears to involve some degree of self-monitoring. Shimamura and Squire (1986) reported that in Korsakoff patients the frequently observed memory impairment was associated with an inability to predict subsequent memory performance. On the other hand, in amnesics and patients receiving

electroconvulsive therapy, memory impairment was not accompanied by deficient metamemory. The authors concluded that the observed metamemory deficit was specific and independent of the presence of anterograde amnesia. Furthermore, the study suggested that the characteristic widespread cognitive impairment with particular frontal lobe involvement often seen in Korsakoff disease may be responsible for the observed deficits in metamemory. A recent study (Janowsky, Shimamura, Kritchevsky, & Squire, 1989) compared metamemory judgements (i.e., feeling of knowing) in patients with frontal lobe lesions, Korsakoff disease and amnesia. The findings were indicative of deficient metamemory in frontal lobe and Korsakoff patients only. The results support previous views that metamemory and memory are dissociable processes, and suggests an essential contribution of the frontal lobes to metamemory. Similarly, additional studies have documented impaired awareness (i.e., lack of insight) in Korsakoff (Squire & Zouzonnis, 1988) and frontal lobe lesions (Blumer & Benson, 1975). Furthermore, dementias that are typically associated with signs of frontal lobe pathology (i.e., AD and Pick's disease) also display loss of insight (Kaszniak, 1986; Mahendra, 1984).

While the results just mentioned suggest that metamemory can be dissociated from actual memory ability, it has also been suggested that both memory-dependent "trace access" mechanisms and inferential mechanisms (i.e., related to frontal lobe function) may contribute to metamemory judgement (Nelson, Gerler, & Narens, 1984).

Research addressing the issue of prediction of memory performance in dementia has suggested a tendency towards overestimation. Schacter and colleagues (1986), and more recently McGlynn & Kaszniak (1991a) observed that when compared to controls, AD patients grossly overestimated their memory performance. Similarly, Green and colleagues (1991) reported overprediction of performance in AD and underestimation in Parkinson's disease (PD). The authors concluded that variables such as limitations in general intellectual function, in recent memory and in inferential ability all contribute to unawareness of deficit.

A few studies have investigated awareness of memory deficit in dementia and/or age-associated memory impairment through the use of questionnaires. Youngjhon and colleagues (1991) used a self-report questionnaire (i.e., both self-assessment and

relatives' responses) to evaluate memory complaints in patients with AAMI and with AD. The self-report measures of memory complaint accounted for very small portions of the variance between the AAMI and AD groups. AD patients actually reported a higher level of memory functioning than did persons with AAMI, suggesting a tendency towards over-estimation of their abilities. In contrast, the two groups could be clearly discriminated using family ratings of everyday memory function. Specifically, the AD group was portrayed as having lower memory functioning than the AAMI group.

Recently, Feher, Larrabee, & Crook (1992) also compared self-report of memory complaints in AD patients and in individuals with a diagnosis of AAMI. The authors observed that (1) both AD patients and the AAMI subjects had more complaints of memory impairment than did normal elderly subjects, (2) level of memory complaint did not differ between the AD and the AAMI groups and, (3) there was no correlation between dementia severity (i.e., MMSE score) and degree of unawareness. There has been some suggestion, however, that the pattern of self-reported memory skills may be different among subjects, with some AD

patients displaying a tendency to report adequate memory skills.

In an earlier study, Feher and colleagues (1991) observed that AD patients rated themselves as having better memory abilities than did family members. The relatives' ratings of memory functioning correlated significantly with objective memory performance, whereas self-report did not. The authors noted, however, that unawareness of memory deficit was quite variable among these patients ranging from very marked (i.e., reports of good memory) to quite mild (i.e., acknowledgement of memory difficulties with minimization of the severity).

McGlone and colleagues (1990) examined whether 29 patients with dementia, 28 individuals with memory and/or cognitive impairment (i.e., including persons with benign forgetfulness, anxiety, depression and others) and 35 controls differed both in self- and relatives' report of memory functioning. The results indicated that controls had fewer memory complaints than both persons with cognitive/memory impairment and dementia patients. However, non-dementing and dementing cases had similar numbers of memory complaints. Ratings by the relatives of control subjects were significantly higher than ratings by

relatives of cognitive impaired individuals which was higher than that for dementia patients. Similar to previous studies, the authors concluded that the relatives' opinions about recent memory change combined with objective memory evaluation were better predictors of dementia than self-report measures. Green and colleagues (1991) also observed that discrepancies between family and patient ratings (i.e., patients' ratings showed less impairment) on a memory questionnaire were greater for AD patients than for controls.

DeBettignies and colleagues (1990) reported greater loss of insight for impairment in independent living skills (i.e., measured by the discrepancy between informant report and patient self-report) in patients with AD in comparison to patients with multi-infarct dementia and controls. Additionally, level of insight did not appear to be significantly correlated with age, education, intellectual abilities, or level of depression. Recently, Reed and colleagues (1991) observed that (1) unawareness of memory loss in AD patients was not correlated with either severity of dementia or disease duration, (2) AD patients who were unaware of their memory deficits were no more likely to be depressed than other patients. Additionally,

regional cerebral blood flow indicated that unawareness was associated with diminished right superior frontal lobe activity. On the other hand, two recent studies (McGlone et al. 1990; Williams, Little, Scates, & Blockman, 1987) reported that AD patients' memory complaints correlated with depression rather than with objective memory performance. Similarly, Feher and colleagues (1991) suggested that AD patients who are aware of their memory deficits are more likely to be depressed.

In summary, the limited number of studies that have investigated metamemorial processes in persons with dementia or in memory-impaired individuals, and the unknown psychometric properties of many of the instruments used make it extremely difficult to reach firm conclusions about the nature and degree of the memory awareness disturbance in these populations.

In contrast to the situation with clinical populations, there is a considerable number of careful investigations of metamemory in normal adulthood. Additionally, the findings regarding age-related changes in metamemorial processes as well as the psychometric properties of the most widely used instruments are well documented in the literature (Cavanaugh, 1986-87; Cavanaugh & Poon, 1989; Lowen,

Shaw, & Craik, 1990). Two methods have been used to examine adult's metamemory processes: self-report questionnaires and monitoring of memory performance (Hultsch, Hertzog, Dixon, & Davidson, 1988).

1. Self-Report Questionnaires

A variety of questionnaires/rating scales have been developed in order to assess memory complaints (Gilewski & Zelinski, 1986; Herrman, 1982; Mcglone et al. 1990). The majority of these measures have, however, unknown psychometric properties. There is also a tendency in this area of research to adapt portions of previously published questionnaires and develop them into new instruments. This approach makes it very difficult to ascertain whether the constructs underlying the self-report measures are in fact being replicated (Zelinski & Gilewski, 1988). Finally, a small number of these questionnaires have been specifically employed in studies with elderly populations.

Gilewski and Zelinski (1986) reviewed the psychometric properties of ten questionnaires frequently used with the elderly and found that only two of them have acceptable validity and reliability. These two instruments are the Memory Functioning

Questionnaire (MFQ; Gilewski, Zelinski, Schaie, & Thompson, 1983) and the Metamemory in Adulthood (MIA) Questionnaire (Dixon & Hultsch, 1984). These instruments appear to be, therefore, the ones indicated for clinical and research use because of both psychometric criteria and extensive normative data that has been collected across the adult lifespan (Zelinski & Gilewski, 1988). A more recently developed scale, The Memory Assessment Clinics Self-Rating Scale (MAC-S), appears also to have acceptable psychometric properties (Crook & Larrabee, 1990). Overall, these questionnaires address aspects of one's perception of memory abilities in everyday situations (e. g., ability to recall names, phone numbers, faces, etc.). The MIA focuses on a subset of this domain and, in addition, addresses the use of strategies, personal beliefs and affect (Dixon, 1989).

The MIA Questionnaire has 120 items consisting of eight theoretically meaningful scales that reflect everyday relevant activities, behaviors and conditions (Dixon & Hultsch, 1983a, 1984). Each scale represents a dimension of metamemory: (1) use of memory strategies (Strategy), (2) knowledge about memory tasks and processes (Task), (3) perception of own memory capacities (Capacity), (4) perception of change

in memory abilities (Change), (5) activities supportive of memory (Activity), (6) memory and state anxiety (Anxiety), (7) memory and achievement/motivation (Achievement), (8) perception of personal control in memory abilities (Locus; Dixon, 1989).

Internal consistency reliability estimates (Chronbach's alpha) obtained from five independent samples (total N=1108) ranged between .71 and .93 for seven of the eight original MIA subscales (Dixon & Hultsch, 1983). The Capacity scale was internally consistent but was highly correlated with the Change scale. Subsequently, the Activity scale was dropped due to relatively low internal consistency (.28 to .76) (Hultsch et al. 1988). Conceptually, the low alpha scores for the activity subscale are intuitively reasonable since different activities do not have to be highly correlated with a single performance on a specific memory task. The MIA has, therefore, proven to be an encompassing and internally valid measure of metamemory.

Cross validation studies involving a total of 750 subjects (Hertzog, Dixon, Schulenberg, & Hultsch, 1987) indicated that there are at least two higher order factors in the MIA: memory self-efficacy (i.e.,

beliefs about competence) and memory knowledge (i.e., knowledge about memory, affect related to memory ability). The researchers found that factor loadings on the memory knowledge dimension (i.e., Strategy, Task, Achievement, and Anxiety scales) did not vary according to age. On the other hand, the factor loadings on the memory self-efficacy dimension did vary with age. Specifically, the scales Change and Locus related more highly to the self-efficacy dimension in the old group (i.e. 60 to 70 years of age) than in the young group (i.e., 20-30 years of age). Overall, the results were thought to show that perceptions of change are more highly associated with anxiety about memory and perceptions of reduced control over memory abilities in the elderly than in younger adults.

Hultsch and colleagues (1988) reported evidence for convergent validity between the MIA and the MFQ (Gilewski et al., 1983). Analyses derived from several studies found convergence of the MIA and the MFQ measures of strategy use and perceived change in memory. Convergence between the questionnaires on a Self-Efficacy factor was also reported, with the MIA Capacity and the MFQ Frequency of Forgetting being the best indicators.

Preliminary analyses reported by Hultsch and colleagues (1988) also provided evidence for the MIA discriminant validity. Specifically, these analyses indicated that constructs identified in the MIA are not accounted for by generalized locus of control, state or trait anxiety, depression, or concurrent depressive affect. The MIA Anxiety scale appears to be correlated significantly with trait and state anxiety but has an independent significant relationship to memory Self-Efficacy.

The literature examining adult age differences in metamemory through self-report questionnaires reveals variable results. There has been disagreement about whether older adults report more memory failures than younger adults (Perlmutter, 1978; Sunderland, Harris, & Baddeley, 1983). Similarly, variable patterns have been observed for self-perception of memory abilities or capacities with older adults showing poorer perception than younger adults (Gilewski et al. 1983; Zelinski, Gilewski, & Thompson, 1980), as well as the opposite pattern (Bennet-Levy & Powell, 1980). A recent study with a sample of 14,000 older adults (Cutler & Grams, 1988) reported an age-related increase in complaints of declining memory functioning with persons over 85 years of age reporting more

difficulties in everyday memory activities than younger adults. There is, however, considerable diversity in the selection of measures in the majority of the studies which hinders the ability to separate age effects from measurement effects.

Recent studies using the MIA indicated that there may be reliable age differences on dimensions of metamemory (Cavanaugh & Poon, 1989; Hultsch, Hertzog, & Dixon, 1987). There is evidence to suggest that when compared to younger adults, older adults perceive themselves as having less memory capacity, report memory decline, make less use of strategies to improve performance, and believe they cannot do much to enhance memory functioning or to prevent its deterioration.

Lowen and colleagues (1990) detected meaningful age differences in metamemory using the MIA. The authors observed an increase in self-reported memory problems and strategy use with age. According to their findings older adults appeared to make use of external reminders as opposed to internal strategies more often than young adults. The use of external aids may, however, be related to life style (e.g., appointments to remember) as much as it seems to be an age-related attempt to compensate for memory failures.

Overall, in both the MIA and the MFQ age differences are particularly pronounced on subscales that ask for ratings of memory relative to past performance (Hultsch et al. 1988).

The relationship between memory self-reports and memory performance in the elderly is also a controversial issue. Hermann (1982, 1984) has suggested that the predictive validity of metamemory questionnaires is relatively limited. The observed low correlations between some questionnaires and performance measures may be a result of (1) low reliability in the metamemory scale, i.e., the scale itself is a poor measure, (2) lack of a clear definition of metamemory, or (3) questionable ability to generalize laboratory tests to everyday memory-related activities.

Recent studies have pointed out that metamemory is multidimensional, therefore, it is important that the memory tasks and the complaint measures administered assess similar aspects (Dixon, 1989; Dixon & Hertzog, 1988). Gilewski and Zelinski (1986) suggested that among laboratory tasks the most appropriate measures are delayed recall and recall of passages because they are more approximate to everyday memory functioning. Similarly, Dixon and Hultsch

(1983b) suggested that metamemory-memory performance relations are more likely to occur when memory tasks have high ecological validity.

Dixon and colleagues (1986) reported low to moderate correlations between MIA scales and several memory and verbal comprehension tests. Additionally, the authors observed that for older adults the MIA scales Task, Achievement and Locus were more related to cognitive and memory tasks than were any other scales. Hertzog and colleagues (1990) reported, however, significant correlations between memory self-efficacy (i.e., as measured by the MIA Questionnaire and the MFQ) and the recall of words and texts.

2. Monitoring of Memory Performance

The second method that has been widely used to investigate metamemory in normal adulthood is monitoring of memory performance, also known as awareness of ongoing memory processes or on-line awareness (Cavanaugh, 1989; Klatzky, 1984). On-line awareness has been examined from a limited number of perspectives in adult developmental research. The majority of studies in the literature involve some type of memory prediction paradigm (Bruce, Coyne, & Botwinick, 1982; Coyne, 1985: Murphy et al. 1981).

The procedure involves giving the subjects a description of a task, followed by a request to predict performance. Some researchers have found that the elderly were as accurate as the young in predicting their performance (Lachman, Baltes, Nesselroade, & Willis, 1982; Perlmutter, 1978; Rabinowitz, Ackerman, Craik, & Hinchley, 1982), whereas others have found that the elderly tend to overestimate their performance (Bruce et al. 1982; Murphy et al. 1981). A possible factor accounting for the overestimation of performance in older adults is lack of metamemorial knowledge about task demands (Cavanaugh, 1989). This observation is consistent with research reporting that older adults are less aware of the nature of tasks demands and how they influence performance (e.g., recall versus recognition).

Most previous aging research has emphasized awareness of memory as reflected by predictions of future performance. An additional aspect of memory monitoring involves the ability to derive accurate memory evaluations on the basis of awareness of recent performance levels. Devolver and colleagues (1990) examined younger (19-41 years) and older (59-93 years) adults' estimates of performance either before (i.e.,

predictions) or after (i.e., postdictions) completing memory tasks. The authors used large samples (total n=272), several memory tasks (e.g., including laboratory tests and ecologically valid tasks, with replication across samples), and identical monitoring measures across studies. Predictions were less accurate than postdictions at both age levels, suggesting that the subjects monitored their performance during testing. Age differences in monitoring occurred only in predictions, with younger adults being more accurate than older adults in some tasks (e.g., recognition) but not in others (e.g., appointment keeping task). These findings support previous research (Lovelace & Marsh, 1985) reporting that both young (17-24 years) and old (60-75 years) adults were accurate in the evaluation of their responses in a verbal recognition memory task.

Performance prediction and postdiction, however, are not the only manifestation of self-monitoring or on-line awareness. Monitoring involves the whole experience of knowing about ongoing cognitive functioning (Cavanaugh, 1989). In everyday memory, on-line awareness may occur in the form of keeping track of what one is thinking about or what has to be done, a realization of when something is going right

or wrong, etc. These different forms of monitoring are, however, more difficult to address with objective laboratory tasks.

In summary, a review of the literature indicates that disturbances in awareness of memory deficit do occur in AD. There have, however, been few attempts to investigate this phenomenon systematically, despite the fact that memory impairment is one of the most prominent cognitive deficits in AD. Furthermore, preliminary results suggest that individuals displaying age-related memory deficits appear to be aware of their memory difficulties. Finally, although some studies investigating unawareness made use of objective measures (e.g., questionnaires), these are not widespread and some of these assessment tools are themselves characterized by methodological problems.

Neuropsychological studies addressing awareness of memory deficit in AD and in persons with age-related memory deficits by using metamemory techniques appear to be potentially helpful in characterizing the unawareness phenomena and may contribute substantially to further progress in the area. The extensive research addressing metamemory processes in adulthood has clearly defined concepts and developed instruments with acceptable psychometric criteria that may be

adapted for investigating unawareness in clinical populations.

Purpose of the Study

The overall purpose of the present study was to apply the concepts and instruments described in the metamemory literature to the study of awareness of memory deficit in patients diagnosed as having possible or probable AD (McKhann et al., 1984) as well as in individuals displaying memory impairment.

The multidimensional approach to metamemory proposed by Cavanaugh (1989), Dixon (1989), Hultsch and colleagues (1988), and Klatzky (1984) appears to account for relevant aspects involved in the awareness of memory deficit phenomena. According to Hultsch and colleagues (1988) age differences in the MIA are particularly pronounced on subscales that address memory relative to past performance, with older adults being more likely to report memory decline than younger adults. Although McGlone and colleagues (1990) observed that AD patients and individuals with memory/cognitive impairment displayed a tendency to report similar levels of change and/or complaints in memory abilities, most studies have not specifically addressed perceptions of change in memory functioning

among AD patients. The Change scale was used, therefore, in order to compare AD patients, memory impaired subjects, and controls in their report of memory capacity in relation to previous levels of functioning.

Additionally, a modified Change scale (i.e., in informant-rated format) was prepared to be completed by the relative/ caregiver. Recent studies investigating both patient self-report and relatives' report of memory functioning (e.g., McGlone et al., 1990; Youngjhon et al., 1991) indicated that family ratings were particularly useful in discriminating AD patients from AAMI and normal elderly groups. Comparisons between self-report and relative's report were also made since there is evidence that it provides relevant information regarding awareness of memory deficit in AD (e.g., Feher et al., 1992).

The relationship between performance on objective memory tests and perception of change (i.e, both self- and caregiver's report) in memory abilities was investigated since there is some indication that in dementia patients relative's report of memory abilities is more strongly associated with memory performance than is patient self-report (e.g., McGlone et al., 1990).

Studies using the MIA with normal elderly (e.g., Cavanaugh & Poon, 1989; Hultsch et al., 1987) reported that older adults appear to believe they have reduced control over memory abilities and make less use of strategies to improve memory performance when compared to younger adults. Furthermore, perception of change in memory appear to be associated with anxiety in memory-related activities and reduced control particularly in older adults (Hertzog et al., 1987). Although clinical observations have associated preserved awareness of memory deficit in AD with the presence of anxiety (Neary et al., 1986), objective information regarding the contribution of these various metamemorial aspects to the awareness phenomena in clinical populations is lacking. The MIA scales Locus, Strategy, and Anxiety were used, therefore, to address the question of whether AD patients, memory-impaired individuals, and normal controls differ in these three aspects of metamemory.

Klatzky (1984) and Cavanaugh (1989) have proposed that on-line awareness or self-monitoring is an important dimension of metamemory. Recent clinical investigations have suggested that intrusion errors (Shindler et al., 1984), ability to self-correct (Marshal & Tompkins, 1982), and evaluation of memory

performance (Devolver et al., 1990) may be useful as indicators of preserved or defective self-monitoring abilities. The ability to self-monitor was investigated in the three subject groups by analyzing the occurrence of intrusion errors and self-corrective behavior on selected neuropsychological tests, and by assessing the ability to evaluate level of performance (i.e., postdictions) on memory tests.

Expected Findings

According to the literature review addressing metamemory processes in AD patients, memory-impaired individuals and "normal" elderly, the following general findings were expected:

If AD patients present diminished awareness of memory deficit in comparison to the other two groups, they would be less likely to: (a) report memory decline, (b) report lack of internal control over memory abilities, (c) use strategies to improve their performance, and (d) report anxiety in memory-related activities. (e) A greater discrepancy between the self- and the relative's report of memory decline (i.e., relative reporting more decline than subject) would be expected for the AD group than for the other two groups. Overall, (f) relative's report of memory

change would be expected to be more highly correlated with actual memory performance than self-report of change in memory functioning.

AD patients were expected to display diminished self-monitoring abilities in comparison to memory-impaired individuals and controls. Specifically, the AD group would be more likely to: (g) make more intrusion errors with fewer self-corrections, and (h) provide less accurate estimates of their performance on memory tests than the other two groups.

METHOD

Subjects

A total of fifty-six subjects participated in the present study, including twenty patients with AD, eighteen individuals with memory-impairment, and eighteen normal elderly controls.

The majority of the subjects (80%) were community or institution residents from Vancouver Island who were recruited to participate in the "Canadian Study of Health and Aging" (CSHA). Among the subjects involved in the CSHA who received a complete clinical assessment (i.e., Geriatrician's evaluation, laboratory tests, neuropsychological assessment;n=97), three diagnostic groups were selected to be included in the present study. The first group was made of nine subjects meeting the DSM-III-R (1987) diagnostic criteria for dementia. Among these individuals, four met the NINCDS-ADRDA (McKhann, 1984) criteria for Probable AD and five for Possible AD.

The second group included individuals who did not meet the criteria for dementia but who nevertheless displayed evidence of memory impairment upon clinical examination (i.e., Geriatrician's evaluation) and neuropsychological assessment (n=26). The final

diagnosis of specific memory impairment was obtained by consensus after discussion (i.e., case conference) among all professionals involved in the diagnostic process. Only the individuals who displayed circumscribed memory deficits with no history of alcohol or drug chronic use, psychiatric disorders, neurological disorders, or head injury with unconsciousness formed the memory-impaired group (n=18).

The normal control group included eighteen individuals who did not display cognitive deficits upon clinical or neuropsychological evaluation, had no history of alcohol or drug chronic use, psychiatric disorders, neurological disorders or head injury, and were, therefore, considered as being cognitively intact upon clinical consensus. Subjects who did not meet these criteria (n=3) were not included in the control group.

In order to increase the number of AD patients, eleven additional subjects were obtained from three different sources. (1) Four individuals referred to the Elderly Outreach Service (EOS) in Victoria, B.C., who were diagnosed as having Possible AD upon neurological and neuropsychological evaluations were selected to be included in the AD group. (2) Two AD

patients (one with Possible AD and another with Probable AD) were obtained from the private practice of the Geriatrician involved in the CSHA. (3) Five patients were obtained from the Clinic for Alzheimer's Disease and Related Disorders at the UBC Health Science Centre Hospital in Vancouver, B.C.. These five patients received extensive clinical and neuropsychological examinations with final diagnosis of either Probable AD (n=2) or Possible AD (n=3).

A total sample of 56 individuals between the ages of 66 and 95 were thus included in the three groups. The AD group included twenty patients, seven patients with Probable AD and thirteen with Possible AD. Among the Possible AD patients, nine had a coexisting disease and four showed an atypical presentation. Eighteen subjects formed the memory-impaired group while eighteen subjects were included in the normal control group.

All subjects obtained from the CSHA and AD patients referred from the EOS or the Geriatrician were evaluated on a 13-item self-report depression scale (i.e., the selection of questions as well the cutoff scores were defined by the CSHA) while AD patients obtained from the Clinic for Alzheimer's disease in Vancouver received the Geriatric Depression

obtained from sources other than the CSHA received the 3MS or the MMSE as part of the overall clinical and neuropsychological assessment.

2. Neuropsychological Test Battery

All subjects except the AD patients obtained from The Alzheimer's Disease Clinic in Vancouver received the following neuropsychological tests: (1) Information subtest of the Wechsler Memory Scale-Revised (WMS-R;Wechsler, 1987); (2) Buschke Cued Recall Procedure for memory assessment (Buschke, 1984; Tuokko & Crockett, 1989); (3) Rey Auditory-Verbal Learning Test (Rey, 1964; Lezak, 1983); (4) Benton Visual Retention Test- Multiple Choice Form F (Benton, 1974); (5) Digit Span (WMS-R;Wechsler, 1987); (6) The following subtests of the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981): Similarities (short form), Comprehension (short form), Block Design (short form), Digit Symbol; (7) Token Test Form A (Benton & Hamsher, 1989); (8) Word Fluency Test (letter and animal;Spreen & Benton, 1977). The duration of the neuropsychological evaluation was approximately two hours.

The neuropsychological test battery administered to the patients seen at the Alzheimer's Clinic in Vancouver included:
the Similarities, Information, Digit Span, Block Design, and Digit Symbol subtests of the WAIS-R (Wechsler, 1987), the Buschke Cued Recall Procedure for memory assessment (Buschke, 1984; Tuokko & Crockett, 1989), the Word Fluency Test (letter and animal;Spreen & Benton, 1977), Finger Tapping (Reitan & Davidson, 1974), and the Design Recall and Design Reproduction subtests of the Luria Nebraska Neuropsychological Battery (Golden, 1981).

3. Estimation of Performance

Upon completion of the Neuropsychological test battery the subjects were asked to estimate the total number of correct responses they thought they were able to obtain on selected memory tests. These tests are the Buschke Cued Recall Procedure (i.e., total number of items remembered on the third trial), the Rey Auditory-Verbal Learning Test (i.e., total number of items recalled on the fifth trial) and the Benton Visual Retention Test (i.e., total number of correctly identified designs). Additionally, confidence ratings regarding the accuracy of the postdictions (e.g.,

confident, somewhat confident, not confident) were required from all subjects (see Appendix A). Performance ratings for which subjects were not confident were disregarded.

Measures of postdiction accuracy were calculated for each test according to the paradigm suggested by Levin and colleagues (1977). The paradigm involves subtracting the actual score (A) from the postdiction score (P) and dividing it by the actual score (A) (i.e., (P - A)/A). The postdiction accuracies were then averaged across the three tests in order to obtain a single postdiction score for each subject.

4. Modified MIA Questionnaire

Estimation of performance was followed by the completion of a self-report questionnaire. Since all subjects received a complete battery of neuropsychological tests, only 15 minutes were available for the completion of a metamemory questionnaire. Since the complete MIA questionnaire (Dixon & Hultsch, 1983) requires about sixty minutes, a shortened version was made by selecting a subset of items from the original MIA. Only some of the items on the Change, Strategy, Anxiety, and Locus scales were included according to their relevance to the

issues to be addressed in the present study. Overall, an effort was made to include items with ecological validity for both community and institution subjects (i.e., for AD patients, memory-impaired individuals, and controls).

On the Change scale items that involve self-perception of change were selected while statements addressing daily activities (e.g., reading), expectations of memory performance, and evaluation of someone else's ability were eliminated. On the Strategy scale, items that address the use of internal strategies (e.g., visual imagery) were selected, while items involving the use of external strategies (e.g., keeping an appointment book) were eliminated since such items may be irrelevant to individuals who are no longer working and/or are living in institutions. On the Anxiety scale, items that involve perception of anxiety in memory-related situations were selected, while statements addressing knowledge that particular tasks/situations may produce anxiety were disregarded. All items on the Locus scale were included. The resulting questionnaire comprised the following number of items: 9 from the Change scale, 9 from the Strategy scale, 7 from the Anxiety scale, and 9 from the Locus scale. A total of 34 statements from the four scales

were randomized to form the reduced version of the MIA Questionnaire (see Appendix B).

Additionally, a version of the Change scale in informant-rated format was completed by the relative (see Appendix C). Subsequently, a discrepancy score between the relative's and the patient's response to the same items was obtained.

The original MIA instructions were slightly simplified in order to guarantee clear understanding. Instructions and questions were read aloud by the examiner while the subjects followed them on their copy. Answers were given orally and the examiner marked them on the questionnaire. Although the instructions were also read aloud for the relatives, these individuals completed the scale without further help from the examiner.

Items on each scale are rated on a 5-point Likert scale. Some items involve strength-of-agreement responses (e.g., agree strongly, agree, undecided, disagree, disagree strongly) while others involve frequency of occurrence (e.g., never, rarely, sometimes, often, always). The results are computed so that a higher number reflects a more positive response (e.g., less change in memory abilities, more frequent use of strategies).

Internal consistency reliability for the modified MIA scales was obtained from a data base including 397 normal elderly with ages ranging from 55 to 86 years (Hultsch et al 1990). Cronbach's alpha values were as follows: .76 for the Strategy scale, .86 for the Change scale, and .82 for the Anxiety scale. Cronbach's alpha for the original Locus scale is .81.

Internal consistency estimates of reliability for the modified MIA on the present sample were not expected to be significantly lower than the values obtained with the normal elderly sample. Furthermore, discriminant and convergent validity of the selected scales was expected to be equivalent to the original version since only a reduction in the number of items had been attempted. However, further research would be necessary in order to confirm the validity of the instrument.

5. Intrusion Errors and Self-Corrections

According to previous studies, intrusion errors are particularly prominent during the execution of specific neuropsychological tests (Butters et al. 1987; Fuld et al. 1982). For the tests administered, the subjects' performance on the following were investigated: Buschke Cued Recall Procedure, Rey

Auditory-Verbal Learning Test, Word Fluency, and Animal Fluency. The procedure involved recording the subjects' correct responses, errors, and comments regarding either perception of errors (i.e., self-corrective behavior) or correct responses.

Taking into account the diversity of definitions of intrusion errors and perseverations that have been proposed in the literature, the following criteria were selected. Intrusion errors were defined as either (1) prior-task intrusions (i.e., repetition of responses from a preceding test or procedure, or (2) extra-task intrusions (i.e., introduction of unrelated items not presented in preceding tasks). Perseverations were defined as repetition of a correct word within a given task or trial.

The definition of self-corrective behavior includes either of two types of responses: (1) indication of some degree of perception of the occurrence of an error without correction (i.e., verbal acknowledgements of response inadequacies such as "I think I said this word before" or "Was this word on the list?"); (2) perception of the occurrence of an error followed by correction (e.g.,"I've said this word already", "This word was not on the list").

Additionally, comments on correct responses (e.g., "I said this word already") were also noted.

Total scores were computed for intrusion errors (i.e., the sum of prior-task, extra-task, perseverations) and self-corrections (i.e., the sum of acknowledged errors, corrected errors, comments on accuracy). An evaluation of type of intrusions and type of self-corrections was performed.

Statistical Analysis

Multivariate Analysis of Variance (MANOVA) on the dependent variables age, education, and estimated IQ was performed in order to examine whether the three groups differed on these variables. A one-way ANOVA with the 3MS as the dependent variable was performed to examine the expected differences among groups in overall level of cognitive abilities.

A MANOVA was performed using the MIA scales Change-Self, Change-Care, Strategy, Locus, and Anxiety as dependent variables and Group (AD, memory-impaired, control) as the independent variable in order to compare groups on these scales. Post Hoc comparisons (i.e., Scheffé test) were used to investigate group differences.

Correlations between the subjects' performance on the Buschke delayed recall and self-report of change in memory functioning, as well as correlations between delayed recall and relative's report of memory change were performed.

A measure of delayed recall of information was selected since it appears to best approximate the content of the Change scale items (e.g., ability to remember names or dates). Furthermore, there has been some suggestion that delayed recall measures better approximate everyday memory functioning than do immediate recall measures (Gilewski & Zelinski, 1986).

In order to investigate unawareness of memory deficit, a discrepancy score was computed between the Change scale in self-report format (Change-Self) vs. the Change scale in informant-rated format (Change-Care). A One-way ANOVA was performed to study overall group differences on this variable. Planned comparisons (i.e., t-tests) were used to further examine specific group differences.

A one-way ANOVA was performed on the average number of mispostdictions in order to investigate differences between groups. Planned comparisons (i.e., t-tests) were used to specifically examine which groups were different.

MANOVAS were performed in order to compare groups on type of intrusion error (i.e., prior-task, extra-task, perseverations) and self-corrections (i.e., acknowledged, corrected, comments). Post hoc comparisons (Scheffé procedure) were used to investigate group differences.

RESULTS

Demographic and Psychometric Variables

Multivariate Analysis of Variance (MANOVA) was performed with three dependent variables: age, education, and estimated IQ in order to investigate if the three groups (AD, memory-impaired, controls) differed on these demographic variables. The multivariate test of significance for Group effect was significant (Wilk's Lambda =.78, $F(6,102)=2.31$, $p<.001$). Follow- up univariate F tests revealed that significant group differences occurred for age ($F(2,53)=3.32$, $p<.044$) but not for education or estimated IQ. Post hoc tests (Scheffé procedure) indicated that the memory-impaired group was significantly ($p<.05$) older (mean=84.28, s.d.=5.8) than the AD group (mean=78.45, s.d.=7.6). No significant ($p>.05$) age differences between the memory-impaired and control groups were observed.

A one-way ANOVA with 3MS as the dependent variable and group as the independent variable indicated significant group differences ($F(2,52)=29.74$, $p<.001$). A total of 55 cases was used for this procedure since one case was missing a score on the 3MS. Post hoc tests (Scheffé procedure) showed that the AD group obtained

significantly ($p<.01$) lower 3MS scores (mean=69.8, s.d.=8.3) than both the memory-impaired (mean=80.67, s.d.=9.01) and the control groups (mean=90.61, s.d.=7.20), and the memory-impaired group's 3MS score was also significantly ($p<.01$) lower than the control's score. Table 1 provides statistics on sex, age, education, estimated IQ, 3MS score, and depression score as well as on selected cognitive variables.

Possible differences within the AD group were examined since patients were obtained from various sources. The AD group was divided into three subgroups according to source: (1) patients obtained through the CSHA (n=9), (2) patients referred from the EOS/Geriatrician (n=6), (3) patients assessed at the Alzheimer's disease Clinic in Vancouver (n=5). A MANOVA was performed on four dependent variables: age, education, estimated IQ, and 3MS score, with group (CSHA, EOS/Geriatrician, Vancouver) as the independent variable. The original 20 cases were reduced to 19 with the exclusion of a case missing a score on the 3MS. The multivariate test of significance for group effect was significant (Wilk's Lambda=.18, $F(8,26)=4.38$, $p<.002$). Univariate F tests revealed significant group differences for age ($F(2,16)=10.7$, $p<.001$) and 3MS score ($F(2,16)=10.3$, $p<.001$) but not for education or

Table 1

Statistics for Demographic and Psychometric Variables (3 Groups)

	Group			
	AD	Memory Impaired	Controls	
	M (SD) n=20	M (SD) n=18	M (SD) n=18	F
Age	78.45 (7.63)	84.28 (5.77)	81.78 (7.39)	3.32*
Sex(M/F)	4/16	7/11	10/8	
Education	11.4 (2.87)	10.2 (3.34)	12.39 (4.23)	1.81
Est. FIQ	102.7 (7.54)	101.78 (10.5)	107.6 (9.41)	2.11
3MS	69.84 (8.26)	80.67 (9.01)	90.6 (7.20)	29.74**
Depression Score	1.4 (1.76)	1.3 (.96)	1.6 (2.28)	.16
Free Recall-Buschke	10.1 (4.08)	20.9 (6.38)	26.22 (4.62)	49.99*
Delayed Recall-Buschke	2.9 (2.24)	7.4 (3.11)	10.06 (1.55)	44.11**
Word Fluency	26.25 (10.2)	26 (10.2)	33.6 (14.1)	2.55
Animal Fluency	9.2 (2.17)	12.7 (3.83)	17.6 (4.41)	25.96*

Note. The AD group depression score was calculated only for subjects who received the 13-item scale (N=15).

* $p < 0.05$ ** $P < 0.01$

estimated IQ. Post hoc comparisons (Scheffé procedure) indicated that patients obtained from the CSHA were significantly ($p<.05$) older (mean=84.1, s.d.=4.5) than both patients referred from the EOS/Geriatrician (mean=76.3, s.d.=7.7) and patients evaluated at the Alzheimer's disease Clinic in Vancouver (mean=70.8, s.d.=3.1). Post hoc comparisons also indicated that the patients obtained from the CSHA had significantly ($p<.05$) lower 3MS scores (mean=63.6, s.d.=5.6) than both patients referred from the EOS/Geriatrician (mean=74.2, s.d.=4.9) and patients assessed at the Alzheimer's disease Clinic in Vancouver (mean=76.8, s.d=6.9). No significant differences were observed between patients referred from the EOS/Geriatrician and patients evaluated at the Alzheimer's disease Clinic in Vancouver on these variables. Statistics on the four dependent variables and depression score according to AD patient source are presented in Table 2. It is important to note that the CSHA study used a stratified sampling procedure which forced a higher percentage of older subjects into the sample than would be obtained in a typical clinic admission sample.

Because of the lower age and the higher 3MS score of the patients obtained from the EOS/geriatrician and from the Alzheimer Clinic in Vancouver, these patients

Table 2

AD Subjects Characteristics According to Source

	Group			
	CSHA	EOS/Geriat.	Vancouver	
	M (SD) n=9	M (SD) n=6	M (SD) n=5	F
Age	84.11 (4.48)	77.8 (7.62)	70.8 (3.11)	10.7*
Education	10.55 (1.66)	13.4 (3.13)	11.00 (4.12)	1.68
Est. FIQ	99.44 (5.59)	108.4 (6.80)	103.4 (9.76)	2.55
3MS	63.55 (5.59)	74.2 (4.9)	76.8 (6.87)	10.34*
Depression Scales	1.33 (2.23)	1.5 (.84)	6 (3.74)	

Note. Mean scores for depression are derived from a different scale (30 items) for the Vancouver sample.

* $p < 0.05$

were combined into one group (NON-CSHA; n=11) and compared to the AD patients recruited from the CSHA (n=9), the memory-impaired subjects, and the normal controls. Post hoc comparisons (Scheffé procedure) indicated that the NON-CSHA AD patients were significantly ($p<.05$) younger (mean=73.81, s.d.=6.48) than all other CSHA subjects, who did not differ on age ($p>.05$). Scheffé tests also showed that the AD patients from the CSHA obtained significantly ($p<.05$) lower 3MS scores (mean=63.55, s.d.=5.6) than the NON-CSHA AD patients (mean=75.5, s.d=5.8), the memory-impaired group (mean=80.67, s.d.=9.01) and the controls (mean=90.61, s.d.=7.20). While the normal controls obtained significantly higher ($p<.05$) 3MS scores than all other groups, no significant differences were observed between the memory-impaired and the AD patients obtained from the NON-CSHA sources on this variable. Statistics for the four groups on age, estimated IQ, education, and 3MS score, are presented in Table 3.

Differences between AD patients diagnosed as having Possible AD (n=13) or Probable AD (n=7) were also investigated. A MANOVA was performed on the dependent variables age, education, estimated IQ, and 3MS score with group (Possible vs. Probable) as the independent variable. The multivariate test of significance for

Table 3

Subjects Characteristics (4 Groups)

	Group				
	CSHA-AD	NON-CSHA-AD	Memory-Impaired	Controls	
	M (SD) n=9	M (SD) n=11	M (SD) n=18	M (SD) n=18	F
Age	84.11 (4.48)	73.81 (6.48)	84.28 (5.76)	81.78 (7.39)	7.1*
Education	10.55 (1.66)	12.09 (3.57)	10.2 (3.34)	12.39 (4.23)	1.53
Est. FIQ	99.44 (5.57)	105.36 (8.12)	101.78 (10.5)	107.6 (9.41)	2.14
3MS	63.55 (5.59)	75.5 (5.79)	80.67 (9.01)	90.6 (7.20)	28.2*

* $p < 0.05$

group effect was non-significant (Wilk's Lambda=.57, $F(4,14)=2.61$, $p>.081$) indicating that Possible and Probable AD patients did not differ on these dependent variables.

MIA Scales Reliability

Internal consistency reliability estimates (Chronbach's alpha) were obtained for the modified MIA scales using the whole sample of subjects. Chronbach's alpha values were as follows: .83 for the Change scale, .95 for the Change scale in informant-rated format, .82 for the Locus scale, .83 for the Strategy scale, and .74 for the Anxiety scale. Overall, the five modified scales appear to be internally consistent.

Reliability estimates for the modified MIA scales were also obtained for each group separately (i.e., AD, memory-impaired, controls). Chronbach's alpha values on the five scales ranged from: (1) .72 to .92 for the AD group, (2) .60 to .88 for the memory-impaired group, and (3) .69 to .93 for the control group. Reliability information is presented in Table 4.

MIA Scales-Overall Analyses

A MANOVA was performed using the modified MIA scales Change-Self, Change-Care, Strategy, Anxiety, and

Table 4

Modified MIA Questionnaire Reliability (Cronbach'a Alpha)

	Whole Sample	Group		
		AD	Memory-Impaired	Controls
	n=56	n=20	n=18	n=18
Change-Self	.83	.81	.76	.86
Change-Care	.95	.92	.88	.93
Locus	.82	.72	.86	.86
Strategy	.83	.90	.82	.69
Anxiety	.74	.78	.60	.74

the original Locus scale as dependent variables with group (AD, memory-impaired, controls) as the independent variable. Two subjects were excluded from this analysis due to missing data. The multivariate test of significance for Group effect was significant (Wilk's Lambda=.34, $F(10,94)=6.75$, $p<.001$). Post hoc comparisons (Scheffé procedure) found no significant group differences ($p>.05$) for the Strategy scale, the Anxiety scale, the Locus scale, or the Change-Self scale. Post hoc comparisons (Scheffé procedure) did, however, show that all three groups were significantly ($p<.01$) different from each other on the Change-Care scale (mean for the AD group=12.8, s.d.=3.5; mean for the memory-impaired group=21.5, s.d.=7.3; mean for the control group=31.3, s.d.=7.4). Post hoc comparisons also indicated that the CSHA AD patients did not differ ($p>.05$) from the NON-CSHA AD patients on the Change-Care scale (mean=11.4, s.d.=3.3, mean=13.9, s.d.=3.4, respectively) or on the Change-Self scale (mean=18.9, s.d.=5.1; mean=20.1, s.d.=4.4, respectively).

An evaluation of the Change-Care scale means showed that the AD patients' informants reported more change in memory functioning than did both the memory-impaired subjects' informants and the controls' informants. Furthermore, the memory-impaired subjects' informants

reported more change in memory abilities than did the controls' informants.

Although Scheffé tests showed that the groups were not significantly different on the Change-Self scale ($p>.05$), suggesting that all subjects reported similar levels of change in memory functioning (mean for the AD group=19.6, s.d.=4.7; mean for the memory-impaired group=19.3, s.d.=5.2; mean for the control group=24, s.d.=5.7), examination of the means showed that the control group had a tendency to report less change in memory performance than did both AD and memory-impaired subjects (see Figure 1).

Table 5 provides the mean values for the modified MIA scales for the three groups of the present sample as well as for a sample of 67 normal elderly 74 years of age or older (mean age=78.7, s.d.=3.01; Hultsch et al., 1990). Overall, the two samples appeared to report equivalent levels of (1) change in memory functioning, (2) anxiety in memory-related activities, (3) control over memory abilities, and (4) use of strategies to improve memory performance.

Perception of Memory Change/Memory Performance

A one-way ANOVA comparing the three groups on the change-self vs. change-care discrepancy score revealed

FIGURE 1

Means and SEM for the MIA Questionnaire Scales.

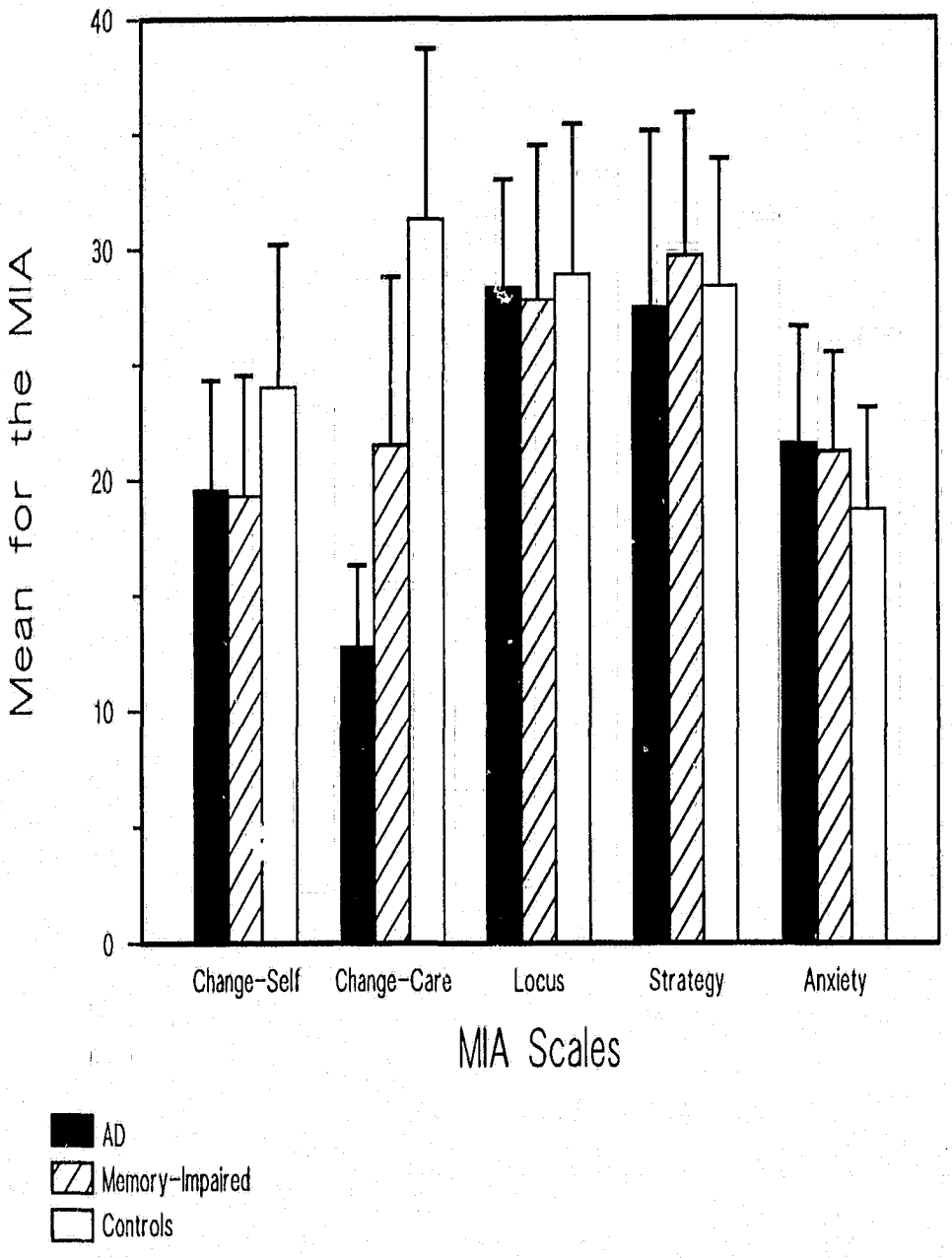


Table 5

Group Comparisons on the Modified MIA Questionnaire Scales

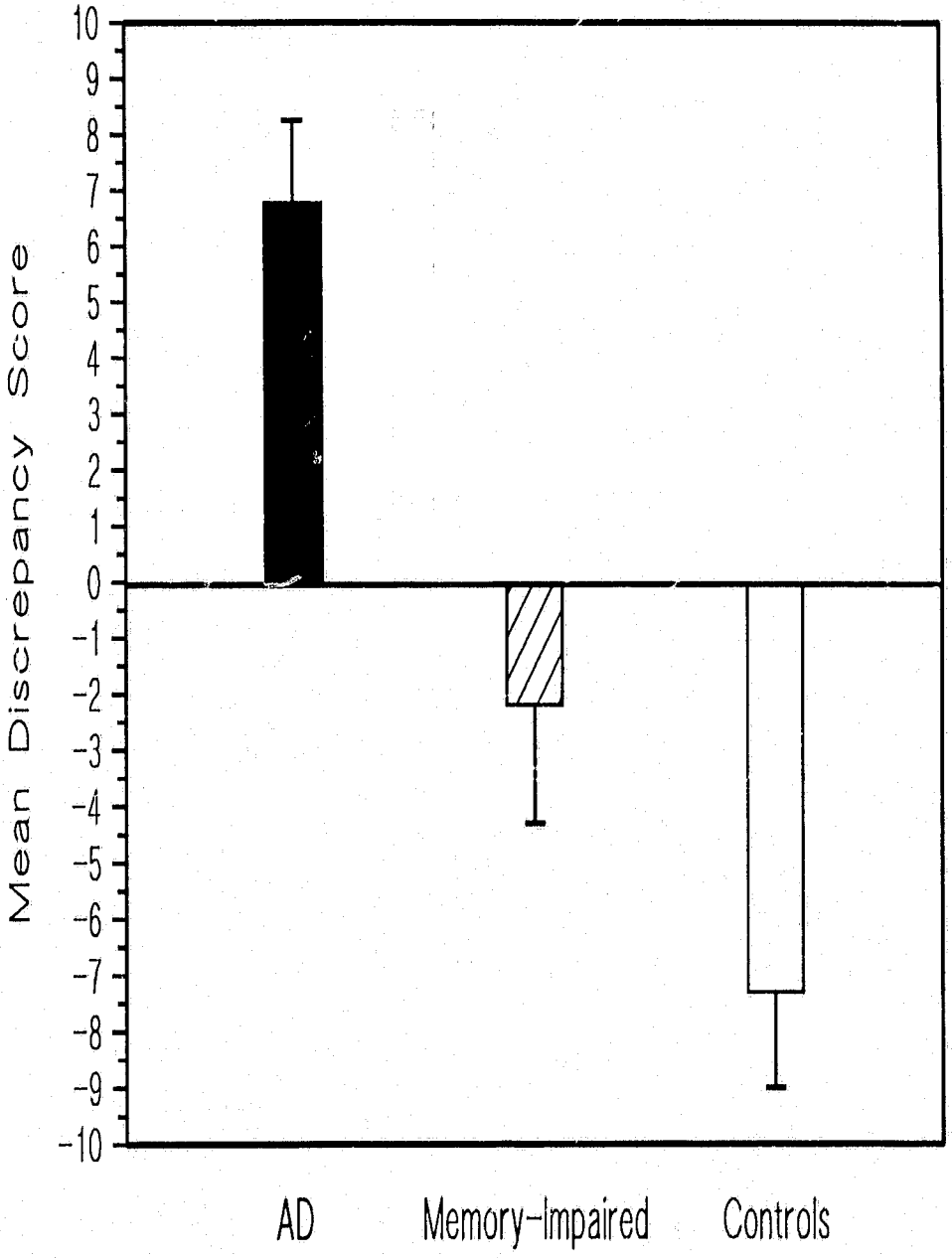
	Group			Additional Sample
	AD	Memory-Impaired	Controls	
	M (SD) n=20	M (SD) n=18	M (SD) n=18	M (SD) n=67
Change-Self	19.6 (4.7)	19.3 (5.2)	24.0 (6.2)	23.3 (5.6)
Change-Care	12.8 (3.5)	21.5 (7.3)	31.3 (7.4)	
Locus	28.4 (4.6)	27.8 (6.7)	28.9 (6.5)	29.3 (5.8)
Strategy	27.5 (7.6)	29.7 (6.2)	28.4 (5.5)	31.8 (5.1)
Anxiety	21.6 (5.0)	21.2 (4.3)	18.7 (4.4)	21.2 (5.3)

significant differences among groups ($F(2,51)=17.36$, $p<.001$). Planned comparisons indicated that the AD group was significantly different from the memory-impaired ($t(51)=3.6$, $p<.001$) and the control ($t(51)=5.8$, $p<.001$) groups on the discrepancy score. No significant differences between memory-impaired and control subjects were observed ($t(51)=1.91$, $p>.06$, 2-tailed). The positive mean values obtained by the AD patients (mean=6.8) indicated that these patients reported relatively less change in memory abilities than did their informants. Conversely, the negative mean values obtained by the memory-impaired (mean=-2.2) and control (mean=-7.3) groups showed that these subjects reported relatively more change in memory functioning than did their informants (see Figure 2). Post hoc comparisons indicated that the CSHA and the NON-CSHA AD patients did not differ on this variable ($t(18)=.39$, $p>.701$).

Post hoc analyses were performed to investigate whether, for the AD patients, the change-self vs. change-care discrepancy score was associated with severity of dementia (i.e., 3MS score), memory performance (i.e., delayed recall), or with any of the demographic variables. All correlations were non-significant indicating that the AD patients' tendency to report less memory change than suggested by their

FIGURE 2

Means and SEM for the Change-Self vs. Change-Care Discrepancy Score



informant's report did not appear to be associated with severity of the dementia, memory impairment, age, education, or estimated IQ. Correlations are listed in Table 6. Correlations between the discrepancy score and the 3MS, and between the discrepancy score and delayed recall using the whole sample were significant ($r=-.66$, $p<.001$, $r=-.64$, $p<.001$, respectively).

A oneway ANOVA comparing groups on the Buschke delayed recall showed significant differences among groups ($F(2,53)=44.11$, $p<.001$). Scheffé tests indicated that the AD group obtained significantly ($p<.01$) lower delayed recall scores (mean=2.9, s.d.=2.2) than the memory-impaired group (mean=7.4, s.d.=3.1), which scored significantly lower than the control group (mean=10.1, s.d.=1.6).

Correlations were performed in order to address the relation between memory performance (i.e., delayed recall) and both self-report and informants' report of memory change across groups. The correlation between delayed recall and self-report of memory change, while statistically significant ($r=.263$, $p<.025$, 1-tailed), nevertheless showed that only 7% of the variance in actual delayed recall performance is associated with self-report of memory change. The distribution of scores on these two measures across

Table 6

Correlations Between Change Scale Discrepancy Score and Demographic and Psychometric Variables for the AD Group (n=20)

Variable	Change-Self vs. Change Care	P
Age	.14'	.56
Education	.12	.62
Est. FIQ	.01	.96
3MS	-.07	.76
Delayed-Recall Buschke	.17	.47

groups (see Figure 3) showed that, regardless of how the subjects performed on the delayed recall test, they reported approximately equivalent levels of change in memory abilities.

Correlations between delayed recall and informants' report of memory change were highly significant ($r=.77$, $p<.001$), and showed that informants' report accounted for 59% of the variance in delayed recall performance. Furthermore, a comparison of the distribution of scores on these two measures across groups (see Figure 4) showed that informants reported more change in memory abilities for subjects who obtained lower scores on the delayed recall test than they did for subjects who obtained higher scores on the memory test.

Estimation of Memory Peformance

A one-way ANOVA comparing AD patients (excluding the 5 patients obtained from the Clinic for Alzheimer's disease in Vancouver for whom no data were available), memory-impaired subjects and controls on the average number of mispostdictions showed significant differences among groups ($F(2,41)=7.48$, $p<.002$). Planned comparisons indicated that the AD patients made a higher number of mispostdictions than the combined memory-impaired and control groups ($t(41)=3.6$, $p<.001$). N

FIGURE 3

Distribution of Scores on the Buschke Delayed Recall and Change-Self Scale

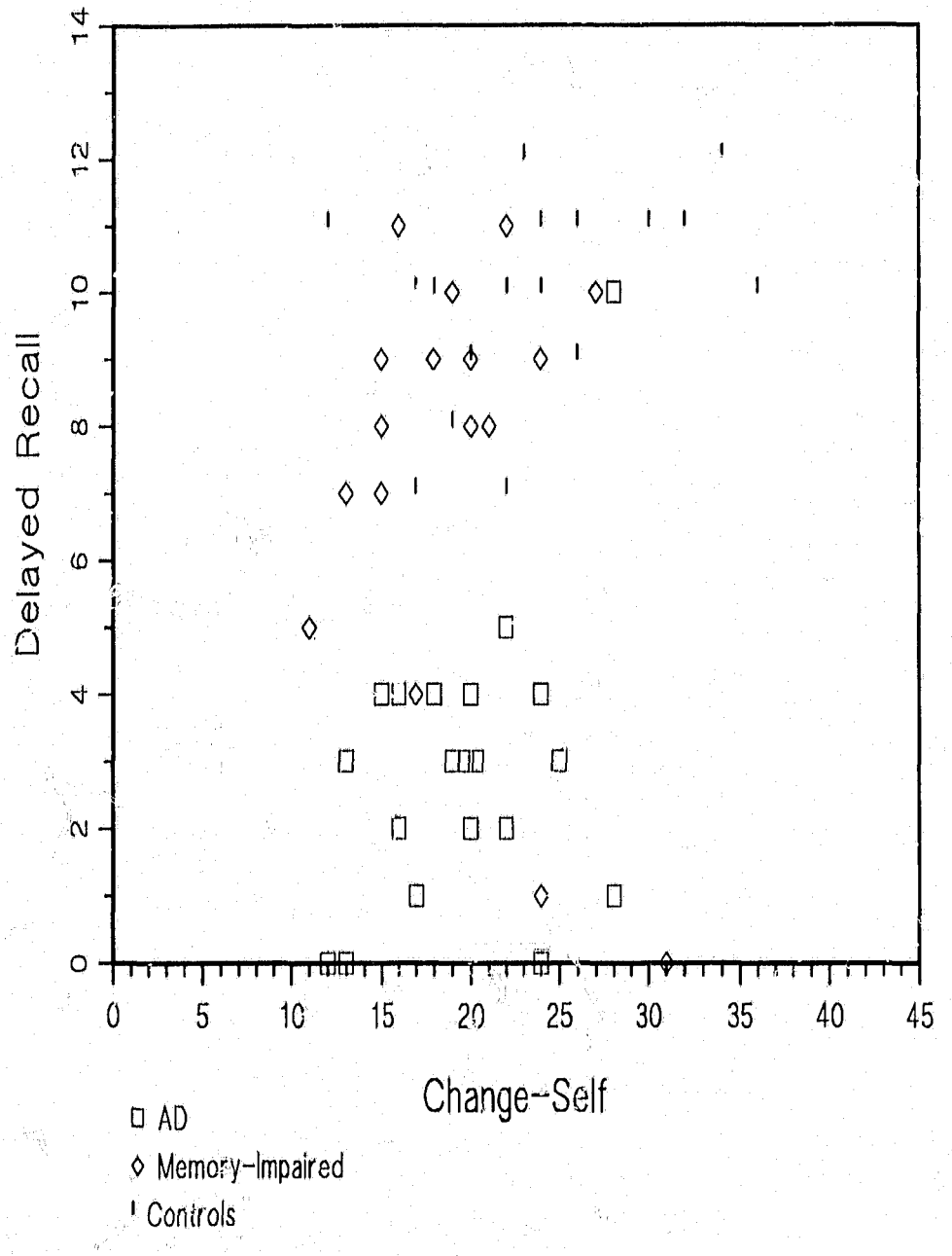
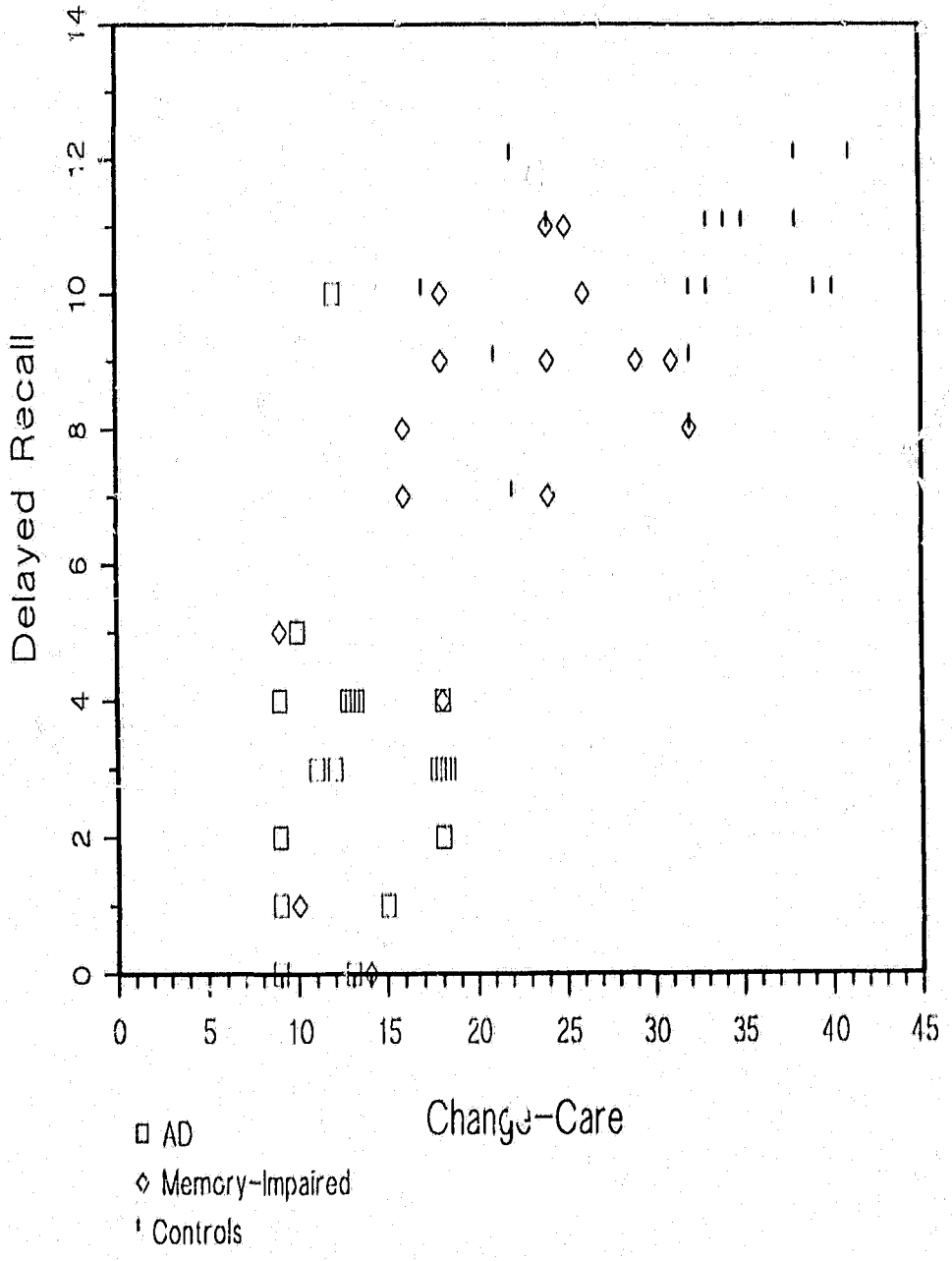


FIGURE 4

Distribution of Scores on the Buschke Delayed Recall and Change-Care Scale



significant difference was observed between the memory-impaired and control groups on this variable ($t(41)=1.3$, $p>.198$). AD patients displayed a clear tendency to overestimate their performance on memory tests (mean=.48) while memory-impaired subjects (mean=.09) and controls (mean=-.07) estimated their memory performance quite accurately (see Figure 5).

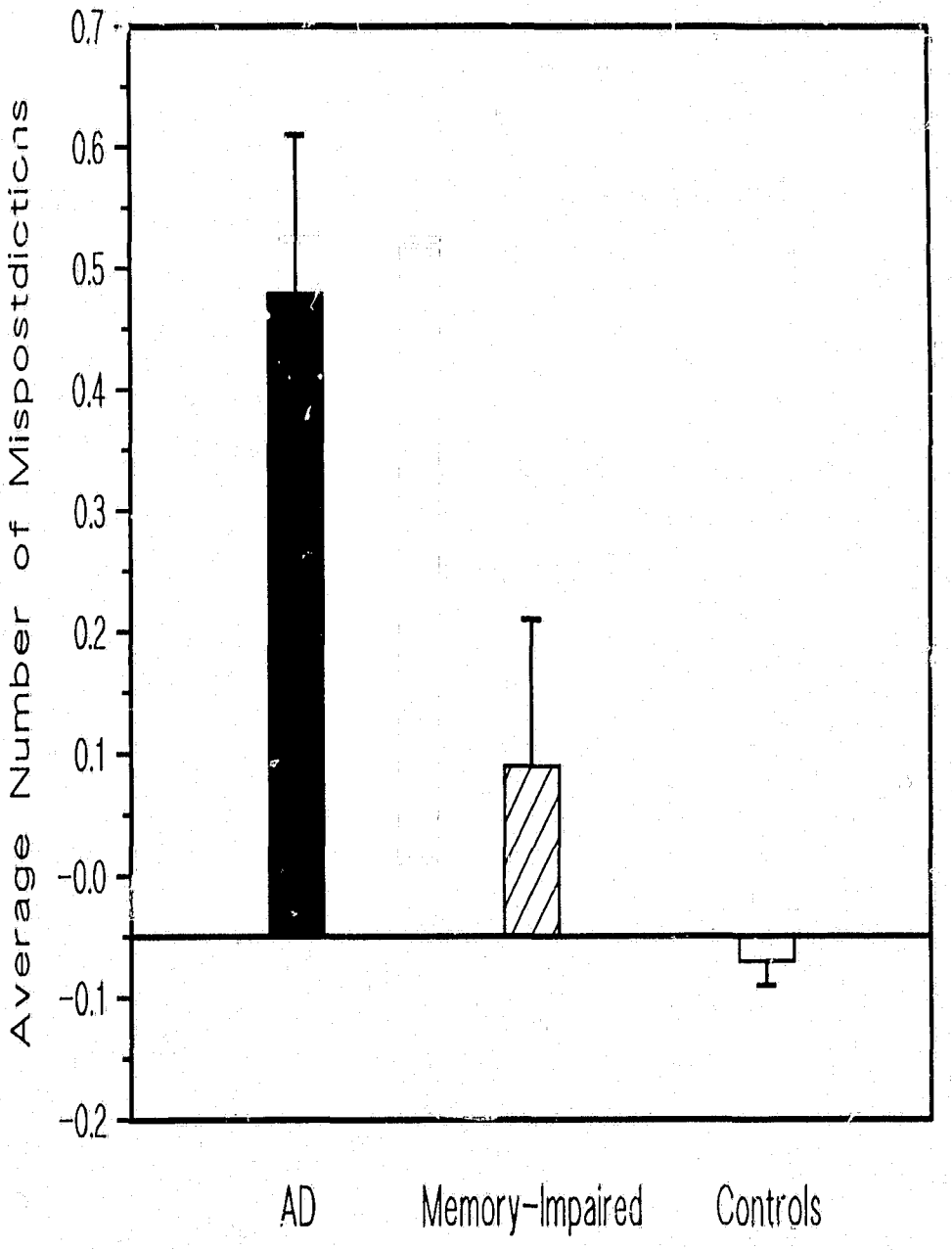
Post hoc analyses were performed to investigate whether the high number of mispostdictions obtained by the AD group was associated with memory performance (i.e., delayed recall). Correlations between mispostdictions and delayed recall were nonsignificant ($p>.46$) suggesting that the AD patients' tendency to overestimate their memory performance was not related to their memory impairment.

Intrusion Errors

A MANOVA was performed to investigate group differences on type of intrusion error (i.e., prior-task, extra-task, perseverations). The AD patients obtained from the Alzheimer's disease Clinic in Vancouver (n=5) were excluded from this analysis since they did not receive all tests necessary for computing intrusion error scores. The multivariate test of significance for group effect was significant (Wilk's

FIGURE 5

Average Number and SEM for Mispostdictions Across Groups



Lambda=.56, F(6,92)=5.07, p<.001). Post hoc comparisons (Scheffé procedure) indicated that the AD group made significantly more (p<.01) extra-task intrusions (mean=8.27, s.d.=4.7) than did memory-impaired subjects (mean=2.06, s.d.=2.6) and controls (mean=2.2, s.d.=2.8), who did not differ (p>.05). Scheffé tests also showed that the AD group made significantly more (p<.05) perseverations (mean=15.4, s.d.=7.13) than did memory-impaired subjects (mean=9.28, s.d=6.6) and controls (mean=8.6, s.d.=5.7), who did not differ (p>.05). Finally, Scheffé tests indicated that the three groups were not significantly different (p>.05) on number of prior-task intrusions (see Figure 6).

Post hoc analyses were performed to investigate whether the high number of intrusions displayed by the AD patients were associated with memory performance (i.e., delayed recall) or language abilities (i.e., naming on the Buschke, Word Fluency Test). All correlations were non-significant suggesting that the AD patients' tendency to make intrusion errors did not appear to be associated with their memory impairment or with language abilities. Correlations are listed in Table 7.

FIGURE 6

Means and SEM for Intrusion Types Across Groups

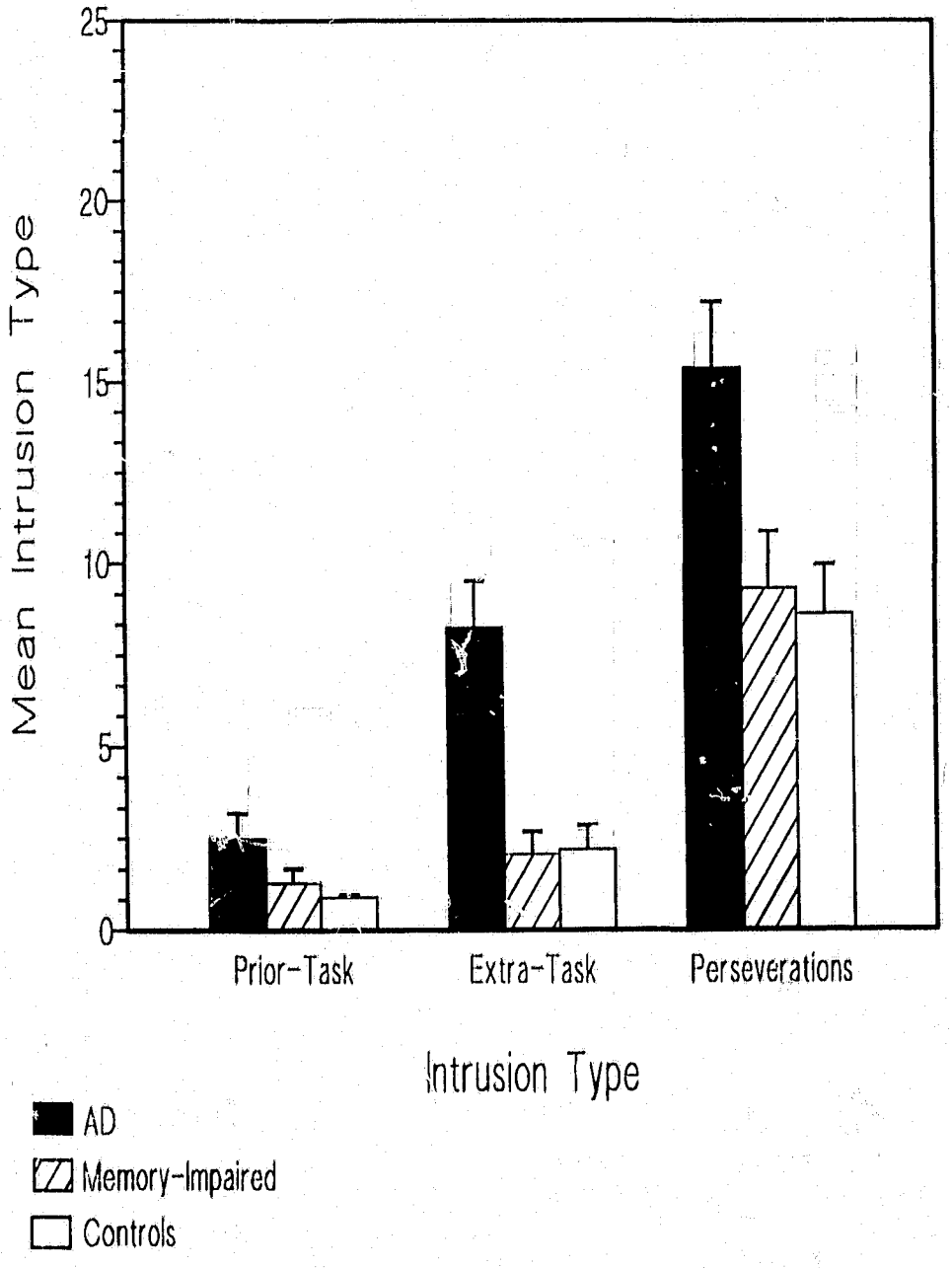


Table 7

Correlations Between Intrusions and Psychometric Variables for the AD Group (n=20)

Variable	Total Intrusions	P
Delayed-Recall Buschke	-.37	.17
Naming Buschke	-.28	.31
Word Fluency	.34	.21
Animal Fluency	.01	.99

Self-Correction

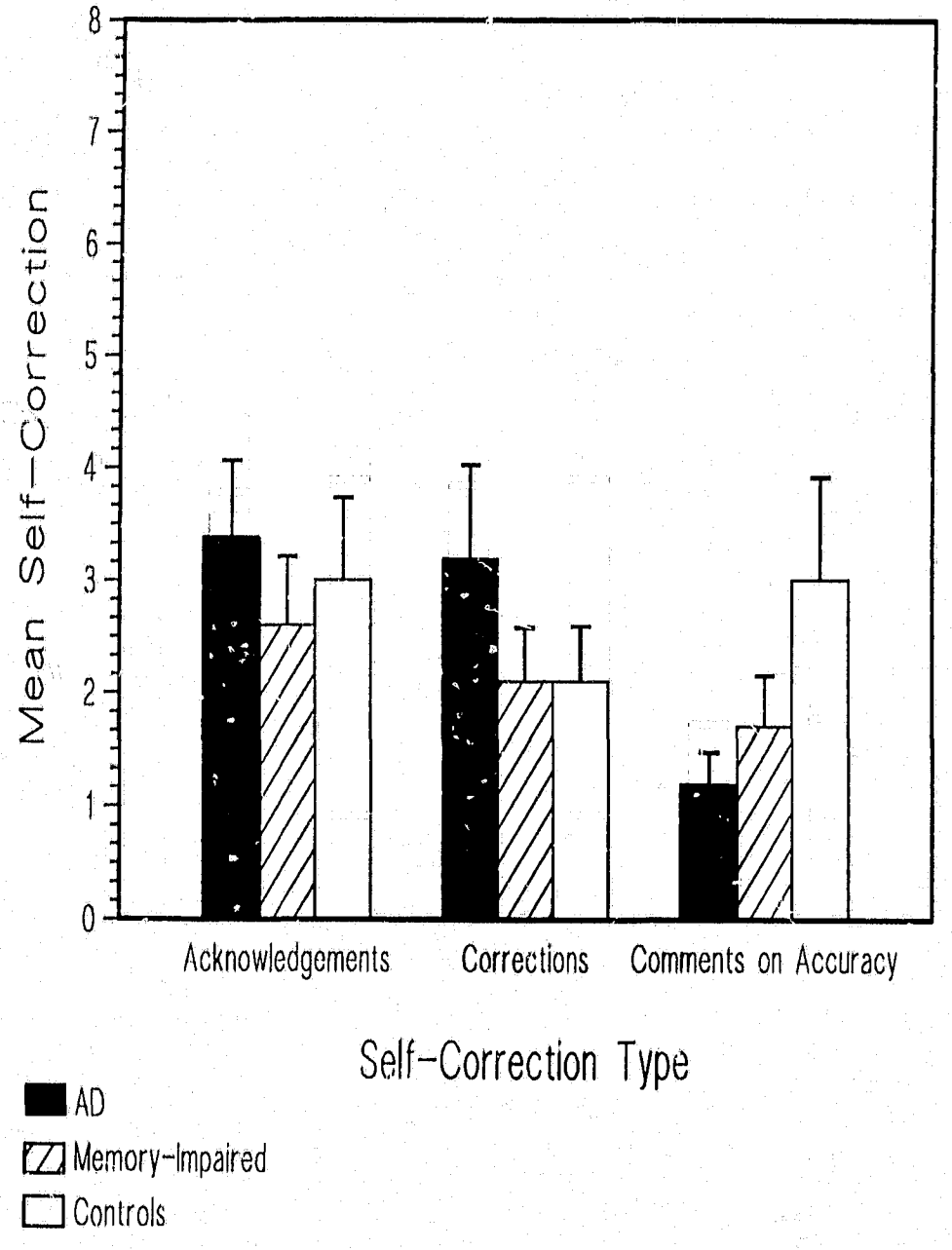
A MANOVA was performed to examine differences among groups on type of self-corrections (i.e., acknowledged, corrected, comments). The AD patients obtained from the Alzheimer's disease Clinic in Vancouver were also excluded from this analysis. The multivariate test of significance was non-significant (Wilk's Lambda=.87, $F(6,92)=1.05$, $p>.352$), indicating that the three groups did not differ on type of self-correction (see Figure 7).

The three types of self-corrections were combined and the total number of self-corrections obtained. A one-way ANOVA performed on the total self-correction score revealed non-significant differences between groups ($F(2,48)=.14$, $p>.87$) on this variable.

In order to investigate the relation between self-corrections and intrusions a proportion score was computed in which the number of acknowledged and corrected intrusions (i.e., excluding any comments on accuracy) were added and then divided by the total number of intrusions (i.e., three types) to obtain a proportion score. A one-way ANOVA performed to examine group differences on the proportion score revealed no overall significant differences among groups ($F(2,48)=1.6$, $p>.21$). Planned comparisons did show,

FIGURE 7

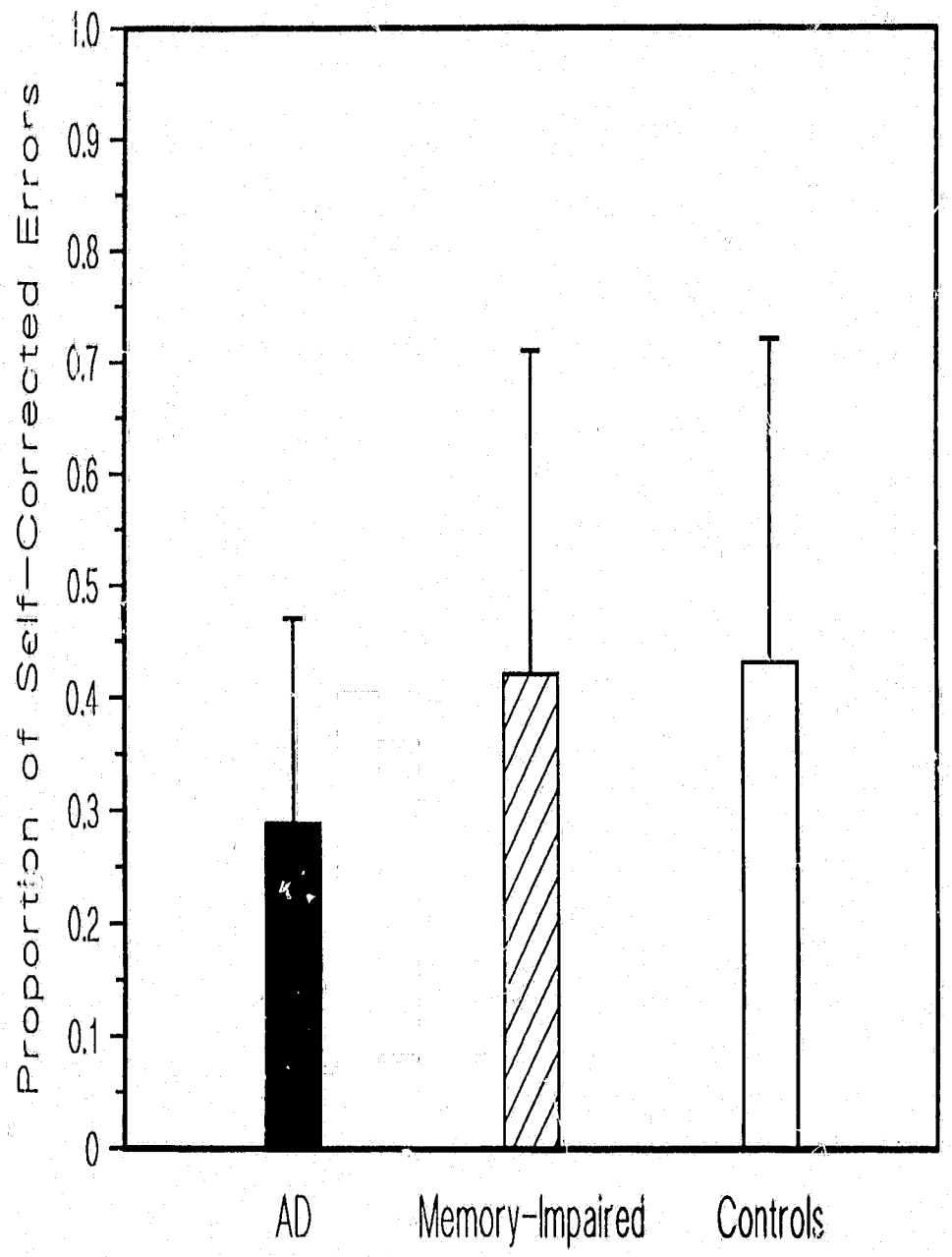
Means and SEM for Self-Correction Types Across Groups



however, that the AD patients corrected significantly fewer of their mistakes (mean=.29, s.d.=.19) than did the memory-impaired (mean=.42, s.d.=.26) and control groups (mean=.43, s.d.=.27) ($t(48)=1.8$, $P<.042$, 1-tailed). No significant differences between memory-impaired and control groups were observed ($t(48)=.07$, $p>.47$, 1-tailed) (see Figure 8).

FIGURE 8

Proportion and SEM for Acknowledged and Corrected Intrusion Errors Across Groups



DISCUSSION

The present study has addressed the awareness phenomena in individuals with AD, memory impairment, and in normal controls through the investigation of various metamemory dimensions. The findings are discussed regarding (1) patients' and relatives' report of memory change as well as the relationship between memory performance and report of memory change, (2) report of strategy use, locus of control, and anxiety, (3) self-monitoring abilities including an evaluation of frequency of intrusion errors, self-corrections, and estimation of recent memory performance, (4) demographic and psychometric variables.

Report of Memory Change

An evaluation of self-report of memory change indicated that the AD patients, memory-impaired subjects and normal controls reported equivalent levels of change in memory functioning. The results do not support, therefore, the prediction that mild AD patients would report less change in memory abilities than the other two groups. The findings suggest that AD patients, like the other subjects, do perceive some decline in their memory functioning in comparison to previous levels.

The present results are consistent with some recent studies examining memory complaint in AD and in individuals displaying age-related cognitive impairment. For instance, McGlone and colleagues (1990) observed that patients with AD and individuals with cognitive deficits displayed similar levels of memory change and complaints on a self-report questionnaire, while controls had fewer complaints. Feher and colleagues (1992) also reported equivalent levels of memory complaint in AD and age-associated memory impairment, suggesting that self-report of memory abilities is of little diagnostic value in differentiating these two groups. Youngjhon and colleagues (1991) also reported that AD patients and AAMI subjects could not be differentiated on the basis of self-report measures of memory complaint. The authors observed, however, that AD patients displayed a tendency to report a higher level of memory functioning than did persons with AAMI.

The observation that the normal controls displayed only a slight tendency to report less memory change than the other groups appear to be somewhat discrepant from findings in other studies. The present study has used, however, normal elderly that are considerably older than the samples used in most studies. Since memory decline is particularly evident after the eight decade, these

individuals might in fact be more likely to report changes in memory. Furthermore, the literature on metamemory in adulthood has reported an age-related increase in complaints of declining memory functioning (Hultsch et al., 1988), particularly among individuals over 85 years of age (Cutler & Adams, 1988). The comparable levels of change in memory reported by the present sample and Hultsch's sample of individuals over 74 years of age provide further support for the notion that self-report of change in memory abilities might be more prominent among older adults.

An examination of the relation between self-report of memory change and ability to remember words after a delayed period of time revealed that a very small portion of the variance in delayed recall is explained by self-report of decline in memory. The pattern of results suggested that although the three groups performed at significantly different levels on the objective memory test (i.e., AD patients recalling fewer words than memory-impaired, who recalled fewer words than controls), they all reported equivalent levels of memory change.

The present results are consistent with research suggesting that the predictive validity of metamemory questionnaires is relatively limited (Hermann, 1982,

1984). Furthermore, Dixon and colleagues (1986) observed only moderate correlations (.25 to .53) between MIA scales and memory tests, and emphasized the importance of using ecologically valid memory tests. Similarly, Sunderland and colleagues (1983) reported significant correlations of various components of metamemory with story recall but not with word recall. Although among all tests available in the neuropsychological battery the Buschke delayed recall appeared to best approximate the content of the MIA Change scale, it might still be a test that is low in ecological validity, which would partially explain the low correlations obtained.

The results on the informants' report of change in memory functioning showed significant group differences with the AD patients' relatives reporting considerably more change in memory abilities compared to past performance than did the memory-impaired subjects' relatives, who reported more change than the controls' relatives.

The pattern of findings is consistent with recent studies by McGlone and colleagues (1990) and Youngjhon and colleagues (1991)
which indicated that family ratings of memory ability (or change) were significantly lower for AD patients

than for cognitively impaired and for control subjects. The results also support the view that relatives' evaluation of memory change in comparison to past performance is particularly useful in differentiating mild AD patients from individuals displaying memory impairment and from normal elderly.

The correlation between relatives' report of change in memory and subjects' performance on the Buschke delayed recall was highly significant and accounted for a considerable proportion of the variance. An evaluation of the distribution of scores indicated that the informants actually reported more memory change for subjects who scored lower on the delayed recall measure than they did for individuals recalling a higher number of words. This finding is consistent with previous studies (Feher et al., 1991; McGlone et al., 1990) and confirms that relatives' opinions about memory change combined with objective memory tests can be more useful than self-report measures alone in differentiating patients with AD.

An evaluation of the discrepancy between self-report and relatives' report of change in memory abilities indicated that the AD patients reported relatively less memory change than did their informants. This pattern of results is consistent with recent

research and provides further evidence that mild AD patients display diminished awareness of the severity of their memory deficit, which is one of the most prominent cognitive impairments seen in this population.

The responses given by the AD patients and their informants suggests that while both indicate that memory has changed in comparison to past abilities, the informants are reporting a greater degree of change than the AD patients are. This is consistent with Neary and colleagues' (1986) observation that some AD patients admit to memory impairment but display little awareness of the severity of their memory deficit.

The few studies that compared family/informant and patient ratings of memory complaints (Feher et al., 1991; Green et al., 1991; McGlone et al., 1990; Yougjhon et al., 1991) have consistently shown that AD patients rated themselves as having better memory abilities than did their relatives, suggesting that such comparisons are useful measures of degree of unawareness of memory deficit (McGlone et al., 1990; McGlynn & Kaszniak, 1991a). Although this study has addressed discrepancies in the perception of <u>change</u> in memory in relation to past performance, the findings appear to support research addressing discrepancies in other aspects of memory functioning such as memory capacity and everyday

memory skills. Furthermore, the findings provide additional information demonstrating that mild AD patients are not fully aware of the extent of the changes that have occurred in their memory functioning.

This study has found that degree of unawareness of change in memory functioning among AD patients (i.e., as measured by the discrepancy between ratings) was not associated with memory performance or with severity of dementia. This finding is consistent with recent research (DeBettignies et al., 1990; Feher et al., 1992; Reed et al., 1991) and supports the view that cognitive impairment and awareness of memory deficit are dissociable processes, i.e., that unawareness does not necessarily accompany cognitive decline in AD. A few studies did observe that impaired awareness of memory deficit becomes more marked as dementia progresses (Anderson & Tranel, 1989; McGlynn & Kaszniak, 1991b; Reisberg et al., 1985). However, the degree of association between severity of dementia and unawareness has been modest in most of these studies. It is also possible that differences in measures of unawareness contributed to the conflicting findings. Thus, although awareness may diminish as the dementia progresses, dementia severity alone does not appear to completely explain the diminished awareness seen in patients with

mild AD.

The mild AD patients in the present sample did not display any evidence of depression which indirectly supports research reporting a negative correlation between unawareness and depression (Feher et al., 1991; Williams et al., 1987). There has been some suggestion that intact awareness of memory loss may place AD patients at risk for depression. However, since some recent studies have failed to find an association between depression and degree of unawareness in AD patients (DeBettignies et al., 1990; Reed et al., 1991), further research including AD patients with and without evidence of depression would be necessary to clarify this issue.

The present study did not include any measures of regional cerebral function (e.g., cerebral blood flow) and, therefore, did not provide an opportunity to specifically address the involvement of different brain areas in the unawareness phenomena. There is some evidence that impaired awareness of memory deficit is associated with signs of frontal lobe dysfunction (Schacter, 1991). Additionally, the findings that Korsakoff patients exhibit impaired memory awareness in all studies that addressed this issue, and that amnesics with restricted temporal lobe pathology do not display

deficits in memory awareness, also strongly supports the role of the frontal lobes in awareness.

The degree of frontal lobe involvement in AD appears to be variable, however, with most patients showing predominantly parietotemporal hypometabolism while some patients show predominantly frontal metabolic abnormalities (Grady et al., 1990). Interestingly, Reed and colleagues (1991) have recently suggested that unawareness of memory loss in AD may be associated with diminished right superior frontal lobe activity (i.e., evident in measures of regional cerebral blood flow). Similarly, Anderson & Tranel (1989) observed an association between unawareness of cognitive deficits and right-hemisphere damage in patients with cerebral infarctions and with dementia. It is possible that the variability in memory awareness observed in AD patients is related to the degree of involvement of the frontal lobes. Future research combining direct measures of regional cerebral physiologic function as part of the neurological evaluation of AD patients with behavioral measures of unawareness would be useful in determining the relation between unawareness and degree of frontal lobe (or other brain regions) involvement.

The evaluation of the discrepancy between self-report and relatives' report of memory change has also

shown that both the memory-impaired subjects and the controls reported more change in memory abilities than did their relatives. This finding indicates not only that these individuals are aware of changes in their memory abilities in comparison to past performance but also that they report/perceive a greater degree of change than do their relatives. Interestingly, the discrepancy in ratings were slightly larger for the normal controls than they were for the memory-impaired subjects. Although there are no systematic studies specifically addressing discrepancies between self- and relatives' report of memory change in individuals displaying memory impairment, the findings appear to be consistent with the literature on self-report of memory abilities in normal elderly. These studies often report that older adults perceive themselves as less competent in memory-related activities than younger adults (e.g., Hertzog et al., 1987).

In sum, although an evaluation of self-report of memory change among the AD patients would initially suggest that they are aware of their memory deficit, a comparison between patient and relative's ratings indicates that the AD patients are unaware of the extent of the decline in their memory functioning. This pattern of results suggests that unawareness is not an

"all or nothing" phenomena and that variations in degree of awareness may occur at different stages of the disease. A similar view has been proposed by McGlynn and Schacter (1989) who pointed out that unawareness is not a unitary construct that classifies patients as aware or unaware. There may be different components or levels of unawareness that can be differentially affected depending on the type of brain disease or the brain regions involved. Additionally, it is possible that different results would be obtained depending on the instruments used to assess unawareness, as each measure may be sensitive to distinct dimensions of awareness (McGlynn & Kaszniak, 1991b).

Report of Strategy Use, Locus of Control, and Anxiety

The results on the modified MIA questionnaire scales Strategy, Locus, and Anxiety did not support the predictions that in comparison to the memory-impaired and control subjects, the AD patients would report less frequent use of strategies, less control over memory abilities, and less anxiety in memory-related situations.

The observation that all subject groups use equivalent levels of internal strategies to enhance their memory performance suggests that this aspect of

metamemory is not more affected by AD or memory impairment than it is affected by the normal aging process. The comparison between the present sample and the additional sample of normal older adults (Hultsch et al., 1990) showed similar results, providing indirect support for previous studies reporting that older adults do not make use of internal strategies (i.e., mental association, rehearsal) as often as younger adults (Lowen et al., 1990).

It could be argued that if the AD patients were aware of the extent of the decline in their memory functioning they would be making more use of internal strategies to compensate for their memory difficulties. The finding that the AD patients do not display an increase in strategy use would then provide further evidence that the AD patients show diminished memory awareness. However, the finding that memory-impaired subjects, who appear to be more aware of the extent of the changes in their memory, reported the same level of strategy use as did the controls, does not support such argument.

The results on locus of control were also contrary to the view that AD patients displaying diminished memory awareness would report a higher degree of internal control over their remembering skills than the

memory-impaired subjects and the normal elderly. Furthermore, the equivalent levels of internal sense of control reported by all subjects both in the present sample and in the additional sample of normal elderly indirectly support previous findings that when compared to younger adults, older adults believe there is little they can do to enhance their memory or prevent its deterioration (Hultsch et al., 1988).

It is possible that although the AD patients are unaware of the extent of the changes in their memory functioning, the perception of some change in memory in comparison to past performance may be sufficient to produce a sense of diminished control over memory abilities. The finding that all subjects reported approximately the same levels of change in memory and in locus of control, as well as Hertzog and colleagues' (1987) observation that in the elderly perceptions of change are more highly associated with perceptions of reduced control over memory abilities would support such view. It remains to be investigated, however, whether AD patients who do not report significant memory changes would also perceive themselves as having internal control over their memory abilities.

An evaluation of the results on the Anxiety scale revealed that all subjects reported some level of

emotional tension or anxiety in memory-related situations. The equivalent levels of anxiety reported by the present sample and the additional sample of older adults also indirectly support observations that the elderly are more likely to report anxiety when faced with situations that require them to use their memory skills (Hertzog et al., 1987).

The present results do not support suggestions that unawareness of memory deficit in AD is associated with lack of anxiety in memory-related situations (Neary et al., 1986) since the AD patients did report the presence of anxiety when faced with memory-demanding situations. It is again possible that the perception of some change in memory functioning is sufficient to produce a certain level of anxiety even though the AD patients are not fully aware of the extent of their memory deficit. Furthermore, Hertzog and colleagues (1987) observed that perceptions of change in memory are more highly associated with anxiety about memory in older than in younger adults. It remains to be clarified, however, whether lack of awareness of memory change would be accompanied by a decrease in anxiety levels.

Overall, the findings suggest that the MIA scales Strategy, Locus, and Anxiety are not particularly sensitive for investigating variations in degree of

unawareness in mild AD patients since although these patients did show diminished awareness of the extent of the decline in their memory functioning, their responses on these scales were equivalent to the memory-impaired and control subjects' answers. On the other hand, the results support the view that metamemory is a combination of several dimensions which assess different aspects of memory awareness and may not be necessarily interrelated (Hultsch et al., 1988). It is possible, therefore, that these metamemory aspects are in fact not more affected by circumscribed memory deficit or mild dementia than they are affected by the normal aging process.

Self-Monitoring

The present results confirm previous findings showing an increased number of intrusion errors among AD patients (Fuld, 1983; Butters, 1985), particularly extra-task intrusions and perseverations (Butters, 1983; Kramer et al., 1988; Heindel et al., 1989). Interestingly, although both of these types of errors were prominent among AD patients, group differences were more highly significant for extra-task intrusions.

The present study, therefore, provides indirect support for research reporting that extra-task (or

unrelated) intrusions are an important characteristic of AD, and can be particularly useful in discriminating patients with mild AD from other clinical populations (Lowenstein et al., 1991), as well as direct evidence that such errors appear to be more frequent in mild AD patients than in older adults displaying memory impairment.

Studies reporting predominantly extra-task intrusions in AD (e.g., Wilson et al., 1983) have argued that such errors are an important feature of the memory impairment observed in this population since it may reflect an encoding rather than a retrieval deficit. Lowenstein and colleagues (1991) have observed that the tendency of AD patients to make extra-task intrusions might reflect a failure to consolidate information as well as difficulties in self-monitoring since some of the patients in their study appeared to be unable to recognize that their errors were not related to the to-be-remembered information.

The observation that the AD group made significantly more extra-task than prior-task intrusions support the view of deficient encoding of information in this population. However, the present study has found no significant correlations between intrusions and delayed recall performance, or severity of dementia

among AD patients, suggesting that although memory/cognitive impairment may underlie the production of extra-task intrusions, additional mechanisms might be involved.

Shindler and colleagues (1984) have also reported little correlation between intrusions and either verbal memory test performance or dementia severity among AD patients, and suggested that a failure to suppress incorrect responses may contribute to the production of intrusions. The authors also noted that patients with AD and patients with Wernicke's aphasia are particularly prone to making intrusions which may be related to the often observed diminished insight into the illness and lack of self-monitoring of speech in these conditions. Intrusions in AD may be, therefore, the result of (1) a failure to find or efficiently search for the correct word in long-term memory (i.e., mainly as a consequence of defective encoding), (2) the selection of a recently heard word from short-term memory, or of unrelated environmental stimuli, and (3) a failure to assess (or monitor) the adequacy of the response, or even to inhibit it. Luria (1980) has also suggested that intrusions, often observed in frontal lobe pathology, may be due to weak and poorly organized memory traces, resulting in an inability to screen or repress incorrect

responses.

Intrusions and perseverations, often observed among both AD and Korsakoff patients, have been associated with neuropathological studies (e.g., Arendt et al 1983) reporting loss of neurons in basal forebrain structures (e.g., medial septal nuclei, nucleus basalis of Meynert). Since the basal forebrain is the source of cholinergic input to the hippocampus and association cortex, the occurrence of intrusion errors in these populations may suggest a similar underlying cholinergic deficiency (Butters et al., 1987). Sandson & Albert (1987) have also suggested that recurrent perseverations (i.e., repetition of a previous response to a subsequent stimulus) may be associated with a specific cholinergic deficit. It remains unclear, however, whether such deficiency is sufficient to produce intrusions since increased numbers of such errors in AD have been correlated with both cholinergic deficiency and a large number of plaques in the cortex (Fuld, 1983). Furthermore, the presence of intrusions among individuals with aphasia and with non-Alzheimer dementia (Sandson & Albert, 1984), makes it problematic to link intrusions exclusively to a cholinergic deficiency.

Further evidence supporting the view that intrusions cannot be explained solely by defective

memory has been provided by studies reporting that patients with Huntington's disease make fewer intrusions than AD patients even when both groups display equivalent levels of memory impairment (e.g., Butters et al., 1987). Furthermore, the results of the present study showed that although the memory-impaired subjects obtained significantly lower scores than the controls on delayed recall, no overall differences in number of intrusions were observed between these groups suggesting that the presence of a circumscribed memory deficit, albeit less severe than in AD patients, is not sufficient to produce an increase in the number of intrusions.

The present results are consistent with the literature reporting that intrusion errors are not prominent among normal elderly (Fuld, 1983), and provide new evidence suggesting that intrusions are not particularly frequent among memory-impaired older adults. Extra-task intrusions and perseverations appear to be, therefore, potentially useful in differentiating mild AD patients from older adults displaying memory impairment.

Some recent studies have found that test intrusions are not specific to AD (Gordon et al., 1984; Kramer et al., 1988). Several of these studies, however, have

examined intrusion without addressing specific types. Since there is considerable variability in the definition of intrusions, further research investigating intrusion types in other dementing and amnestic syndromes would provide useful information regarding the underlying mechanisms of intrusions as well as their utility in differentiating AD patients from other populations.

It is important to note that the overall number of intrusion errors observed among all subjects appeared to be somewhat higher than the number reported in other studies. However, the increased number of intrusions across groups appears to be more a consequence of summing errors from numerous tests than from an actual tendency of the present sample to make more of these errors. Several studies examining intrusions among individuals with dementia have obtained data from one or two measures (e.g., Lowenstein et al., 1989; Butters et al., 1987) while in this study intrusions were computed from two different lists of words involving several immediate recall trials and delayed recall trials, as well as word fluency tests. The use of several tests, therefore, may have provided the subjects with more opportunities to make intrusion errors.

Additionally, it should also be noted that all

subjects displayed a higher number of perseverations in comparison to extra-task or prior-task intrusions. Since the present sample is considerably older than the populations investigated in most studies, it might be possible that older adults are more prone to making perseverative errors when given enough opportunities. A tendency to perseverate may indicate, therefore, that while search and retrieval mechanisms as well as monitoring abilities are clearly impaired in AD patients these might not be fully intact in older adults either. It has also been suggested that the nature of the task used to examine intrusions strongly influences the frequency and type of perseverative response (Bayles, Tomoeda, Kaszniak, Stern, & Eagans, 1985). The use of tests involving several learning trials, and tasks that require the individual to provide new information quickly, might be more likely to elicit perseverations in older adults, particularly in patients with mild AD. Further research is, however, necessary to investigate the frequency of the occurrence of perseverations in older populations.

Overall, observations from previous research and the results from the present study suggest that memory deficit as well as diminished self-monitoring abilities are involved in the production of intrusion errors among

mild AD patients. Furthermore, the present findings indicate that extra-task intrusions and perseverations may be particularly useful in differentiating mild AD patients from memory-impaired individuals and normal elderly.

The results on self-corrections indicated that, as expected, the three groups did not differ on the number of acknowledged or corrected intrusions, or on comments on accuracy. However, a comparison between acknowledged and corrected errors in relation to the total number of intrusions, did indicate that the AD patients self-corrected significantly less of their intrusions than did memory-impaired and control subjects.

Although self-corrective behavior has not been systematically investigated in AD, Marshall & Tompkins (1982) suggested that among aphasic individuals, spontaneous self-corrections are indicators of the intactness of their self-monitoring system. The authors also observed that from all aphasia types studied, patients with Wernicke's aphasia displayed the lowest proportions of self-corrections in relation to number of errors displayed.

Self-corrections appear to involve, therefore, some level of recognition that a response has already been

given, which requires ongoing monitoring of performance throughout the execution of cognitive tasks. The observation that mild AD patients self-correct few of their intrusion errors suggests that these patients have diminished ability to monitor their cognitive functioning. Zaidel (1987) has suggested that preserved awareness of deficit requires an intact process of error monitoring. Recently, Goldberg and Barr (1991) argued that to be aware of a specific cognitive deficit an individual must have an internal representation of the desired cognitive product, as well as the feedback regarding the actual output, and an intact mechanism for comparing the output with the internal representation. Disturbances of various aspects of this monitoring process may account for different types of impaired awareness.

The results on individuals with memory impairment and healthy older adults indicated that they do self-correct a higher proportion of their errors than do AD patients, suggesting that these groups' ability to self-monitor is more preserved. Furthermore, the normal controls made a slightly higher number of comments regarding the accuracy of their responding, which may provide additional evidence that these individuals' memory self-monitoring is preserved.

Interestingly, the proportion of self-corrected intrusions was less than 50% even for memory-impaired and control subjects, suggesting that self-corrective behavior might not be very frequent among older adults. A comparison between younger and older populations would be useful to examine the relative frequency of self-corrections in these groups. Future research is also necessary in order to determine whether other clinical populations that are likely to produce intrusion errors (e.g., Korsakoff's patients) also display few self-corrections, or whether such behavior is restricted to mild AD patients and individuals with Wernicke's aphasia.

The findings on estimation of recent memory performance indicated that AD patients made a significantly higher number of mispostdictions than did memory-impaired and control subjects. Furthermore, the AD patients tendency to overestimate their performance was not correlated with their scores on the Buschke delayed recall, suggesting that overestimation could not be explained solely on the basis of memory impairment. The present results, therefore, support the view that in AD patients overestimation of performance on memory tasks may be indicative of diminished ability to self-

monitor.

Estimation of performance prior to completing memory tasks (i.e., predictions) has been the most frequently used measure of self-monitoring ability, which is viewed as a dimension of overall metamemory processes (Bruce et al., 1982; Coyne et al., 1985). Although the majority of studies on estimation of memory performance have examined predictions rather than postdictions, the present results are consistent with the current literature on memory predictions in AD, and also indicates that both measures can be useful for investigating memory self-monitoring.

The few studies examining memory predictions in AD have reported a tendency towards overprediction in this population. McGlynn & Kaszniak (1991) interpreted AD patients' inability to make accurate predictions about their own performance on cognitive tasks as reflective of a specific self-monitoring breakdown which prevents these patients from updating knowledge about their own cognitive performance. Green and colleagues (1991) suggested that in AD, deficient self-monitoring (i.e., observed through overprediction of actual recall of a word list) as well as overall unawareness of memory deficit are influenced by limitations in intellectual functioning, in short-term memory, and in inferential

ability.

Shimamura & Squire (1986) have argued that impaired feeling of knowing (i.e., prediction of the ability to recognize previously presented information) is not an obligatory feature of memory deficit since while Korsakoff's patients were impaired in making feeling-of-knowing judgements, patients with severe anterograde amnesia produced accurate estimations of their performance. The observation that impaired ability to accurately estimate memory performance is particularly evident in diseases involving some degree of frontal lobe pathology (i.e., Korsakoff's syndrome, Pick's disease, AD) suggests that the integrity of frontal lobe functioning may be particularly important for self-monitoring. Stuss and Benson (1986) argued that regions of the frontal lobe are involved in self-awareness and monitoring of one's own cognitive functioning, and that anosognosia may indicate the presence of defective self-monitoring. There have been also suggestions, however, that either a combination of frontal and limbic lesions (Janowsky, Shimamura, & Squire, 1989), or simultaneous lesions of several cerebral areas (Stuss & Benson, 1986) may be necessary for producing deficient self-monitoring abilities.

The results on mispostdictions also indicate that

individuals displaying memory-impairment and normal elderly are accurate in their estimation of recent memory performance. Furthermore, the findings provide new evidence suggesting that older adults displaying memory-impairment have preserved ability to monitor their performance during memory testing.

The results regarding the normal elderly group appear to be consistent with some of Devolver and colleagues' (1990) observations that both younger and older adults were equally accurate in their ability to assess recent memory performance (i.e., postdictions), while younger adults were more accurate than older adults in memory predictions.

Some studies on memory predictions in normal adulthood have reported preserved memory self-monitoring in older adults since they appear to be as accurate as younger adults in predicting performance on memory tasks (Lachman et al., 1982; Rabinowitz et al., 1982). Conversely, other reports have noted that older adults were more likely to overestimate their performance, whereas younger adults were likely to underestimate it (Murphy et al., 1981). While this study shows that older individuals appear to make accurate estimates of recent memory performance, further research appears to be necessary in order to determine whether (1) older

adults are in fact more accurate in postdicting than predicting their performance (2) predictions and postdictions are actually assessing the same self-monitoring abilities in this population.

It is important to note that all participants in this study were asked to evaluate their performance on recent memory tests after the completion of the neuropsychological battery of tests. The fact that postdictions were not obtained immediately after finishing each memory test might have had a detrimental effect upon the subjects' accuracy in assessing their performance. Although this procedure did not seem to affect the memory-impaired or the control subjects' ability to accurately estimate their performance, the fact that AD patients have a more pronounced memory deficit as well as diminished self-monitoring may have made the estimation of performance after a prolonged delay a more difficult task for them. In an attempt to overcome this problem only subjects who were confident or at least somewhat confident of their estimations were included in the misposdictions analyses. However, an evaluation of mild AD patients' ability to estimate their performance immediately after completing memory tests would be warranted in order to confirm that these patients display a tendency to overestimate their

performance under such circumstances.

Additionally, future research assessing both predictions and postdictions in AD could also provide interesting information regarding whether AD patients are more or less impaired in one of these measures, or whether there is any discrepancy between prediction and postdiction for the same task.

In sum, the three different approaches for investigating self-monitoring abilities used in the present study have consistently shown that mild AD patients have diminished memory self-monitoring abilities since when compared to memory-impaired and normal older adults, these patients (1) display a tendency to make numerous intrusion errors while performing memory tasks, (2) self-correct few of their intrusions, and (3) overestimate their performance on recent memory tests.

Demographic and Psychometric Variables

An evaluation of demographic variables indicated that while subjects did not differ on years of education or estimated IQ, the memory-impaired subjects were significantly older than the patients with AD. Since decrements in cognitive abilities (mostly in memory) are particularly evident after the eight decade (Mitrushina

& Satz, 1991), it could be argued that the memory-impaired group is showing difficulties in memory because of their advanced age. However, the results do not appear to support this conclusion since the normal controls did not differ significantly from the memory-impaired subjects on age.

Additionally, the analyses examining subjects according to source revealed that the NON-CSHA AD patients were younger than all other CSHA subjects while no differences on age were observed for the subjects obtained from the CSHA regardless of group membership. However, the observation that NON-CSHA AD patients were younger than all CSHA subjects and also obtained higher 3MS scores than the CSHA AD patients did not appear to differentially influence the results regarding the modified MIA questionnaire or the discrepancy between patient's and relative's report of memory change.

The results also showed that the CSHA and the NON-CSHA AD patients differed on overall severity of cognitive impairment as measured by the 3MS. Cutoff scores of 75/76 out of 100 on the 3MS have been suggested to be equivalent to the MMSE cutoff score of 23 out of 30 (Teng & Chui, 1987) often used to differentiate patients with dementia from cognitively intact individuals (Folstein et al., 1975). Although

there are no specific ranges on the 3MS for determining severity of dementia, it is possible to infer that the NON-CSHA AD patients are at the very mild stages of dementia (mean 3MS score=75.5) while the CSHA AD patients are more likely to be at the mild stage (mean 3MS score=63.6).

Interestingly, there was no significant difference between the NON-CSHA AD patients and the memory-impaired subjects on the 3MS, suggesting that although the latter group obtained higher scores (i.e., 5 points), the two groups have similar levels of overall cognitive abilities. Recent studies (e.g., Jackson & Ramsdell, 1988) have suggested that the MMSE and cognitive screening tests in general are not sensitive enough to detect mild disorders. Furthermore, Galasko and colleagues (1990) reported that among 380 elderly outpatients with memory complaints, 15% of the individuals diagnosed as having dementia scored above 23 on the MMSE and 7% scored above 27. The present findings also support previous research (Storandt & Hill, 1989) suggesting that a significant overlap on the level and/or pattern of impairment observed in very mild AD patients and in individuals displaying memory deficits.

It is important to note that although both the NON-

CSHA AD patients and the memory-impaired group displayed approximately the same overall level of cognitive abilities, only the AD group showed both diminished awareness of the extent of their memory change and deficient self-monitoring abilities. This finding provides further support to the view that unawareness may not be necessarily related to cognitive impairment.

Since it has been shown that some older adults displaying circumscribed memory impairment might progress to a dementia stage upon follow-up (Rubin et al., 1989; Tuokko et al., 1991), longitudinal evaluations of the memory-impaired subjects who participated in the present study would provide valuable information regarding how many of these individuals in fact display a specific memory deficit.

The present results also support previous studies (Welsh et al., 1991) suggesting that delayed recall measures are particularly useful in differentiating AD patients from individuals displaying memory impairment and from normal elderly. Furthermore, while the AD patients did not differ from the other two groups on the Word Fluency test, these patients obtained significantly lower scores on the Animal Fluency test. This observation supports the view that the AD patients' deficits in recalling information are related to

impaired semantic processing (Butters et al., 1987; Cushman et al., 1988).

Adittionally, all modified MIA scales (i.e., Strategy, Change, Anxiety) appeared to be internally consistent with Cronbach's alpha values similar to the original MIA scales, indicating that the new scales also have acceptable reliability.

Although it could be argued that completing the MIA questionnaire is a task that is too complex for patients with AD, which would question the validity of the answers obtained, the present results do not appear to support such argument. Firstly, the reliability analyses showed that all scales were internally consistent, i.e., the AD patients were not responding randomly or inconsistently to the questions. Secondly, the AD patients displayed mild levels of dementia (i.e., as measured by the 3MS), indicating that they were not too cognitively impaired to understand the questionnaire. Thirdly, these patients obtained scaled scores in the low average range on the Similarities (i.e., 8.6) and within average on the Comprehension (i.e., 9.5) subtests of the WAIS-R, suggesting that they do not display impaired judgement or abstract reasoning.

It is important to note, however, that the AD

patients in the present study had mild levels of dementia. It is possible that AD patients in the moderate to severe stages of the disease would not be able to accurately comprehend or answer the MIA questionnaire. In such cases, clinical observations or the development of less complex questions/answers might be necessary to investigate degree of memory awareness.

Finally, since the MIA questionnaire scales (original or modified) have not been previously administered to mild AD patients or memory-impaired older adults, further research is necessary to verify the utility of this instrument in assessing the awareness phenomena in clinical populations.

Summary and Conclusions

The findings of the present study showed that although mild AD patients, memory-impaired subjects, and normal controls reported equivalent levels of change in memory abilities in relation to past performance, a comparison between self- and relative's report revealed that the AD patients appeared to be unaware of the extent of the decline in their memory functioning. These results support previous studies reporting diminished awareness of memory abilities in mild AD.

However, no differences among groups were observed in the MIA scales investigating the use of strategies, internal locus of control, and anxiety in memory-related activities.

Relatives' report of change in memory and actual performance in memory tests were particularly useful in differentiating AD patients from memory-impaired and control subjects, and may be important aspects to be considered in the diagnostic process of these clinical populations whenever a question of mild AD vs. memory/cognitive decline is raised.

The results also revealed that the AD patients produced more intrusion errors (i.e., particularly extra-task intrusions and perseverations), corrected fewer of their errors, and overestimated their actual memory recall performance. These findings suggest that when compared to memory-impaired and "normal" older adults, AD patients display diminished ability to monitor their own cognitive performance.

The overall findings suggest, therefore, that disturbances in awareness of change in memory abilities as well as diminished self-monitoring abilities do occur in mild AD. Furthermore, the results appear to support the notion that preserved awareness of memory deficit requires intact self-monitoring abilities, since both

metamemory dimensions were impaired among the AD patients and preserved among the other two groups. It is possible, therefore, that preserved self-monitoring abilities are necessary in order to update information concerning perception of level of memory functioning an/or impairment. However, the number of studies that have systematically investigated the unawareness phenomena in AD is small, and further research is necessary to clarify the various aspects that might be involved in the production of diminished awareness of memory functioning.

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APPENDIX A

PERFORMANCE EVALUATION

Ex: " I will ask you a few questions about some of the tasks we have done today and I want you to try to remember them."

1." I showed you 12 pictures of different objects and asked you to name them. Later on I asked you to tell me the names of as many of the objects as you could remember. We did this 3 times and each time I told you the ones you forgot."

"Do you remember doing this task?" YES NO

"How many words do you think you did remember by the end of the third time?" __ "How confident are you that you did remember __ words?"

( ) CONFIDENT ( ) SOMEWHAT CONFIDENT ( ) NOT CONFIDENT

2."I also asked you to learn a list of 15 words. I read the list 5 times and each time I asked you to tell me as many words as you could remember."

"Do you remember doing this task?" YES NO

"How many words do you think you did remember by the end of the fifth time?" __ "How confident are you that you did remember __ words?"

( ) CONFIDENT ( ) SOMEWHAT CONFIDENT ( ) NOT CONFIDENT

2. "I showed you 15 cards with geometrical figures on them and then asked you to point to the figure you had just seen among other figures that you had not seen before."

"Do you remember doing this task?" YES NO

"How many figures do you think you identified correctly?" __ "How confident are you that you did identify __ figures?"

( ) CONFIDENT ( ) SOMEWHAT CONFIDENT ( ) NOT CONFIDENT

APPENDIX B

MODIFIED MIA QUESTIONNAIRE

DIRECTIONS: (TO BE READ BY THE EXAMINER)

"IN THIS QUESTIONNAIRE, WE WOULD LIKE YOU TO TELL US ABOUT YOUR MEMORY AND HOW YOU FEEL ABOUT IT. THERE ARE NO RIGHT OR WRONG ANSWERS TO THESE QUESTIONS BECAUSE PEOPLE ARE DIFFERENT".

"EACH QUESTION IS FOLLOWED BY FIVE CHOICES. DRAW A CIRCLE AROUND THE LETTER CORRESPONDING TO YOUR CHOICE. MARK ONLY ONE LETTER FOR EACH STATEMENT".

"SOME OF THE QUESTIONS ASK YOUR OPINION ABOUT MEMORY-RELATED STATEMENTS; FOR EXAMPLE:" **(GIVE 1ST SAMPLE QUESTION)**.

"IN THIS EXAMPLE YOU COULD, OF COURSE, CHOOSE ANY ONE OF THE ANSWERS. IF YOU AGREE STRONGLY WITH THE STATEMENT YOU WOULD CIRCLE A. IF YOU DISAGREE STRONGLY YOU WOULD CIRCLE LETTER E".

"THE B AND D ANSWERS INDICATE LESS STRONG AGREEMENT OR DISAGREEMENT. THE LETTER C ANSWER GIVES YOU A MIDDLE CHOICE, BUT DON'T USE C UNLESS YOU REALLY CAN'T DECIDE".

"SOME OF THE QUESTIONS ASK YOU HOW OFTEN YOU DO CERTAIN THINGS THAT MAY BE RELATED TO YOUR MEMORY. FOR EXAMPLE:" **(GIVE 2ND SAMPLE QUESTION)**.

"AGAIN, YOU COULD CHOOSE ANY ONE OF THE ANSWERS. CHOOSE THE ONE THAT COMES CLOSEST TO WHAT YOU USUALLY DO".

MODIFIED MIA QUESTIONNAIRE

SAMPLE QUESTIONS

1. I KNOW IF I KEEP USING MY MEMORY I'LL NEVER LOSE IT.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

2. DO YOU TRY TO CONCENTRATE HARD ON SOMETHING YOU WANT TO REMEMBER?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

1. I CAN REMEMBER THINGS AS WELL AS ALWAYS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

2. WHEN YOU ARE LOOKING FOR SOMETHING YOU HAVE RECENTLY MISPLACED, DO YOU TRY TO RETRACE YOUR STEPS IN ORDER TO LOCATE IT?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

3. I GET UPSET WHEN I CANNOT REMEMBER SOMETHING.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

4. DO YOU THINK ABOUT THE DAY'S ACTIVITIES AT THE BEGINNING OF THE DAY SO YOU CAN REMEMBER WHAT YOU ARE SUPPOSED TO DO?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

5. I CAN'T EXPECT TO BE GOOD AT REMEMBERING POSTAL CODES AT MY AGE.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

6. I AM LESS EFFICIENT AT REMEMBERING THINGS NOW THAN I USED TO BE.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

7. I GET ANXIOUS WHEN I AM ASKED TO REMEMBER SOMETHING.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

8. I HAVE LITTLE CONTROL OVER MY MEMORY ABILITY.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

9. I AM JUST AS GOOD AT REMEMBERING AS I EVER WAS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

10. WHEN YOU TRY TO REMEMBER PEOPLE YOU HAVE MET, DO YOU ASSOCIATE NAMES AND FACES?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

11. I AM USUALLY UNEASY WHEN I ATTEMPT TO A PROBLEM THAT REQUIRES ME TO USE MY MEMORY.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

12. I MISPLACE THINGS MORE FREQUENTLY NOW THAN WHEN I WAS YOUNGER.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

13. AS LONG AS I EXERCISE MY MEMORY IT WILL NOT DECLINE.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

14. COMPARED TO 10 YEARS AGO, I NOW FORGET MANY MORE APPOINTMENTS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

15. WHEN YOU HAVE TROUBLE REMEMBERING SOMETHING, DO YOU TRY TO REMEMBER SOMETHING SIMILAR IN ORDER TO HELP YOU REMEMBER?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

16. I KNOW IF I KEEP USING MY MEMORY I WILL NEVER LOSE IT.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

17. MY MEMORY FOR IMPORTANT EVENTS HAS IMPROVED OVER THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

18. I FEEL JITTERY IF I HAVE TO INTRODUCE SOMEONE I JUST MET.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

19. IT'S UP TO ME TO KEEP MY REMEMBERING ABILITIES FROM DETERIORATING.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

20. DO YOU CONSCIOUSLY ATTEMPT TO RECONSTRUCT THE DAY'S EVENTS IN ORDER TO REMEMBER SOMETHING?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

21. MY MEMORY FOR DATES HAS GREATLY DECLINED IN THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

22. DO YOU TRY TO RELATE SOMETHING YOU WANT TO REMEMBER TO SOMETHING ELSE HOPING THAT THIS WILL INCREASE THE LIKELIHOOD OF YOUR REMEMBERING LATER?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

23. EVEN IF I WORK ON IT, MY MEMORY ABILITY WILL GO DOWNHILL.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

24. WHEN SOMEONE I DON'T KNOW VERY WELL ASKS ME TO REMEMBER SOMETHING, I GET NERVOUS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

25. DO YOU TRY TO CONCENTRATE HARD ON SOMETHING YOU WANT TO REMEMBER?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

26. NO MATTER HOW HARD A PERSON WORKS ON HIS MEMORY, IT CANNOT BE IMPROVED VERY MUCH.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

27. MY MEMORY FOR NAMES HAS DECLINED GREATLY IN THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

28. I GET ANXIOUS WHEN I HAVE TO DO SOMETHING I HAVEN'T DONE FOR A LONG TIME.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

29. IF I WERE TO WORK ON MY MEMORY I COULD IMPROVE IT.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

30. DO YOU MAKE MENTAL IMAGES OR PICTURES TO HELP YOU REMEMBER?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

31. I GET TENSE AND ANXIOUS WHEN I FEEL MY MEMORY IS NOT AS GOOD AS OTHER PEOPLE'S.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

32. MY MEMORY HAS IMPROVED GREATLY IN THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

33. DO YOU MENTALLY REPEAT SOMETHING YOU ARE TRYING TO REMEMBER?

A. NEVER
B. RARELY
C. SOMETIMES
D. OFTEN
E. ALWAYS

34. I THINK A GOOD MEMORY COMES MOSTLY FROM WORKING AT IT.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

APPENDIX C

MODIFIED MIA QUESTIONNAIRE
RELATIVE/CAREGIVER

DIRECTIONS:

IN THIS QUESTIONNAIRE, WE WOULD LIKE YOU TO TELL US ABOUT THE MEMORY OF MR./ MRS. . PLEASE TAKE YOUR TIME AND ANSWER EACH OF THESE QUESTIONS TO THE BEST OF YOUR KNOWLEDGE.

EACH QUESTION IS FOLLOWED BY FIVE CHOICES. DRAW A CIRCLE AROUND THE LETTER CORRESPONDING TO YOUR CHOICE. MARK ONLY ONE LETTER FOR EACH STATEMENT.
THE QUESTIONS ASK YOUR OPINION ABOUT MEMORY-RELATED STATEMENTS, FOR EXAMPLE:

THE OLDER HE/SHE GETS THE HARDER IT IS FOR HIM/HER TO REMEMBER.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

IN THIS EXAMPLE YOU COULD, OF COURSE, CHOOSE ANY ONE OF THE ANSWERS. IF YOU AGREE STRONGLY WITH THE STATEMENT YOU WOULD CIRCLE A. IF YOU DISAGREE STRONGLY YOU WOULD CIRCLE LETTER E.
THE B AND D ANSWERS INDICATE LESS STRONG AGREEMENT OR DISAGREEMENT. THE LETTER C ANSWER GIVES YOU A MIDDLE CHOICE, BUT DON'T USE C UNLESS YOU REALLY CAN'T DECIDE.

KEEP THESE POINTS IN MIND:
(A) ANSWER EVERY QUESTION, EVEN IF IT DOESN'T SEEM TO APPLY TO HIM/HER VERY WELL.
(B) ANSWER AS HONESTLY AS YOU CAN WHAT IS TRUE ABOUT HIM/HER. PLEASE DO NOT MARK SOMETHING BECAUSE IT SEEMS LIKE THE "RIGHT THING TO SAY".

1. HE/SHE CAN REMEMBER THINGS AS WELL AS ALWAYS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

2. COMPARED TO 10 YEARS AGO, HE/SHE NOW FORGETS MANY MORE APPOINTMENTS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

3. HE/SHE MISPLACES THINGS MORE FREQUENTLY NOW THAN WHEN HE/SHE WAS YOUNGER.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

4. HE/SHE IS JUST AS GOOD AT REMEMBERING AS HE/SHE EVER WAS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

5. HIS/HER MEMORY FOR DATES HAS GREATLY DECLINED IN THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

6. HIS/HER MEMORY HAS IMPROVED GREATLY IN THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

7. HIS/HER MEMORY FOR IMPORTANT EVENTS HAS IMPROVED OVER THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

8. HE/SHE IS LESS EFFICIENT AT REMEMBERING THINGS NOW THAN HE/SHE USED TO BE.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY

9. HIS/HER MEMORY FOR NAMES HAS DECLINED GREATLY IN THE LAST 10 YEARS.

A. AGREE STRONGLY
B. AGREE
C. UNDECIDED
D. DISAGREE
E. DISAGREE STRONGLY