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**Remote memory processes in early Alzheimer's disease**

**Malamut, Barbara Lynn, Ph.D.**

**City University of New York, 1989**

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A

**REMOTE MEMORY PROCESSES IN EARLY ALZHEIMER'S DISEASE**

**BY**

**BARBARA LYNN MALAMUT**

A dissertation submitted to the Graduate Faculty in Psychology  
in partial fulfillment of the requirements for the degree of  
Doctor of Philosophy, The City University of New York.

1989

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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## Abstract

## REMOTE MEMORY PROCESSING IN EARLY ALZHEIMER'S DISEASE

by

Barbara L. Malamut

Adviser: Dr. Wilma G. Rosen

Severe anterograde amnesia is considered a hallmark of Alzheimer's Disease (AD) even in the early stages, yet little is known about the status of remote memory functioning. The purpose of this study was to examine remote memory for both autobiographical and public events in early AD with regard to semantic and episodic information and its temporal distribution.

Autobiographical memory was assessed by modifying a technique developed by Crovitz & Schiffman (1974) where single words were used as prompts to elicit memories. Whereas previous studies used words not targeted to any time period (temporally neutral), the present study included words that were strongly associated with specific decades from the 1920's to the present.

Memory for public events was assessed with an updated version of the Boston Remote Memory Battery (BRM).

Overall, patients recalled fewer autobiographical memories and in less detail than healthy elderly controls. When memory content was examined, the presence of a temporal gradient was dependent upon whether the words were decade

specific or neutral. Decade specific words yielded an equal loss for all decades, while neutral words yielded a loss that was most severe for recent decades.

Results of the BRM demonstrated a severe impairment for patients relative to controls that was characterized by poorer performance across all decades. These findings conflict with those of the autobiographical memory test when neutral words were included in the analyses but are in agreement with the temporal distribution when analyzing only decade specific words.

When results of both tests were considered together, they indicated that remote memory for both semantic and episodic information was greatly affected in the early stages of AD. Furthermore, the presence of a temporal gradient was dependent upon the structure of the task. When questions or prompt words targeted the same time periods and each time period was equally represented, the patients' memory loss was extensive and affected all decades equally. When words were neutral and allowed patients to exhibit a bias, a temporal gradient that was most severe for recent decades was found.

To William F. Caveness and Carol Mirsky  
whose memories shall live in my heart forever.

## ACKNOWLEDGEMENTS

It is with intense gratitude that I thank Raquel and Ruben Gur and all members of the Brain Behavior Laboratory at the University of Pennsylvania for their support, cooperation and encouragement throughout the research and preparation of this dissertation. While everyone in the laboratory was extremely helpful, there were a few people who deserve special mention. I thank Carol Moran for her administrative assistance as well as her devoted friendship and optimism; Rollin Erwin for sharing his knowledge of SAS and helping me translate many error messages into meaningful commands; and Susan Resnick for advising me on many methodological issues of the task. It is impossible to include all that Barbara Burns' contributed to this study. I especially appreciated her untiring assistance in recruiting controls, scheduling patients and for acting as the second rater for the autobiographical task. Also, I thank Gary Gottlieb and again Raquel Gur for skillfully screening and rating patients for study and their steadfast enthusiasm and support throughout this project.

From the inception of my dissertation, Louis Gerstman, Ruben Gur and Wilma Rosen served as advisors. I thank Lou for his unwavering and ardent support throughout the

dissertation process and for introducing the basics of computer use in statistics in such a non-threatening manner. I am indebted to Ruben for his kindness, patience and encouragement while teaching me the mechanics of SAS. In addition, I thank him for his invaluable guidance in the analysis and interpretation of the data. My deepest appreciation to Wilma Rosen, my chief advisor, for her insightful and encouraging comments and careful editing of all versions of this dissertation. The frequent stimulating interchanges contributed greatly to many ideas within this manuscript.

I am grateful to Jason Brandt for his generous suggestions and ideas that formed the basis of this study. Also, while writing the Discussion section I benefitted greatly from conversations with Larry Squire and Stuart Zola-Morgan, who offered many useful comments.

While not directly involved in the execution of my research, there were several people whose contribution unquestionably was of equal measure. I thank my parents for instilling the fortitude and perseverance needed to complete a project such as this. And to Phyllis, Joy, Gary, Marc and Eric - for their confidence, loyalty and love, I thank them. Also, I am fortunate to have such close and understanding friends. I am indebted to Edward Moss, my officemate and neuropsychology partner, for his abiding good cheer, sensitivity and unlimited supply of jokes and peanut M &

M's. I am most appreciative to Julie, Linda, Andrea, Bonnie and Alan for their warm consolation on the most difficult days and never allowing me to become too discouraged throughout my graduate school career.

Lastly, I respectfully acknowledge Robert Glassman and Mort Mishkin for encouraging and guiding my intellectual curiosity. The knowledge and experience gained in their laboratories has immeasurably influenced my present work.

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Chapter 1  
OBJECTIVES AND BACKGROUND

1.1 Objectives

The primary purpose of this dissertation is to examine remote memory functioning in patients with Probable Alzheimer's Disease (AD). Specifically, I address the selectivity of deficit in remote memory processes in regard to the age and the nature of the memory (i.e. autobiographical versus public events; episodic versus semantic memories). In order to achieve this goal, a specific aim of this research was the development of a task examining remote autobiographical memories. In addition, because a significant decline in the acquisition and recall of new information is a hallmark of Alzheimer's Disease, the relationship between new learning and remote memory processes was also examined.

Hypotheses are:

1) AD patients are impaired relative to elderly controls in recalling remote information that is both

autobiographical and from public events.

2) For Group AD, the overall pattern of performance yields a temporal gradient such that fewer memories are recalled from the most recent decade and a greater number of memories are recalled from earlier in the patients' lives.

3) For Group AD and controls (NC), recall of remote events correlates positively with measures of new learning.

4) For Group AD, overall recall of remote events is related to decline in intellectual functioning, particularly verbal skills.

The study population consists of patients with a diagnosis of Probable Alzheimer's Disease. This population has been selected for the following reasons. First, a significant decline in the acquisition and recall of new information has been well documented in Alzheimer's Disease, but only a few studies have examined these patients' ability to recall memories from their past. These results are inconclusive with regard to the specificity of deficit. Furthermore, Alzheimer's Disease is a slowly progressive disorder that affects diffuse cortical regions, bilaterally. Since studies have shown that global amnesia can result from circumscribed damage to a variety of brain structures, studying patients with early AD offers the opportunity to extend our knowledge on the role of the cortex in the

organization and recall of memory for remote events. Qualitative comparisons between deficits observed in amnesia and dementia, may result in a better understanding of the processes underlying the memory disorders. Furthermore, dissociations between new learning and recall of remote information have been established in many amnesic groups and found to be related to the site of neuropathology. Yet, a "memory profile" for Alzheimer's Disease is not established. By assessing remote memory functions in early AD, the relationship between new learning and remote memory functioning can be compared to the pattern of memory functioning in amnesic patients where the pathology is known. These types of comparisons in patients in early stages of AD may aid in determining if AD begins as a circumscribed amnesic disorder where the memory dysfunction could be attributed to the same neuropathology as in amnesia. Alternatively, since AD is characterized by impairment in many cognitive functions besides new learning, the investigation of remote memory functioning may lend further insight into the relationship between cognition and remote memory processes. Therefore, the analysis also includes a comprehensive evaluation of cognitive abilities to assess the mental status of the patients but also to examine the relationship between cognition and remote memory functioning.

## 1.2 Background

At the turn of the century, much interest was focused on memory functioning. Psychologists conceptualized memory as a unitary system that could be subdivided into many components. Therefore, in order for memory to occur, information needed to be encoded, consolidated, stored and retrieved. A breakdown anywhere in this system led to a failure to remember. Within the domain of memory, further subdivisions were made in an attempt to better understand the organization of memory in the brain. These subdivisions have been incorporated into what is entitled the information processing model. Over the last thirty years, investigators have used these theories as a framework to outline the deficits exhibited in amnesia and more recently, in dementia. The following section will review studies of patients with Mild to Moderate Alzheimer's Disease with regard to the information processing model. Since memory is thought to decline as a result of the aging process alone, studies examining age-related changes in healthy elderly individuals (NC) will also be discussed in order to differentiate the effects of normal aging from the effects of Alzheimer's Disease.

### 1.3 Information processing model of memory

The following section discusses the many laboratory studies of Alzheimer's disease and normal aging that are based on the information processing model. The underlying assumption of this model is that in order for information to be remembered, it must process serially through the stages outlined below.

#### 1.3.1 Sensory Memory

The first stage is a modality-specific sensory memory which holds a limited amount of information over a very short period of time (e.g. echoic memory in the auditory system or iconic memory in the visual system). Laboratory studies of sensory memory involves identifying stimuli that have been exposed for a very brief period of time and includes tachistoscopic studies. These studies have shown minimal changes in healthy elderly subjects as well as in patients with mild to moderate AD. (Salthouse, 1982; Albert, 1988)

#### 1.3.2 Primary Memory

The next stage involves processing and retaining newly learned information and is referred to as primary or short-term memory. It involves storing limited amounts of untransformed material for short periods of time (up to 30 seconds). In order for information to be held for a longer

time within primary memory, it must be actively rehearsed. Studies on primary memory have essentially employed three paradigms: free recall, digit span, and the Peterson and Peterson distractor task.

The performance of healthy elderly populations clearly demonstrate that with the exception of slower response times, there are only slight differences with age (Craik, 1977).

The results of studies with Alzheimer patients are more varied depending on the task. In a review of the many studies that investigated primary memory capacity in AD, Morris and Baddeley (1988) summarized that "there is, at most, only a slight reduction in performance on the recency portion of free recall, a moderate and consistent reduction in immediate memory span, and a more substantial impairment on the Peterson and Peterson task" (pg. 283). They reasoned that the greater deficit found in studies employing the Peterson and Peterson task may be due, in part, to its demand for divided attentional resources; whereas, the other two paradigms require only continuous attention. Therefore, the greater impairment may reflect difficulty in divided attentional ability. The severity of deficit in all three tasks, however, appears to be related to the level of dementia (Corkin, 1982).

### 1.3.3 Secondary Memory

Secondary memory involves retaining and manipulating large amounts of material for a substantial period of time. The general view is that when information is processed, primary and secondary memory continually interact with one another.

Results of age-related studies on secondary memory are not as straightforward as those examining sensory and primary memory. In general, substantial decline with age in free recall paradigms, but not in cued recall or recognition paradigms, has been found. This difference in performance between free recall versus recognition or cued recall has led researchers to examine secondary memory with respect to encoding, storage and retrieval processes. While studies have found no age-related decline in ability to store information (Wickelgren, 1975), results of studies examining changes in encoding and retrieval processes are less uniform. It has been well established through many studies that older individuals do not spontaneously encode material as frequently as younger subjects. However, when organizational strategies are provided, the difference between ages can disappear. Craik et al. (1987) demonstrated that the decline can be attenuated when cuing is employed during both encoding and retrieval; and the difference between young and old groups is greatest when there was no cuing at any stage.

Experimenters have also found that by manipulating different task variables, they can minimize age differences. These variables include providing organizational strategies, modifying the pace of the experiment, allowing practice trials and using familiar stimulus materials ( Craik & Rabinowitz, 1985; Craik et al., 1987).

Other studies have suggested that there are noncognitive variables which may also be related to level of memory performance in elderly populations. For example, there is evidence to suggest that age-related decline may be attenuated not only in individuals with higher intellectual functioning but socioeconomic status and level of social activity may also be contributory (Arbuckle et al., 1986). These findings have led researchers to conclude that memory is a "context sensitive phenomenon" (Craik et al., 1987). Therefore, in order to best study the effect of aging on secondary memory, one must take an interactional approach that considers acquisition variables, test variables, materials, and subjects.

Studies of secondary memory in patients with AD demonstrated an unequivocal and profound deficit apparent in even the earliest stages of the disease (Corkin, 1982; Rosen, 1983; Wilson et al., 1983; Ober et al., 1985; Huber et al., 1986; Cushman et al., 1988). Moreover, investigators have also reported qualitative differences in

the pattern of performance in AD patients when compared to normal elderly, or patients with Huntington's chorea and Korsakoff's Disease. Thus, two studies have shown that patients with AD make more perseverative and intrusional errors on tests of verbal memory (Butters et al., 1987; Fuld, 1983). Butters also reported that on a test of immediate recall of stories, when compared to NC, AD patients not only remembered fewer correct ideas, but they included more ideas from previous stories as well as ideas that were never presented (i.e. confabulation).

In an attempt to delineate preserved functions in secondary memory processes in patients with mild to moderate AD, Cushman et al., (1988) attempted to control for level of encoding by employing a cuing procedure during both the presentation and recall of a word list. They found that some AD subjects were impaired in the initial stimulus-processing procedure (i.e. cued word presentation), and the subsequent cued recall did not greatly facilitate memory. However, the performance of the least impaired patients was similar to the control subjects in cued recall even though they were impaired on the free recall task, suggesting that AD patients' deficits in recall are related to impairments in utilizing semantic information. The authors state that "indeed, deficits in semantic processing may well underlie or precede failures in episodic memory in AD" (Cushman et al., 1988 p. 691).

#### 1.3.4 Remote Memory

The last stage of the information processing model involves a tertiary memory that is responsible for information that has been stored for very long periods of time (i.e. years). In contrast to the plentiful investigations of secondary memory, fewer studies of age-related effects on retention of remote information have been conducted. Until recently, much of the information gathered about retention of remote memories has been inferred from anecdotal reports of elderly individuals' superior ability to recall very old events relative to recalling more recent events. The limitations associated with anecdotal reports are well recognized (Salthouse, 1982) including difficulty with verification, inferring memories rather than direct recall, equating saliency, and controlling for repetition of memories.

Despite these difficulties, investigators have developed tasks to examine remote memory processes in aging. Recent studies have been concerned with the structure and organization of remote memories and have been primarily guided by two theoretical models. The first model, Ribot's Law of Regression (1882), states that information is forgotten in the reverse order in which it was acquired. The corollary to Ribot's Law states that memory becomes more resistant to disruption as time passes after learning. This

has led investigators to search for temporal patterns of remote memory loss. This has resulted in identification of two forms of remote memory dysfunction, temporally-limited retrograde amnesia and extensive remote memory impairment.

Another approach to the study of remote memory functioning is based on a distinction between semantic and episodic memory systems popularized by Tulving (1972). Semantic memory refers to an individual's knowledge about language and the world (i.e. rules, principles, facts) that is separate from the experiences that led to the accumulation of that knowledge. Episodic memory refers to autobiographical events with regard to the context (i.e. temporal and environmental components) in which it was acquired. Although episodic and semantic memory can operate as two distinct systems in terms of mode of access and method of retrieval, Cermak proposed that they may also be interdependent (1984). In a review of studies on amnesics he argued that impaired semantic memory could be secondary to an impoverished episodic memory system because in healthy individuals, recall of circumstances surrounding the stimulus presentation (i.e. context) can facilitate recall of the semantic memory. Conversely, Tulving et al. (1988) proposed that the opposite may also be true. In a more recent paper, Tulving et al. (1988) demonstrated that what at first appears to be an intact episodic memory is more accurately defined as a semantic memory. He stated that

"Both normal people and amnesic patients can answer questions about themselves and their personal past not only by virtue of consciously remembered episodes but also on the basis of their personal semantic memory, that is, on the basis of their knowledge of the fact that certain personal events happened" (Tulving et al., 1988, p. 15).

Over the past fifteen years, the distinction between semantic and episodic memory has been applied to studies of human amnesia. Using these two theories as a framework, investigators have looked for differential patterns of performance in normals and amnesics with regard to the temporal organization in recalling semantic and episodic knowledge of remote information. The present research addresses the issue of the integrity of memories from the distant past up to the present in patients with mild to moderate Alzheimer's Disease by assessing and comparing their ability to recall episodes and facts when asked about autobiographical and public information.

#### 1.4 Autobiographical Memory

Recently, a small group of investigators have studied autobiographical remote memories by employing a technique first discovered by Sir Francis Galton (1879) and later revised by Crovitz and Schiffman (1974). This procedure entails using a series of words as prompts to elicit memories for episodes from the subject's personal experience. The dates of the reported experiences are reconstructed and plotted as frequency distributions within a person's life. This technique has the advantage of assuming that all individuals will report events that are salient and familiar, thereby circumventing a potential problem of sampling bias for test questions. By using common, every day words, Crovitz found that spontaneous associations to random words tapped a wide range of time in his subjects' lives. Since Crovitz' subjects were all young undergraduates, the issue of whether elderly subjects would demonstrate a similar temporal pattern of recalled events was unknown. Therefore, as will be shown in the next section, several investigators have subsequently employed this technique in studies on the elderly.

#### 1.4.1 Normal Aging

In a later study, Franklin and Holding (1977) required male and female subjects aged 25-75 years, to report personal experiences associated with 50 commonly used words. They concluded that there was not a selective sparing of older memories but rather they found that the median date of the recalled event increased with age. Moreover, the majority of associations produced by adults of both sexes in the 65-74 year age range were triggered by events in the last 20% of their life span. That is, they typically remembered events from when they were 57 years old. Unfortunately, the authors did not report the data in sufficient detail to be able to examine individual differences. In addition, these subjects were not tested on other measures of cognitive functioning so it is unknown whether the different age groups were comparable with regard to level of intellectual, language and short term memory functioning.

Conflicting results were obtained by McCormack (1979) in a series of three studies that employed the same technique but with lists of only 24 words. His groups consisted of male and female normal subjects with ages ranging from 56 to 102 years. In contrast to Franklin and Holding (1977), he reported that the greatest frequency of associations dated from the first quarter of his subjects' lives. Furthermore, he concluded that the frequency of

autobiographical memories declines from the first to the third quarter of life and then rebounds slightly for the last quarter. His subjects in the 65-74 age range typically recalled events from a mean median age of 34 years (as opposed to Franklin and Holding's findings of 57 years).

The significant difference in findings between these studies may be due to differences in the nature and the number of prompt words. Whereas Franklin and Holding used 50 words that were either adjectives, nouns, or words that could have been either nouns or verbs, McCormack used 20-24 words that were nouns with imagery, concreteness, and meaningfulness ratings greater than or equal to 6.00 (Thorndike & Lorge, 1944).

A study by Robinson (1976) makes it questionable as to whether the difference between the stimulus word characteristics could fully account for these disparate findings. Robinson reported no differences in the distribution of memories between nouns, adjectives and adverbs as prompt words. However, his subjects were all college undergraduates, so it is not known whether the same findings would hold true for the elderly. Subject selection could be another area in which the studies differed but neither study assessed other variables such as level of education or verbal intellectual functioning. Since it has been demonstrated that these factors influence secondary memory, they should be considered when studying remote

memory. Another criticism of both studies is that subjects were not screened for psychological, neurological or medical illnesses. This is especially important in elderly populations because of the increased frequency of disease.

#### 1.4.2 Dementia

To date, only one study has used this technique to study autobiographical memory in patients with Probable Alzheimer's Disease. Sagar et al. (1985, 1988) using 10 words as prompts, asked 14 AD patients and 17 normal control subjects to recall episodes and then to reproduce the memories for these same episodes 24-hours later. When subjects had difficulty recalling events the next day, they were cued. These investigators reported that patients with AD were significantly impaired in recalling autobiographical episodes both initially and when cued, but did not differ from control subjects in the age distribution of the episodes recalled. In both groups memories were drawn from the subjects' entire life span. Clustering of memories from discrete time periods were found within subjects but they were not consistently related to any specific decade. Given the small number of prompt words coupled with the impairment of AD's recall on day 1, it is difficult to make any generalized conclusions regarding temporal patterns of recall from this study.

### 1.4.3 Amnesia

In order to compare remote episodic to remote semantic memory, Crovitz' technique has also been employed in various studies of amnesic patients due to different etiologies. While some investigators have proposed that some amnesias can be characterized as a selective deficit in episodic memory, other investigators have argued against the usefulness of this dissociation. Using Crovitz' technique to test remote memory, significant impairment was reported in Korsakoff patients (Wood et al., 1982) and a post-encephalitic patient (Cermak and O'Connor, 1983). These authors concluded that since their subjects exhibited preserved language and social skills, semantic memory was considered to be intact and the impairment was confined to the episodic memory system. However, Zola-Morgan et al. (1983) demonstrated that these findings were confounded by different time periods for the two memory systems. They argued that in order to prove that episodic and semantic memory are differentially affected in amnesia, the test information must represent the same time periods. Therefore, after testing different groups of amnesic patients (due to Korsakoff's Disease, bilateral or unilateral ECT treatments, or a diencephalic lesion) on measures of episodic and semantic memory, Zola-Morgan et al. did not find a selective impairment in any of the amnesic groups. They reported that the performance of the

amnesic groups did not differ from their respective control groups or from each other. However, the results were more variable with respect to the temporal distribution of the recalled events. They reported that even though both groups were around 50 years old at the time of testing, the average age of memories for patients with Korsakoff's syndrome was 30.4 years compared to 20.1 for the alcoholic control group. In addition, their results indicated that memories were not recalled from all decades with equal frequency.

#### 1.5 Public Events

One method used to investigate remote semantic memory has been to test for recall and/or recognition of faces or events occurring in the news at some specified time. While on the one hand this technique has the advantage of testing objective and verifiable events, on the other hand, there remain many serious difficulties with regard to sampling bias of test questions (Erber, 1981). Some of the most crucial issues involve equating test items across decades for 1) level of difficulty; 2) frequency of exposure to material; and 3) personal and public saliency or meaningfulness. Recently, several investigators have successfully developed questionnaires that span many decades with these limitations in mind. These tests concern events about politics (Warrington and Silberstein, 1970; Albert et

al., 1979), sports (Squire and Slater, 1975) and television programs broadcast for a single season (Squire et al., 1975). In addition, Albert and her colleagues (1979), as part of the Boston Remote Memory Battery, developed a test where the subject is asked to identify photographs of famous people who had been in the news at various times in the past. As in their public events questionnaire, the material for the famous faces test samples many decades. While this test has the advantage of using material that is qualitatively similar, it has the possible disadvantage of not assuring when the face was learned since photographs may end up in books, newspapers or shown on TV.

In the following section, the results of studies on memory for past public events in normal aging, dementia and amnesia are presented.

#### 1.5.1 Normal Aging

Investigations of retention of past public events using multiple-choice questionnaires with healthy elderly subjects in samples of age 40-90 years (Warrington and Sanders, 1971), age 50-90 years (Squire, 1974), and age 50-74 years (Butters and Albert, 1982) revealed poorer performance among older individuals. Furthermore, there was no evidence to suggest selective retention of older memories. Although the results of these three studies were consistent with each other, the methodology of Warrington's

and Squire's experiments differed significantly from Butters and Albert's study. While Butters and Alberts equated items for difficulty across decades, the other two studies did not. Furthermore, because Squire demonstrated approximately parallel performance for each age group, it was concluded that the overall performance of the oldest groups was worse relative to the younger groups. However, there are two possible explanations for the absence of a temporal gradient. First, it could represent, as Squire argued, an equal loss of memories across all decades. Alternatively, since the items from the more recent decades were judged to be more difficult, these scores could be due to an impairment in the registration of more difficult information with advancing age rather than forgetting. That is, the older groups are less proficient at learning more difficult information than the younger groups.

### 1.5.2 Dementia

Only a few studies have systematically examined remote memory functioning for factual information in dementia. One study by Wilson, Kazniak and Fox (1981) used the Boston Remote Memory Battery (Albert et al., 1979) to assess patients with Alzheimer's Disease and concluded that they were impaired across all time periods sampled. Although the etiology of the experimental group was uniform, the authors did not control for the degree of severity of dementia and the more impaired patients may have masked any subtle effects of decade. Furthermore, the control group was significantly more educated than the patient group. Since education is correlated with performance, it is unclear to what extent the impairment can be attributed to the disease rather than to the differences in education.

A more recent study by Flicker et al. (1987) also reported deficits in remote memory in patients with SDAT of mild to moderate severity. While they carefully selected and screened their patient and control groups, these investigators modified the remote memory questionnaire of Squire (1974) and excluded all items except those from the 1950's. Since this study sampled memories from only one decade, it does not yield information about an individual's ability to retrieve memories from their entire life.

### 1.5.3 Amnesia

As mentioned above, the two well-studied amnesic cases, H.M. and N.A., both demonstrated a marked discontinuity between recall of events that preceded their amnesia and subsequent events. On a recognition test of famous faces H.M. had normal scores for the 1920's - 1940's, but minimal recognition for faces from the 1950's and 1960's (Marslen-Wilson & Teuber, 1975). Since his surgery occurred in 1953, these results suggest that H.M.'s retrograde amnesia is brief and dates back only a few years.

Early studies with patient N.A. whose injury occurred in 1960, have yielded a pattern of retrograde amnesia that was thought to be similar to H.M. (Cohen & Squire, 1981). However, results of later studies have suggested that N.A. may actually have a mild remote memory impairment. Cohen and Squire (1981) reported that N.A.'s memory for events up to 1960 was normal on six out of seven tests of remote memory including recall and recognition of the famous faces test (i.e. Boston Remote Memory Battery), recognition of factual events and recall and recognition of television programs. He was reported to be significantly impaired on one test of detailed recall of public events that occurred premorbidly, even though his performance was significantly worse for events that occurred postmorbidly. When it was discovered that N.A. exhibited impairment on Crovitz' episodic memory task compared to his control group, Zola-Morgan et al.

raised the possibility that "N.A. has a real impairment of remote memory, albeit a mild one that is not detectable by many tests of remote memory. A degree of impairment in remote memory might therefore be a regular feature of diencephalic amnesia" (pp. 496).

As part of the study mentioned above, Cohen and Squire (1981) also examined patients after bilateral ECT and patients with Korsakoff's Disease. They found that the results of the ECT group were related to their pre-ECT profile. For instance, on the tests where they exhibited a forgetting curve pre-ECT, they exhibited a temporally graded retrograde amnesia post-ECT. Similarly, on the tests where there was no gradient before treatment, the ECT affected all decades equally.

Similar to the findings of Albert et al. (1979), Cohen and Squire (1981) reported a very different pattern of results for KD patients than for N.A. and ECT patients. All seven tests of remote memory yielded a severe and extensive impairment for even the earliest decade sampled for KD patients. Furthermore, for all but the detailed recall test of former one-season television programs, KD patients demonstrated a temporal gradient that was most severe for the recent decades. Their performance on the television test was too impaired for any pattern to emerge.

Sanders and Warrington (1971b) tested recognition of famous people and factual information with tasks that they

designed in five amnesic patients and reported impaired remote memory for even the earliest decades. However, their study may be criticized on two points. First, the amnesic group was not uniform. Their amnesia was caused by different disease processes associated with different neuropathological states, including Korsakoff's Disease, herpes encephalitis and coal gas poisoning. Second, Sanders and Warrington's tests of remote memory were so difficult that the patient's performance was at chance for free recall and below chance for the multiple choice form across all decades. Thus, this "floor effect" precludes any conclusion regarding a temporal pattern.

## 1.6 Patterns of Anterograde and Retrograde Memory Loss

Neuropsychological studies of human amnesia have provided great insight into the structure and neurological organization of memory processes. The two types of deficits commonly identified after the onset of pathology are anterograde amnesia, which is marked by an inability to learn and retain new information and retrograde amnesia, which is characterized by an inability to retrieve information acquired premorbidly. Studies in patients with different neuropathologies have yielded dissociations of these memory processes. Furthermore, the qualitatively different patterns of overall memory functioning among amnesic patients indicates that amnesia is not a unitary disorder. This has been interpreted by many investigators as evidence for the independence of anterograde and retrograde memory systems (Cohen and Squire, 1981; Butters et al., 1982).

### 1.6.1 Amnesia

One of the most well known series of studies involves a man known as H.M. who had a bilateral temporal lobe resection for treatment of intractable epilepsy. Postoperatively, he had a dense anterograde amnesia but he was able to fully recall past personal and public information up to 3 years before the surgery (Penfield & Milner, 1958; Corkin, 1984).

Another well documented case of a very circumscribed amnesia is known as N.A. He sustained a stab wound to the brain involving left dorsal medial thalamus, mammillary bodies and the right temporal pole that resulted in a dense anterograde amnesia for verbal material and a retrograde amnesia for only 6-12 months before the accident (Teuber et al., 1968; Cohen & Squire, 1981; Squire, 1987).

Studies of persons with a diagnosis of Korsakoff's Disease (KD) which primarily involves damage to the diencephalon, have consistently demonstrated that these patients have a dense anterograde amnesia and are relatively less impaired in recalling remote events. In contrast to H.M. and N.A., their retrograde amnesia extends to all decades but is the most severe for recent decades (Albert et al., 1979; Butters & Cermak, 1980). Part of the deficit for the most recent information is thought to be secondary to an acquisition deficit (i.e. progressive anterograde amnesia) since these patients are usually ill for quite some time before hospitalization.

Cermak and O'Connor (1983) proposed another pattern of anterograde and retrograde dissociation after extensive study of a post-encephalitic patient known as S.S. He received the Boston Remote Memory Battery twice, a year apart. They reported that not only did his overall pattern significantly change between testings, but his individual responses were quite variable as well (i.e. getting items

correct that were incorrect the year before and vice versa). This was true for recall of factual events and famous faces but not recognition. The authors suggested that these differences may be attributable to the subjects' inconsistent access to his collection of memories. Therefore, Cermak and O'Connor argued that S.S.' remote memory loss represented another pattern that differed from other amnesic groups. They stated that S.S.' "remote memory impairment appeared to be composed of both search process disturbances and real information loss while Korsakoff's disorder has been portrayed as including an acquisition deficits component" (pg.229). At the present the question of whether this patients' memory profile actually represents a different pattern of remote memory loss can not be answered because as noted by the authors, consistency of response for individual test questions has not been examined in these other amnesic patients.

Specific patterns of anterograde and retrograde impairments have also been reported for psychiatric patients after receiving electroconvulsive therapy for treatment of depression. Based on a series of studies using a test of one-season television programs, Squire and his colleagues reported that ECT resulted in both anterograde amnesia and a temporally limited retrograde amnesia (Squire and Fox, 1980). They reported that the retrograde amnesia was limited to information acquired 1 - 3 years before the

treatments whereas information learned before that time was not affected (Squire et al., 1975; Squire & Cohen, 1979).

While it has traditionally been assumed that recovery in retrograde amnesia is accompanied by recovery from anterograde amnesia, there are some cases where the opposite pattern has been reported (Symonds, 1966; Goldberg et al., 1981). For example, Goldberg et al. (1981), tested a 36 year old post-traumatic patient on several remote memory tests including items of the Boston Remote Memory Battery corresponding to the 1950's-70's. They reported that the patient experienced a consistent retrograde amnesia that spanned approximately 20 years while his anterograde memory improved. A CT scan showed disruption of the mammillo-tegmental tract such that ascending reticular projections into the hippocampus and mammillary bodies but not the thalamus were probably severed. Goldberg stated that "this was the apparent cause of profound RA in the absence of comparably severe AA or a general arousal deficit may indicate that selective mesencephalic reticular activation of limbic structures constitutes a fundamental component of longterm retrieval"(pp.1393).

### 1.6.2 Dementia

Not only does the issue of recent versus remote memory abilities apply to amnesic patients, but it is also of interest whether recall of recent and past memories are

differentially affected in dementia. In Huntington's Chorea (HC), anterograde and retrograde memory functioning appear equally impaired. Butters et al. (1978) have shown that HC patients demonstrate a global memory impairment that increases with severity as the disease progresses. In contrast to the amnesic subjects mentioned above, patients with HC do not display a temporal gradient but rather they have a loss of memories that extends to all decades (Butters & Alberts, 1982). Further studies of HC's neuropsychological functioning have led investigators to conclude that their memory disorder reflects a general deficit in retrieval (Butters et al., 1986).

The findings are not as clear in Alzheimer's Disease. Whereas severe anterograde amnesia has been well documented in Alzheimer's Disease, only a few studies have examined these patients' ability to recall memories from their past. While retrograde impairment has been demonstrated in AD patients, as discussed above, these results are inconclusive with regard to the specificity of deficit. Therefore, careful study of remote memory processes in patients with mild to moderate AD is needed so that comparisons can be made to other dementia and amnesic groups.

## Chapter 2

### RESEARCH DESIGN AND METHODS

#### 2.1 Subject Selection and Screening

##### 2.1.1 Initial Screening For All Subjects

All subjects were participants in an ongoing study of Aging and Alzheimer's Disease at the Brain Behavior Laboratory in the Hospital of the University of Pennsylvania. With the exception of the presence of dementia, the same criteria were used for both the patient and control groups.

In order to recruit normal subjects, advertisements were placed in local newspapers and letters were sent to alumni of the University of Pennsylvania. These potential control subjects (NC) were first screened over the telephone by a trained research assistant using a structured questionnaire. Criteria for immediate exclusion were the following: 1) Outside the specified age range (60 - 85 years); 2) Left-handers or ambidextrous; 3) History of psychiatric, neurologic or medical disease specified below; 4) Taking medications with known central nervous system

(CNS) effects. Permitted medications were non-narcotics analgesics, diuretics or other anti-hypertensives with no major CNS effects, and vitamin supplements; 5) Alcohol or other substance abuse; 6) Non-native American English speaker; 7) Educational level less than 12 years.

Neurologic exclusions were: history of head trauma; cerebral ischemia; vascular headache; carotid disease; epilepsy; brain tumor; or other causes of dementia such as chronic meningitis, subdural hematoma, pernicious anemia, normal pressure hydrocephalus, Parkinson's disease, Huntington's disease, and multi-infarct dementia. Medical exclusions were: cancer; blood pressure [ $>150/100$ ] uncontrolled by two acceptable antihypertensive medications; cardiac disease (i.e. congestive heart failure, arrhythmia, rheumatic heart disease, uncontrolled angina or history of myocardial infarction); hyperlipidemia; diabetes mellitus and endocrine disorders.

If subjects passed this telephone screening, they next received a comprehensive screening by either one of two geriatric psychiatrists or psychiatric Fellows. All potential subjects received a Structured Clinical Interview for DSM III-R (SCID), a physical examination, a neurological examination, blood analysis, and a MRI scan. During the psychiatric interview, subjects were also evaluated with Reisberg's Global Deterioration Scale (GDS). In accordance with Reisberg's scale, subjects were rated as normal (GDS 1-

2), mildly to moderately impaired (early dementia, (GDS 3-4), or severely impaired (advanced dementia, GDS 5-6).

#### 2.1.2 Patient selection

The diagnosis of probable AD was based upon criteria for primary degenerative dementia (American Psychiatric Association, 1980) and the NINCDS-ADRDA guidelines (McKhann, et al., 1984). The subjects were all outpatients at HUP and had a history of a progressive decline in memory and other cognitive functions ( $GDS \geq 3$ ) in the absence of any other condition which may have accounted for these difficulties.

The group with probable Alzheimer's disease was comprised of 4 men and 6 women who ranged in age from 68 to 80 years ( $73.6 \pm 4.7$ ) and had 12-21 years of education ( $14.8 \pm 3.2$ ). The duration of illness ranged from 1 to 4 years ( $2.1 \pm 0.9$ ). Overall, the patients' illness was considered to be of Mild to Moderate severity. The mean GDS was  $3.6 \pm 0.8$  and the range was 3 to 5. Six patients had a GDS of 3, two patients had a GDS of 4 and the other two patients had a score of 5.

#### 2.1.3 Selection of Control Subjects

The normal elderly control group was comprised of 5 men and 6 women who ranged in age from 67 to 78 years ( $68.6 \pm 4.2$ ) and had 12-21 years of education ( $15.3 \pm 2.6$ ). All subjects met the criteria stated above.

Differences between mean demographic variables was assessed by t-tests. Table 1 contains the means, standard deviations and significance levels for these variables.

All subjects were caucasian and right-handed. There was no difference between groups in age, years of education, or sex.

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Table 1

Demographic variables for patients and controls

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Variables	SDAT	Normals	Significance
1. Subject Characteristics			
Age	73.6 $\pm$ 4.7	69.6 $\pm$ 4.2	n.s.
Education	14.8 $\pm$ 3.2	15.3 $\pm$ 2.6	n.s.
MMSE	24.3 $\pm$ 3.4	28.9 $\pm$ 0.8	**
GDS	3.6 $\pm$ 0.8	-----	
Duration of SDAT (yrs.)	2.1 $\pm$ 0.9	-----	
Age of onset	72.1 $\pm$ 4.4	-----	

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## 2.2 Procedures

### 2.2.1 The Neuropsychological Battery

All participants received the entire neuropsychological battery to determine the overall level of cognitive functioning for each subject. This test battery has been used successfully for the past three years in the ongoing study on aging and Alzheimer's Disease in this laboratory. It is comprised of well established standardized tests that tap a range of abilities including measures of intellectual, attentional, figural and verbal memory, and expressive and receptive language functions. The subtests of the battery were included on the basis of their demonstrated ability to detect the specific pattern of cognitive decline in Alzheimer's Disease. Assessment of these functions allows for between-group comparisons on a global level as well as within group comparisons for individual areas of neuropsychological functions. A list of tests comprising the neuropsychological battery is included in Appendix I. It takes approximately three hours to administer this battery.

### 2.2.2 The Examination of Remote Memory Processes

The assessment of remote memory processes consists of tests for recall of both autobiographical and public events. The test for autobiographical events was developed by myself; whereas, the test for public events, known as the Retrograde Amnesia Battery (RAB), was developed by Albert, Butters, and Levin (Albert et al., 1979) and updated by myself. An effort was made to develop and select tests sensitive to a range of abilities. It takes approximately two hours to administer this battery.

#### 2.2.2.1 Autobiographical Events Task Development

The task that I developed borrows a procedure established by Crovitz and Schiffman (1974), who used single words as prompts for the subject to recall any event in their life associated with that word. By using words that were neutral in affect and common in usage, Crovitz reported that the subjects' spontaneous associations to random words tapped a wide range of time in their lives. For this study, an attempt was made to have normal subjects recall an equal number of memories from each decade of the previous 60 years. This would allow for comparisons between the performance of AD patients and normal subjects with regard to the temporal distribution of remote memories. Therefore, the prompt words were pre-selected to be strongly associated with a finite time period. It was hypothesized that these

'unambiguous' words would prompt subjects to recall events from those same time periods. In this way, an equal distribution of memories from an entire life span could be sampled. Furthermore, since the Boston Remote Memory Battery consists of items from individual decades, within group comparisons could also be made to assess differences between recall of autobiographical and public information.

#### 2.2.2.1.1 Study I

The purpose of Study I was to determine whether elderly adults would associate words with a specific decade. One hundred and eight words were selected from dictionaries of slang words (Weingarten, 1954), magazines (Life and Look) and other etymologic books (Wentworth & Flexner, 1954, 1985) with regard to the time period they attained popular usage in the American lexicon. An effort was made to choose words that were popular within a well-defined time period. These words included manufactured products, slang expressions, technological inventions, foods and medical terminology. The decades represented ranged from the 1920's to the 1980's. The words were presented in a randomized order on a printed form with the following instructions:

Please read the words, one at a time, and think of a time period (decade) that you associate with that word. Place an X in the column corresponding to that decade. If you know the word but cannot associate it with a specific decade then place an X in the column labelled 'NO DECADE'. If you never heard of the word before, or do not know its meaning, mark an X under 'DON'T KNOW WORD'. If you associate a word with two different decades, then choose the time period with the strongest association. There are no right or wrong answers.

A total of twenty normal subjects ( 10 male and 10 female) with a mean age of 70.2 years (range = 57 - 76 yrs.) and a mean education of 14.2 years (range = 8 - 21 yrs.) completed this form. These subjects were either relatives of patients being assessed in the laboratory or people coming to see physicians for reasons other than central nervous system disorders. None of these subjects were screened for higher cortical functioning.

In order to analyze the data, the responses for all subjects were summed. Frequency distributions across decades were obtained for each word and are presented in Appendix II. Words were eliminated if 50% or greater of the total responses were either not associated with a decade or if the word was unknown. Nineteen words were eliminated on this basis. The remainder of the words were further analyzed and determined to be 'unambiguous' for a decade according to the following criteria:

1. If greater or equal to 50% of the total responses were associated with the same decade or
2. If responses for two consecutive decades were

greater than or equal to 50% of the total responses  
Sixty three words met these criteria. Their distribution  
across each decade is presented in Table 2. From these  
data, it can be concluded that some words can be determined  
to be "unambiguously" associated with a specific time  
period.

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Table 2

Number of Words Associated with Each Decade

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1920	1930	1940	1950	1960	1970	1980
7	10	13	4	13	12	4

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#### 2.2.2.1.2 Study II

The purpose of Study II was to increase the pool of words that are considered to be unambiguously associated with specific time periods so that a sufficient number of words from each decade could be used in the final task. Thirty-one new words appearing in newspapers, dictionaries and magazines were added to the 63 unambiguous words from Study I. Particular effort was made to increase the number of words associated with the 1950's and 1980's because these decades had the least representation. In addition, thirteen words that were used in Robinson's study (1976) and considered to be temporally and affectively neutral nouns were also included to test for reliability of subject's ratings. It was expected that subject's responses for these 'neutral words' would be distributed randomly or in the 'No Decade' column. Therefore, a total of 107 words were used. The words were presented in a manner similar to Study I. All 107 words were randomized by decade in blocks of 9 so that one word for each decade and one 'neutral' word was represented in each group. Subjects were unaware of this organization. The forms were identical and the directions to the subjects remained the same.

A total of forty normal subjects ( 15 male and 25 female) with a mean age of 68 (range = 53 to 86) and a mean education of 14.4 years (range = 8 to 21 years) completed Form II. In contrast to Study I where subjects were not

screened for abnormal cognitive functioning, 18 subjects in Study II were screened using objective measures. As participants in 2 other studies, these subjects were either screened by a geriatric psychiatrist with the Mini-Mental Status Examination (Folstein et al., 1975), or they completed comprehensive neuropsychological assessments.

Similar to Study I, frequency distributions by decade were made for each word. These summary data for all words are presented in Appendix II. Since subjects commented that they often associated words with a finite time period but that it spanned across two decades (i.e. 1938 - 1945), the decision was made empirically to further examine this data by grouping the results with adjacent decades. For example, 22 people associated the 1920's and 14 people associated the 1930's with the term 'rumble seat'. These numbers were summed for a total of 36/40 (90%) responses for the 1920-1930's time period. Thus, rather than examining individual decades, these data were analyzed for the following time periods: 1920-1930; 1930-1940; 1940-1950; 1950-1960; 1960-1970; and 1970-1980. The raw values of the frequency distribution arranged by individual time periods are presented in Appendix III.

The same criteria as outlined in Study I were employed to determine the words with strong associations to each time period. The words for the final task were chosen so that the frequency distribution would not differ between time

periods. In addition, after a few subjects were run to pilot the final task, it became apparent that some words had better face validity for eliciting autobiographical memories than others. For example, even though 40/40 subjects associated the word 'AIDS' with the 1970's or 1980's, all of the elderly subjects in the pilot study were unable to recall an experience in their life in which the word 'AIDS' played a role. Therefore, some words were rejected on an empirical basis because it appeared that they would not be appropriate for elderly populations on an autobiographical memory task.

A total of 42 words were selected for the final task. They are presented according to time period in Table 3. The percentage of subjects associating the word with that time period is also presented. Thirty five of these words were the prompt words for the task. An alternate word for each decade was available in case a person was unfamiliar with a word.

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**Table 3**  
**Final Words For Each Time Period**

1920 - 1930	%RESPONSES	MEAN % RESPONSE = 75.7
FOUNTAIN PEN	84.6	
LUCKY STRIKE	76.9	
STUDEBAKER	75.0	
SODA JERK	71.8	
DOUGH BOY	70.0	
*RUNNING BOARD	86.8	

---

Table 3 cont.

<u>1930 - 1940</u>	<u>% RESPONSES</u>	MEAN % RESPONSE = 75.9
ROSIE THE RIVETER	82.5	
NYLON STOCKINGS	80.0	
SWING BAND	76.9	
ZOOT SUIT	71.1	
KILROY	69.2	
*JITTERBUG	64.1	
<u>1940 - 1950</u>	<u>% RESPONSES</u>	MEAN % RESPONSE = 75.1
GI BILL	82.5	
VA MORTGAGE	79.5	
BALL-POINT PEN	76.9	
DRIVE IN MOVIE	70.0	
SADSACK	66.7	
*AUTO TRANSMISSION	61.5	
<u>1950-1960</u>	<u>% RESPONSES</u>	MEAN % RESPONSE = 72.8
BARBIE DOLL	80.0	
HIPPIE	76.9	
HULA HOOP	71.8	
MINISKIRT	68.4	
BEATNIK	66.7	
*LATEX PAINT	65.0	
<u>1960 - 1970</u>	<u>% RESPONSES</u>	MEAN % RESPONSE = 72.1
TEFLON	76.3	
POLAROID CAMERA	75.0	
LEISURE SUIT	74.4	
TRANSISTOR RADIO	70.0	
SMOKE DETECTOR	65.0	
*WOMAN'S LIB.	63.2	
<u>1970 - 1980</u>	<u>% RESPONSES</u>	MEAN % RESPONSE = 76.3
BREAK DANCING	85.0	
MICROWAVE OVEN	82.5	
SINGLE'S BAR	78.9	
SAFETY BELT	75.0	
PACEMAKER	60.0	
*DIGITAL	60.0	

\* = ALTERNATE WORDS

NEUTRAL WORDS

TREE

WINDOW

PICTURE

RIVER

LETTER

\*BELL

\* = ALTERNATE WORDS

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### 2.2.2.1.3 Description of Final Task

Task directions are included in Appendix III. They were read to each subject by the examiner at the beginning of the test session. Subjects were told that they were participating in a study on how people remember personal events from any time in their lives. They were read a word and then asked to recall an experience or event in their life that they were directly involved in and in which the word played a role. After they related an event, they were then asked to estimate when it occurred. The words were presented, one at a time, in five blocks of seven words each so that one word from each decade and one temporally neutral word was included. They were randomized by decade within each block. The subjects were not informed and appeared unaware of this organization. If a subject did not recognize a word, then the alternate word for that time period was employed. The words employed in the final task are shown in Table 4 in the order of presentation.

**TABLE 4**  
**REMOTE AUTOBIOGRAPHICAL MEMORY TEST WORD LIST**

ORDER	DECADE	WORD
1.	NEUTRAL	- TREE
2.	50-60	- BARBIE DOLL
3.	40-50	- GI BILL
4.	30-40	- NYLON STOCKINGS
5.	60-70	- TEFLON
6.	20-30	- FOUNTAIN PEN
7.	70-80	- BREAK DANCING
8.	70-80	- MICROWAVE OVEN
9.	30-40	- ROSIE THE RIVETER
10.	40-50	- VA MORTGAGE
11.	NEUTRAL	- WINDOW
12.	60-70	- POLAROID CAMERA
13.	20-30	- LUCKY STRIKE
14.	50-60	- HIPPIE
15.	60-70	- LEISURE SUIT
16.	30-40	- SWING BAND
17.	50-60	- HULA HOOP
18.	20-30	- STUDEBAKER
19.	70-80	- SINGLE'S BAR
20.	NEUTRAL	- PICTURE
21.	40-50	- BALL-POINT PEN
22.	50-60	- MINISKIRT
23.	70-80	- SAFETY BELT
24.	NEUTRAL	- RIVER
25.	40-50	- DRIVEIN MOVIE
26.	20-30	- SODA JERK
27.	60-70	- TRANSISTOR RADIO
28.	30-40	- ZOOT SUIT
29.	20-30	- DOUGHBOY
30.	NEUTRAL	- LETTER
31.	70-80	- PACEMAKER
32.	50-60	- BEATNIK
33.	30-40	- KILROY
34.	60-70	- SMOKE DETECTOR
35.	40-50	- SADSACK
<b>ALTERNATE WORDS</b>		
36.	20-30	- RUNNING BOARD
37.	30-40	- JITTERBUG
38.	40-50	- AUTOMATIC TRANSMISSION
39.	50-60	- LATEX PAINT
40.	60-70	- WOMAN'S LIBERATION
41.	70-80	- DIGITAL
42.	NEUTRAL	- BELL

In order to help the subjects understand the instructions and nature of the task, one example and five practice words were presented before the start of the task. During both the practice trials and test trials, the examiner interacted with the subject in the following ways. When a subject recalled an event but it was not specific with regard to time and place, the experimenter asked more questions in an effort to obtain the most complete response. For example, when subjects were unable to recall a specific date, they were asked to recall the month or season and the year or decade. Sometimes subjects' recollections were very general. In these instances, the experimenter asked the subject to be more specific and to try to recall a single instance of the event. Since these followup questions concerned memories that were originally recalled by the subject, they were not considered to be probes.

On the other hand, when subjects could not recall a personal memory or event on their own, further probing was employed in a manner adopted from Zola-Morgan et al. (1984). Accordingly, probing involved asking specific questions in an attempt to elicit a memory when a subject was unable to do so spontaneously. For example, in response to the prompt word "ballpoint pen", a subject stated that he gets them free all the time. The examiner then asked the subject to recall one time, when he received a pen for free. So far, this is considered to be a followup question and not

probing. However, when the subject was still unable to relate a specific instance when he received a ballpoint pen, the examiner then provided the subject with concrete cues in an effort to focus and aid him in recollecting a personal memory. In this example, the examiner asked the subject if he received a pen from a store or a bank. When the subject responded that he received a pen from a bank, the examiner then followed up with questions regarding the circumstances (i.e. name of bank, time of year, type of pen). If a subject was unable to recollect any specific memory, then the examiner continued with the next prompt word.

Sometimes a patient perseverated on a word previously presented. When this occurred, the directions were repeated and the subject was asked to recount an episode using the new prompt word. This was allowed because the patient's first response was unrelated to the new prompt word and the goal of the task was to assess whether subjects could recount a memory for each word.

All sessions were tape recorded and subsequently transcribed for scoring.

#### 2.2.2.1.4 Scoring of Task

The test was scored for total number of memories elicited, the content or degree of detail recalled, and the time when the events transpired.

##### 2.2.2.1.4.1 Number of Memories

The number of words that elicited a scorable response (item content greater than 0) were summed for each subject and each decade. The sum of these scores represent the total number of memories recounted and were tallied individually for the no probe and probe conditions.

##### 2.2.2.1.4.2 Content of Memories

The quality of the memory was judged by its content specificity. All responses were independently scored by two raters using the 5-point scale described below. The subjects' response for each word was given either a 0, 1, 2, 3, or 4 according to the criteria outlined in Table 5. In order to determine whether there is a difference between groups in spontaneous recall versus cued recall, separate Content scores were first obtained for all responses 'without probe' and then for the 'probe' condition, where applicable. Therefore, 2 content scores, i.e. no probe (NP) and Probe (P) were obtained for each subject. As defined above, probing involved asking specific questions in an attempt to elicit a memory. This included questions such as

- "Did you ever buy one as a gift?" or "Do you know anyone who has one?" Probing did not include specific questions concerning the time and place of occurrence that was asked after a memory was spontaneously recalled. Occasionally, subjects recalled detailed stories that did not directly involve the prompt word and therefore considered to be tangential. These stories were scored under a separate category of 'tangential response' (TR) and not included in the Item Content score.

After completion of data collection, the stories were rated, one word at a time, across subjects. For example, all subjects' responses for the word 'tree' were rated, then all responses to 'barbie doll' were rated and so on. Because the data collection was completed for the control group earlier than Group AD, the two groups were rated separately. To assess rater reliability between groups, one control subject, chosen at random, was rated a second time along with Group AD.

Table 5  
Item Content Scale

0 = No response; a generic response; a definition of a word; or a memory that does not involve the word.

Examples:

Microwave - "a quick dinner"

Breakdancing - "... instead of dancing uh, ballroom style you break, swing out and come back again"

Hula Hoop - "Hula hoop is just that. A hoop, a large hoop about this size and uh, a lot of the kids and some not so much a kid, uh did all kinds of things with, with these hula hoops. Basically that was what it was for, there was no other reason for it."

1 = A personal memory that is not a specific event and does not include specific details.

Examples:

Barbie doll - "...The barbie dolls, they loved the barbie dolls and they they wanted me to make clothes for them. I wasn't very good at it so I had to buy them clothes for them. And I can't tell you too much about them because all I can tell you is that I bought them and they loved them. And umm, they loved me for it."

Rosie the riveter - "No, it's just hearing the word all the time. I saw a movie one time but I don't remember which movie it was about Rosie the riveter.

X - When was that?

S - Oh a long time. I don't even remember the name or where I saw it. I think I saw a picture about that one time.

X - Can you put it in a time frame for me?

S - Oh, Rosie the riveter was the time, during the war when all these women went to work in the uh, you know the machine shops and the, the quarter masters and things like that. They used to call these girls Rosie the riveter, I think (laughs). That's what I associate it with.

X - Okay, you said during the war. Which war?

S - Second WW.

- 2 - A personal memory of an event that may have occurred more than one time but the details are vague; or a single episode recalled but only a vague recollection of either time or place.

Examples:

Lucky Strike - "Oh, the only event I can think of lucky strike was my brothers smoked lucky strike and I couldn't stand the smell, they were so strong. I used to beg him, change your brand. And of course, he didn't. But that was the only thing I could associate lucky strike with."

X - When was that?

S - "Oh, 40 - 50 years ago."

River - "Well, ...the only experience I, I, I truly missed there for a while, we used to have ferries going across the river to Camden, before your time. And I used to love to take the ferry and go over. Just to take the ride to go over the river because I had never been on water before. You know, at that time. I was a teenager. And then when they took the ferries away, I really missed them because that was the end of my ride across the river."

X - When did they take the ferries away?

S - "Oh good gosh, I knew you were going to ask me that same question. Well when they did away, because that's where Penn's Landing is now, you know. ....it must also be about 40 or 50 years ago. I don't remember."

X - Okay, you said you were a teenager when you used to go from the ferry?

S - "So, it was more than 50 yrs ago if I was a teen. Oh, maybe I was 18,19, 20, around that time."

- 3 - A single event recalled and specific with either time or place; or a personal memory that occurred more than once and is specific with both time and place.

Examples:

GI Bill - "Yes, one in particular. My two brothers were in the service. And at the time, my sister wasn't well so she used to stay home and take care of the house. And she did the letter writing to my brothers. They were overseas. And we had a woman in the neighborhood, of course we were both worried, my father, we were all worried about my brothers. Naturally, everybody was worried about their family in the

service. And I happened to go shopping one day and I met this woman in the neighborhood and she said to me, 'How are your brothers?' I said 'fine' and she said, 'I bet you worry about them.' I thought it was such a dumb question. So, I said 'no I let my sister Yetta do all the worrying.' Why she thought that was terrible. She said, how could you. And I just laughed and I walked away. And this was all over the neighborhood. She told everyone that I didn't worry about my brothers being in the service. So that, that's what comes up, you know."

X - And when was this?

S - "Well, I guess it was 45, 43-45. You know, the second WW. I don't remember just what day. I remember, I know it was warm weather because I happened to be going out. And she was...."

X - Do you remember her name?

S - "I'll tell you her name. It was Mrs. M. I won't tell you anything else about her but her name was Mrs. M. She had a son that became a doctor later on."

Tree - "Well, this goes back a long time ago. I don't remember the year It must have been at least 40 years ago. We had a great big tree in our yard. And we put a hammock up on it. And I was on the hammock and my mother wanted me to get out to let my younger brother in it. And I said no, I just got in it. She said you'll go back to it, just let Joe go in it. I said no, I'm very stubborn so my brother just swung me. He said okay and he pushed me so hard that I fell out of the hammock. (laughs) And my mother said that's because you didn't let Joe get in. I didn't get hurt, you know. But that's, when it comes with, the hammock was hung, spread across the 2 trees, that's the thing that comes to mind when you say tree. I can talk about beautiful trees that I've seen but.."

X - Oh no that's alright. Tell me, when did this happen?

S - "Oh, I guess, I must have been about 15, 16."

X - Okay, about 15-16. Do you remember the time of year?

S - "Oh, it had to be summer, to be out in the hammock."

4 = A single (i.e occurred once) personal event recalled that is specific with respect to both time and place.

Example:

Fountain Pen - "Well, the typical story is that at a bar mitzvah, you get a fountain pen. And I was no different than anyone else. I got several fountain pens at my bar mitzvah but I recall a story, a situation where I uh... uh, envied my oldest brother who had a little silver fountain pen which he got on his bar mitzvah. so I used to sneak it out periodically just to, just to take that one instead of the ones I got at my bar mitzvah. And uh, I went to, was at a Optometrist shop on 8th St. called Lubin's. And while I was waiting for my glasses to be fixed the, I was playing with this silver fountain pen and it fell into the spittoon. Well, you never saw a spittoon. I'm sure you heard about it. And I sat there for the longest time figuring how I was going to get that fountain pen out of that gooky spittoon! And I finally got it out."

X - When was this?

S - "Oh, I couldn't have been any more than 13 yrs. of age."

X - Do you remember the season?

S - "I think it was the summer time."

X - Do you remember anything else about that fountain pen? The name?

S - "It was a Parker, a beautiful little Parker silver fountain pen, I still can see it."

#### 2.2.2.1.4.3 Temporal Distribution

The year that the memory occurred, the number of years since the event occurred (i.e age of memory), and the age of the subject at the time of the episode, were calculated for each word. These calculations were based on the subjects' report of when the event transpired. Sometimes a subject was unable to give an exact year but instead offered a time span. When this occurred, the year was determined by the following rules.

1. When the subject reported that the event occurred in the 'early' part of a decade, the year was considered to be 19X2.
2. When the subject reported that the event occurred in the 'later' part of a decade, the year was considered to be 19X8.
3. When the event occurred during the 'war years', the year 1945 was used.
4. When an event occurred one time in a specific decade but the subject was unable to delineate the time any further, then the middle of that decade was used (i.e. 19X5).
5. When an event occurred more than once, the most recent date was used.

If a subject offered a date that was clearly erroneous, the examiner used the real date rather than the reported date. For example, if the subject spoke about an episode occurring during WW II but reported the year to be

1933, the year 1943 was recorded. If on the other hand, a subject was unable to estimate the year, the examiner asked questions about circumstances surrounding the event. These questions regarded whether the subject was married or had children, etc. In this way, the examiner could estimate the time of occurrence. Whenever possible, the dates were verified by a family member.

#### 2.2.2.2 Memory for Public Events

As stated above, the short form of the Retrograde Amnesia Battery (Albert, Butters, and Levin, 1979) was employed to examine memory for public events. This battery consists of three tests: recall of names of people in photographs who were famous in the past; recall of events and people from the past; and recognition of events and people. These three tests included people and events who were in the news from the 1920's to the 1970's. In order to assess memory up to the present, the recall and recognition forms were revised to include sixteen items from the 1980's. These test questions were taken from events reported in newspapers and magazines up to 1986. The new questions for the recall and recognition forms are presented in Tables 6 and 7. An effort was made to choose items similar in nature to those in the RAB. Since the RAB was organized in a pseudorandom order where the first question was from 1920, followed by 1930, etc., these items were intermixed and presented after questions from the 1970's.

**Table 6**  
**TEST QUESTIONS FOR THE 1980'S**  
**RECALL**

1. Who overthrew the Shah of Iran?  
Ans: Ayatollah Khomeini  
S-Cues: Lived in exile in Paris; very old man; took American hostages.
2. Who is Sandra Day O'Connor?  
Ans: Supreme Court Justice  
S-Cues: Appointed by President Reagan; Politically Conservative; First woman in this position.
3. What was the name of the movie about a homesick extraterrestrial character?  
Ans: E.T.  
S-Cues: Produced by Steven Spielberg; "phone home"; it was a bug-eyed alien.
4. What does "Cabbage Patch" refer to?  
Ans: A doll  
S-Cues: Sold out Christmas of 1984; Comes with its own adoption papers; Made by Coleco.
5. What was Abscam?  
Ans: FBI undercover operation.  
S-Cues: Involved U.S. Congressmen; Many went to jail; Occurred in 1980.
6. What was the Challenger?  
Ans: Space Shuttle  
S-Cues: Exploded while millions of viewers watched; 7 people died; including a school teacher.
7. What woman was convicted of murdering Dr. Herman Tarnower, author of the Scarsdale Diet?  
Ans: Jean Harris  
S-Cues: She was headmistress of a private school; She was his girlfriend; she wrote a book while in prison.
8. What is the name of the drug and alcohol rehabilitation center in Rancho Mirage, California?  
Ans: Betty Ford Clinic  
S-Cues: Founded by an Ex-First Lady of the U.S.; Many actors and actresses have gone there: Including Elizabeth Taylor.
9. Who did Lady Diana Spencer marry?  
Ans: Prince Charles  
S-Cues: British; prince; future heir to the throne.

10. What killed 2500 people in Bhopal, India in 1984?  
Ans: Poison-gas leak  
S-Cues: Accident; Union Carbide Plant: Pesticides.
11. In what country was Benigno Aquino murdered?  
Ans: Philippines  
S-Cues: Airport; His wife is currently its leader; he was returning home.
12. What was the "Freedom Flotilla"?  
Ans: Refugees who came by boat to Florida.  
S-Cues: Occurred in 1980's; Made up of Cubans; many prisoners.
13. In 1984, what island did American troops invaded?  
Ans: Grenada  
S-Cues: tiny island in Caribbean; 600 American medical students were stranded; they overcame Cuban resistance.
14. Who was the woman who ran with Walter Mondale for the position of Vice President of the U.S.?  
Ans: Geraldine Ferraro  
S-Cues: Former Congresswoman; From New York; her husband was later indicted
15. What is Nancy Reagan's favorite color?  
Ans: Red  
S-Cues: The dress she wore on her husband's inauguration was this color.
16. What private American citizen financed a successful operation in Iran to rescue American hostages?  
Ans: H. Ross Perot  
S-Cues: Texan; Billionaire; Politically conservative

**Table 7**  
**TEST QUESTIONS FOR THE 1980'S**  
**RECOGNITION**

1. OPEC regulates
  - a. aid to the homeless
  - b. price of oil
  - c. price of electricity
  
2. "R2D2" is the name of
  - a. a new drug for cancer
  - b. a rock group
  - c. a robot
  
3. In 1982, Great Britain fought an improbable war to retake
  - a. Bimini Islands
  - b. Falkland Islands
  - c. Canary Islands
  
4. The head of Chrysler Corporation is
  - a. John DeLorean
  - b. David Stockman
  - c. Lee Iacocco
  
5. The movie "10" starred
  - a. Bo Derek
  - b. Suzanne Summers
  - c. Farah Fawcett
  
6. The drug that actor Steve McQueen received in Mexico for treatment of cancer was
  - a. AZT
  - b. Laetrile
  - c. Interferon
  
7. In December 1980, the member of the Beatle's rock group who was shot outside his apartment building in New York was
  - a. Paul McCartney
  - b. Ringo Star
  - c. John Lennon
  
8. The leader of Poland's Solidarity movement is
  - a. Lech Walesa
  - b. Wojciech Jaruzelski
  - c. Jerzi Kozinsky

9. The name of the only woman stripped of her title as winner of the Boston Marathon is
  - a. Greta Waitz
  - b. Rosie Ruiz
  - c. Mary Decker
  
10. Dr. Barney Clark was
  - a. the first man to receive an artificial heart
  - b. an astronaut
  - c. U.S. Surgeon General
  
11. In February 1984, Rita Lavelle was fired from her job as chief of what government agency?
  - a. FDA
  - b. HEW
  - c. EPA
  
12. The "Fireside Summit" referred to a meeting between which two leaders?
  - a. Begin and Sadat
  - b. Reagan and Gorbachev
  - c. Kohl and Thatcher
  
13. The first American woman in space was
  - a. Christine McCulloff
  - b. Judith Resnick
  - c. Sally Ride
  
14. The T.V. show about 4 women over the age of 50 who share a house is
  - a. Golden Girls
  - b. Designing Women
  - c. Cagney and Lacey
  
15. Who shot President Reagan?
  - a. Mark Chapin
  - b. John Hinckley, Jr.
  - c. Bernard Goetz
  
16. The movie "Beverly Hills Cop" starred
  - a. Richard Pryor
  - b. Eddie Murphy
  - c. Sidney Poitier

## CHAPTER 3

### Results

#### 3.1 Autobiographical Memory Task

##### 3.1.1 Description of Task Responses

While both groups were able to produce memories in response to the prompt words, many qualitative differences between groups were evident. In fact, the qualitative differences were so obvious that a person unaware of the subject's status would be able to correctly identify the group to which the subject belonged. Responses from Group AD were frequently disorganized, circumlocutory and tangential. This was reflected in longer testing sessions for the patients because their responses were much lengthier than the controls' for each word. Another difference was that perseverations from previous responses were occasionally noted in the patient group but never in the control group.

Another area where patients and controls differed was related to attention. The patients occasionally lost their train of thought in the middle of a narrative. When this occurred, the examiner reminded the patient of what they were saying and in most cases, the patient was able to continue where they left off and complete their response. To

illustrate the qualitative differences between groups, a good and poor response considered typical for each group are presented below for the word 'Fountain Pen'.

Control good response

FOUNTAIN PEN - Okay, uh, after WWII was over and we were still in Europe. We were in Berlin, this would have been in 1945. I was in the Unit that was uh occupying the American zone in Berlin and the other four powers, Russia, France, England also were uh, occupying parts of Berlin. I sold my fountain pen to a Russian soldier for several hundred dollars.

X - Do you remember when you did that? What season it was?

N7 - Uh, yes it would have been during the summer. It was after the war was over and before I came home.

X - Do you remember the month?

N7 - It would have been either June or July.

X - What kind of fountain pen was it?

N7 - It was a Schaeffer, black with a gold uh, cap.

Patient good response

FOUNTAIN PEN - My guilty conscience, that's another one that caused me a heart attack. My first present that my husband, my boyfriend gave me, a fountain pen, it was beautiful. It was a fountain pen and a pencil combination. I remember that I came in, and he was sitting on the couch, and he wasn't the kind who was uh throwing you with gifts, or uh with uh compliments or anything like that and he was very direct and very uh, practical. And uh very wonderful as far as his, his standards were concerned but uh, people didn't fool him by saying this is the best fountain pen so give your girl a present and she'll be nice to you, or anything like that. But he did give me a fountain pen. We were already, we were already going steady after two weeks, but we didn't get married for 3 years. Anyhow, uh, ...he must have given me the fountain, he gave me, he gave, he gave me the the, on a date and he was, I mean we, we were going together quite a, I mean it was serious, not serious about anything except we were going to get married and live happily ever after. So uh, he wasn't appointed yet in the school system, as I told you I was already teaching, I taught the year before.

X - How old were you then?

A8 - Uh, .... gee I have to figure out a lot of things.... uh ..oh, oh see, I don't have to figure it out, I forgot them, I was about 23.

X - Tell me about the pen?

A8 - It was beautiful, I can still, I think I have it. I think I have the pen, I think I lost the pencil, something happened to it. And I'm keeping it because I was going to have it, oh that's the part of the story that's interesting, now, I got the present I enjoyed it, I used it, blah, blah blah. And uh, then the other things came out and I didn't use it anymore. It was in my drawer. My ... my uh, ... younger, ...younger daughter's, my older daughter's daughter saw it, she saw it, she wanted it. I said you can't write with it. She liked it so much. I said you know what, I'll get it fixed so it can be usable and I'll give it to you. She was very young at the time. I knew she would lose it and I didn't want to give it to her. So I uh, kept it and I kept it, and I never got it uh, and I still have it ready to have it done to give to her. But now she's 18 so I'll give it to her.

X - Tell me what kind of pen is it?

A8 - There were names of it, I can't remember but I'll look it up at home if you want. It was a fountain pen, a very good pen.

X - What did it look like?

A8 - It had different colors on it. It was like uh, uh... you know stuff like this, it had a lid and it was, can't even remember the color of it but I remember it had more than one, the feeling is that it had more than one color on it. AND it was dull colors not bright colors. And it was more like a uh, like a metal, like a .. like a glassy metallic material.

X - Is sounds beautiful. Was it a Waterman or a Schaeffer?

A8 - A Waterman, I think, was the most popular fountain pen they ever had. Was there another name?

X - Well, Schaeffer was another one.

A8 - It wasn't Schaeffer, I know that.

X - What time of year was this when he gave you the pen?

A8 - Oh, I don't remember. That would be a good study to know when people give presents. No, I have no idea. Uh, .... Well, maybe it was my birthday, make it in March.

X - Do you think it was your birthday?

A8 - It might have been, it might have been.

#### Control poor response

FOUNTAIN PEN - Well really, I haven't used a fountain pen in so many years that uh..the only time I ever used a fountain pen was when I went to high school.

X - Tell me about that?

N3 - Well in those days you had to ..

X - I want you to tell me something specific about that?

N3 - Well, it was a negative experience. I remember that the pens used to leak and that was the disadvantage of them.

X - Can you tell me about a time when it leaked?

N3 - Well, I remember uh, uh.... in school it leaked on a paper, it spoiled it and it had to be rewritten.

X - Do you remember what the paper was about?

N3 - No, I don't.

X - How old were you then?

N3 - Well, I was about 15.

X - Where was that?

N3 - Soldan High School.

X - When was that? What year?

N3 - Well that was uh..... 1930.

X - Do you remember the time of yr. that was?

N3 - Probably in the fall. September.

X - Are you guessing on that one?

N3 - Yea, I really can't...

X - That's okay.

#### Patient poor response

FOUNTAIN PEN - Oh, I had many of those in my life.

X - Okay, tell me one specific event about a fountain pen?

A3 - I don't think there was anything, anything that was so exciting about a fountain pen.

X - Oh, it doesn't have to be exciting, just..

A3 - A fountain pen was just something you picked up and wrote with. And I had several.

X - Well, tell me about one of them.

A3 - (laughs) His name was George. ....laughs....well every once in a while I would have to refill it. It's ink would run dry. The old fountain pens I don't think are made any more.

X - Did you ever receive one as a gift for some special event or any event?

A3 - Well, I got them as gifts but not for any special event.

X - Well, sometimes people tell me they had a favorite pen that was a fountain pen.

A3 - No,

X - Did you ever give any as gifts?

A3 - Not that I can remember.

X - And sometimes people have told stories about a time when they have leaked. Did a fountain pen ever leak?

A3 - Yeah, I think I had one that used to leak. ....It was many years ago. Today we use pens like you're using now.

### 3.1.2 Interrater Reliability

#### 3.1.2.1 Pilot Study

Reliability between raters for item content scores was assessed using transcripts of two pilot subjects. These data were not included in the final analyses because the subjects did not meet the inclusion criteria. One subject was a control who had only nine years of education. The other subject was diagnosed as Probable AD but was excluded because he also had diabetes. The raters scored the 'no probe condition' responses for a total of 74 words. Pearson correlation coefficient was .93 (73,  $p < .0001$ ), indicating that the scores between raters were very similar.

#### 3.1.2.2 Group NC

The two raters independently evaluated the control group in the same manner as the pilot study (i.e. by words across subjects). The control group and patient group were rated separately because the control group data collection was completed earlier than the patients. Using Pearson product moment correlation analyses, the interrater reliability was calculated for each word for both conditions (no probe/probe). For the control group the coefficients ranged from .71 to 1.00 ( $p < .001$ ) with a mean of .89 for the no probe condition. The interrater reliability was similar after probing where the coefficients ranged from .61 to 1.00 ( $p < .001$ ) with a mean of .89.

### 3.1.2.3 Group AD

The patient group was assessed by the same two raters seven months after the control group in the exact same manner (i.e. by word across subjects). In order to insure consistency in scoring across sessions, one control subject (N7) was scored a second time along with the patients.

For this control subject, each rater's item content scores for the 'no probe' condition from both scoring sessions was analyzed using a Pearson product moment correlation. The results indicated high within-rater consistency between the two scoring sessions ( $r=.97$  for rater 1;  $r=.81$  for rater 2;  $p < .0001$ ), as well as consistency between raters for the two separate scoring sessions ( $r=.90$  for session 1;  $r=.89$  for session 2;  $p < .0001$ ).

For the patient group, the interrater reliability was high for both conditions. Before probing, the Pearson coefficients for the patients ranged from .74 to 1.00 ( $p < .001$ ) with a mean of .94. After probing, the coefficients ranged from 0.60 to 1.00 ( $p < .001$ ) with a mean of .91.

#### 3.1.2.4 Total population reliability

Reliability was calculated for all the subjects together. For the scores before probing, the coefficients ranged from .74 to 1.00 ( $p < .001$ ) with a mean of .94; and after probing the range was .69 to 1.00 ( $p < .001$ ) with a mean of .90. Accordingly, the remainder of the analyses were performed on the average of the two raters' scores.

#### 3.1.3 Task Validity - Temporal distribution

To examine whether the 'unambiguous' words from this task did indeed elicit memories from their associated decade, the relationship between the mean decade that all subjects reported an event to occur with the putative decade for each word was determined. As illustrated in Figures 1 and 2, the reported decade was well correlated with the putative decade for both groups. Pearson correlations yielded coefficients of .92 ( $p < .0001$ ) for the controls and .87 ( $p < .001$ ) for the patients. Thus, the unambiguous words chosen for this task succeeded in eliciting memories from all time periods for each group.

# REMOTE AUTOBIOGRAPHICAL MEMORY ESTIMATED VS REPORTED DECADE

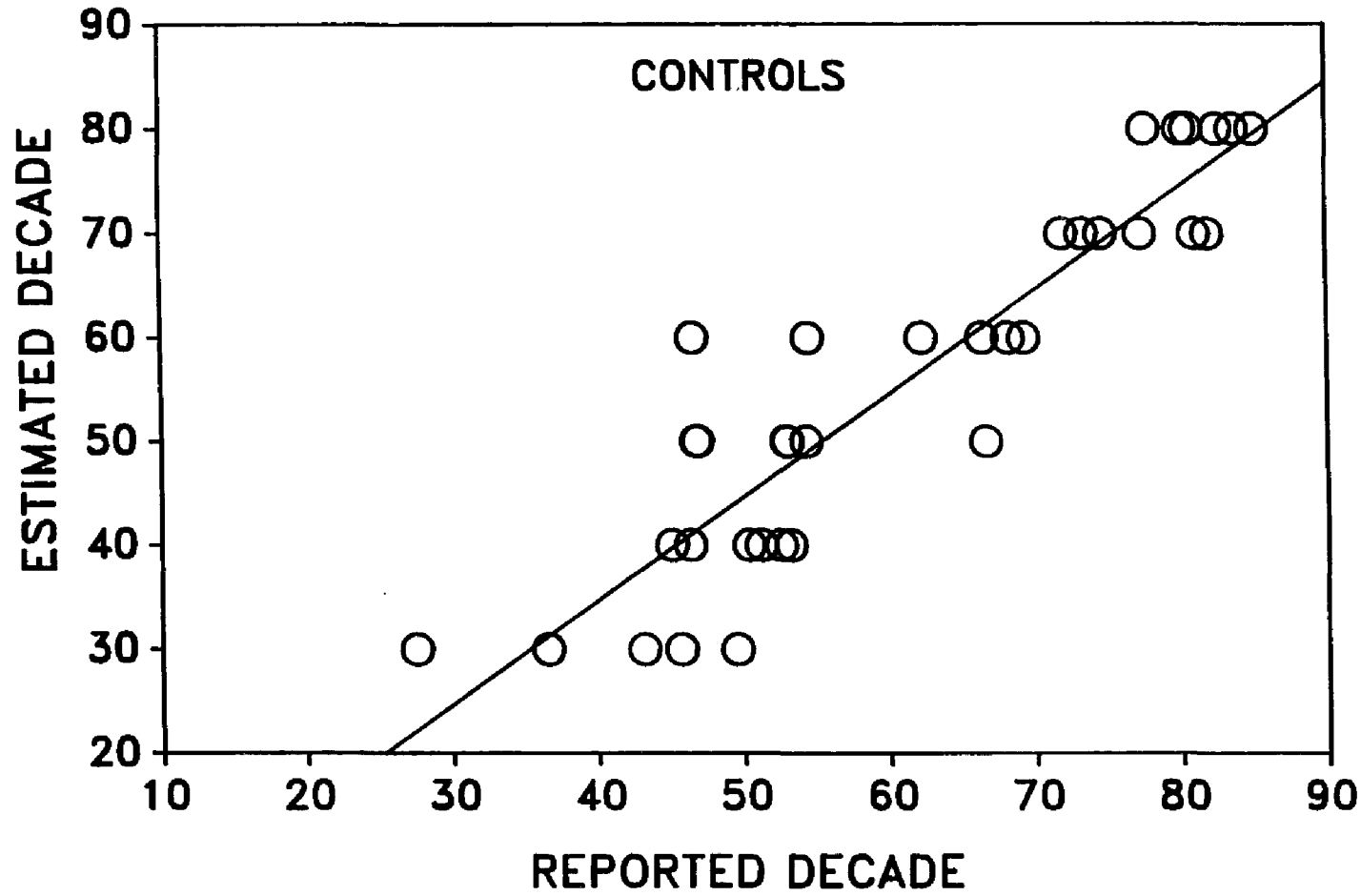


Figure 1

# REMOTE AUTOBIOGRAPHICAL MEMORY ESTIMATED VS REPORTED DECADE

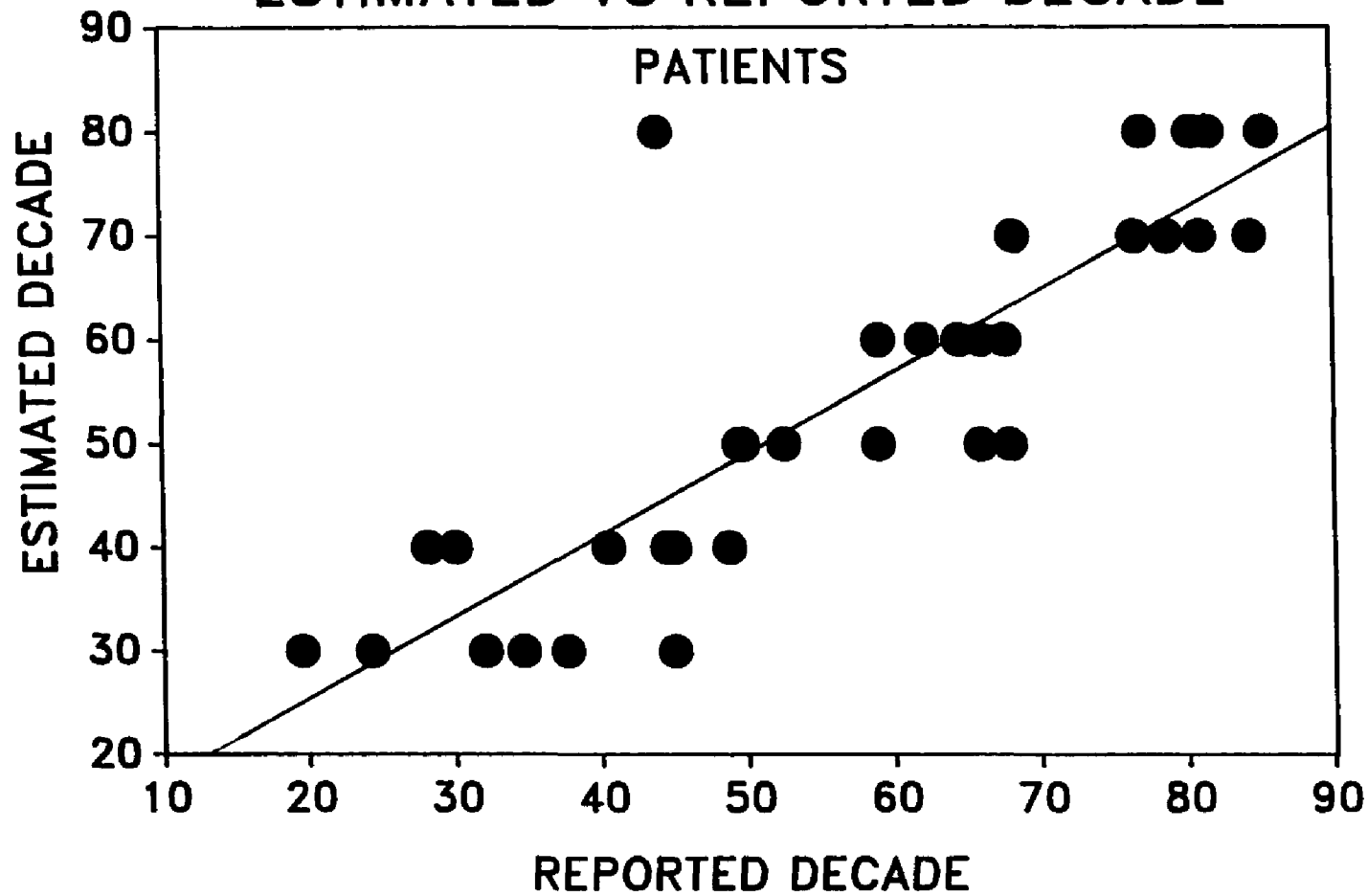


Figure 2

### 3.1.4 Effect of Probing

The effect of probing for both the number and quality of memories was determined for each group separately. The total number of episodic responses was calculated by counting the number of events recalled with a content rating greater than 0 for each subject and then averaging the count for each group. Thus, tangential or non-episodic responses were excluded from these analyses. The mean count was determined separately for each group for the no probe and probe condition.

#### 3.1.4.1 Number of memories

A table of the total number of memories for all words before and after probing for each subject is included in Appendix VI. For each group, the average number of memories in each condition is presented below in Table 1.

Table 1

Total number of memories by group and probe condition

GROUP	N	NO PROBE	PROBE
		MEAN (S.D.)	MEAN (S.D.)
CONTROLS	11	27.91 (3.7)	31.55 (1.6)
PATIENTS	10	15.80 (5.8)	22.70 (5.6)

These results were subjected to an analysis of variance. As illustrated in Figure 3, the patients recounted less memories than controls overall ( $F[1, 19] = 32.53, p < 0.0001$ ). Both groups recalled more memories after probing ( $F[1, 19] = 77.02, p < 0.0001$ ). There was a significant probe  $\times$  group interaction ( $F[1, 19] = 7.39, p < 0.01$ ). Thus, while the patients recalled fewer memories overall, their level of improvement was greater than the controls after probing. Because performances improved significantly for both groups after probing, all subsequent analyses were performed with the after probe scores.

# NUMBER OF MEMORIES BY PROBE

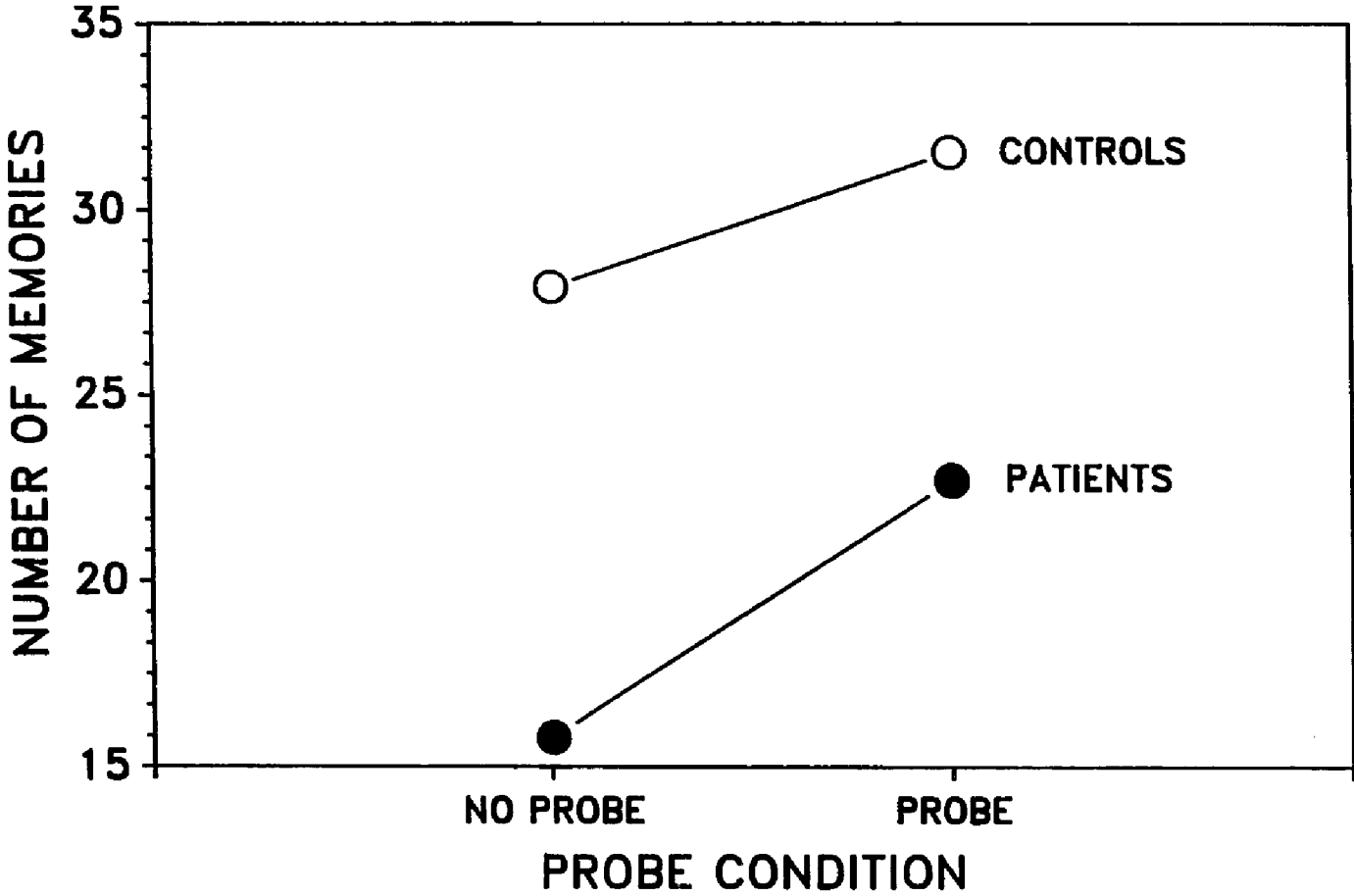


Figure 3

### 3.1.4.2 Memory quality

Table 2 shows the mean content scores of all episodes by group, with and without probing. The distribution of the content ratings for each word are presented by groups in Appendix VII-X for the no probe and with probe conditions. Results of the ANOVA indicated that controls performed better than patients overall ( $F[1, 19] = 34.21, p < 0.0001$ ). Furthermore, both groups recalled more memories after probing than before probing ( $F[1, 19] = 84.53, p < 0.0001$ ). As seen in Figure 4, the quality of memory for both groups improved to the same degree after probing, group (2) x probe(2) ( $F[1, 19] = 2.69, n.s.$ ). Accordingly, the scores for the probe condition will be used for the remainder of the analyses concerning memory quality.

Table 2  
Mean content score prior to and after probing

	NO PROBE			PROBE		
	N	MEAN	SD	N	MEAN	SD
Controls	11	2.03	(0.5)	11	2.23	(0.4)
Patients	10	0.85	(0.5)	10	1.15	(0.4)

# MEMORY QUALITY BY PROBE

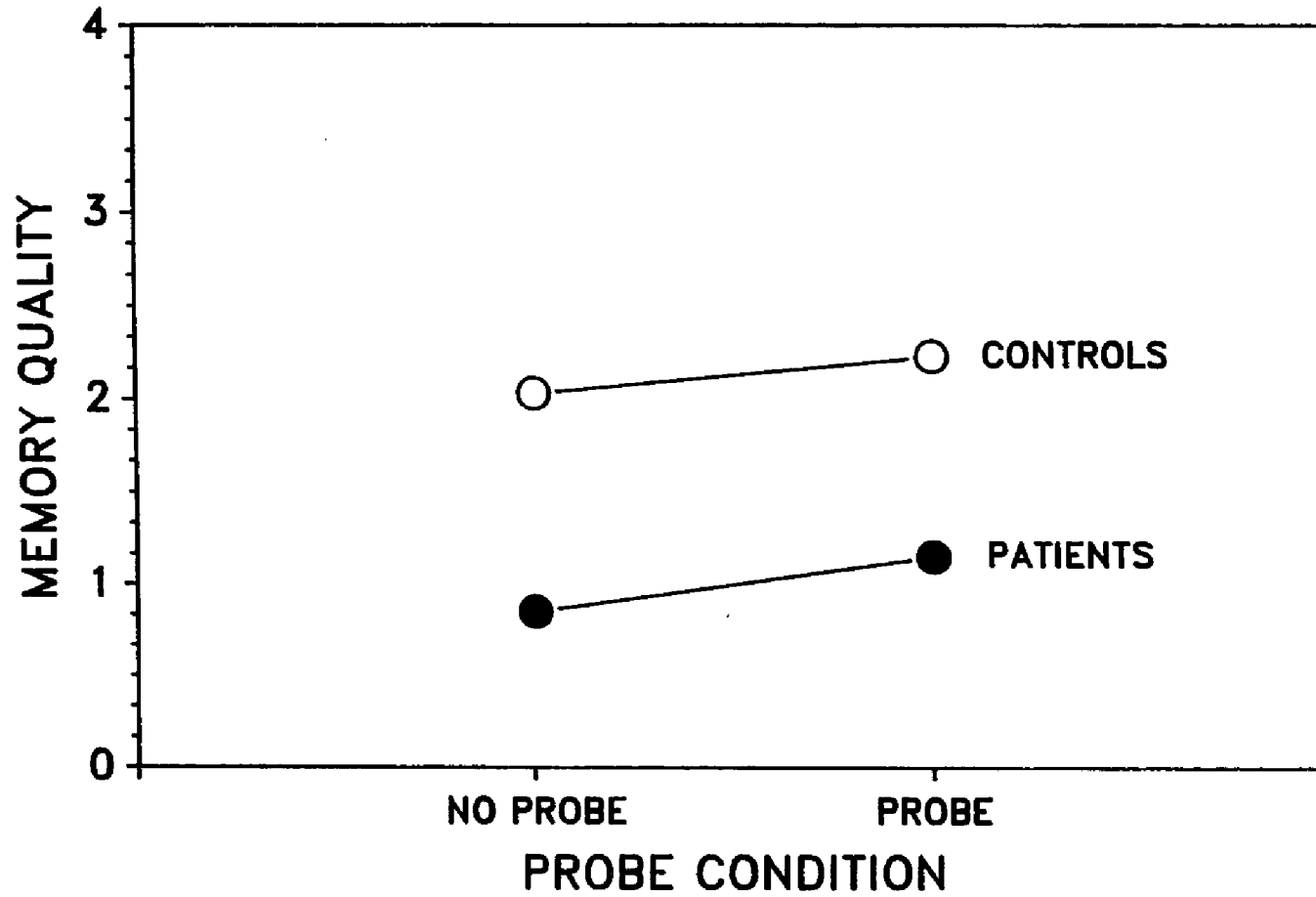


Figure 4

### 3.1.5 Patients vs controls

The autobiographical memory task was analyzed separately for number and quality of recollections and related to the time the memories occurred. These analyses were performed three times according to the nature (i.e. time specificity) of the prompt words. Comparisons between groups are first presented for all of the words together. Next, the pattern of responses elicited by only the decade specific words are examined. Finally, the memories elicited by the neutral words are reviewed.

### 3.1.5.1 Memories elicited by all words

#### 3.1.5.1.1 Number of memories

The average number of memories in relation to the age of the memory was examined for all words together. The age of the memory, expressed as the number of years since the episode occurred, was calculated for each story and then divided into 10-year groups. The mean number of memories that occurred in each 10 year period for each group are presented in Table 3.

---

**Table 3**  
Mean number of memories for each decade (after probing)

<u>DECADE</u>	<u>CONTROLS (N=11)</u>	<u>PATIENTS (N=10)</u>
	<u>MEAN (S.D.)</u>	<u>MEAN (S.D.)</u>
80-89	11.45 (3.7)	8.70 (3.2)
70-79	2.73 (1.8)	1.00 (0.7)
60-69	3.55 (2.5)	1.90 (1.7)
50-59	3.73 (1.5)	2.00 (1.6)
40-49	6.36 (2.5)	2.30 (1.1)
30-39	2.91 (2.0)	2.50 (1.8)
20-29	0.55 (0.9)	2.70 (2.2)
<1919	0.18 (0.6)	0.60 (0.8)

---

For the first analysis, the time distribution was divided into two periods. The 'recent' time includes events that occurred between 1960 to 1989. The 'remote' time refers to those episodes that occurred before 1959. Table 4 presents the sum of the mean number of memories for each group in both time periods.

**Table 4**  
**Number Of Memories - Recent vs Remote**

	N	RECENT		REMOTE	
		MEAN	SD	MEAN	SD
Controls	11	17.73	(3.3)	13.73	(4.1)
Patients	10	11.60	(3.6)	10.70	(3.4)

Analysis of variance demonstrated a significant main effect of group ( $F[1, 19] = 31.36, p < 0.0001$ ) and time period ( $F[1, 19] = 47.87, P < 0.0001$ ). Thus, as seen in Figure 5, the patients' performance was worse overall and both groups recounted more events from the previous thirty years compared to the more remote time period. While the time x group interaction was not significant ( $F[1, 19] = 4.13, p < 0.06$ ), it does represent a trend suggesting a greater difference between groups for recent than remote times.

Between group comparisons within each time period revealed that while the patients recalled significantly fewer memories for recent times ( $F[1, 19] = 16.49, p < 0.0007$ ), they recounted a comparable number of memories within the remote time period ( $F[1, 19] = 3.37, n.s.$ ).

Within group comparisons indicated that both groups recalled a greater number of memories for the recent time period (controls ( $F[1, 10] = 30.57, p < 0.0003$ ); patients ( $F[1, 9] = 19.57, p < 0.002$ )).

# NUMBER OF MEMORIES BY YEARS PAST

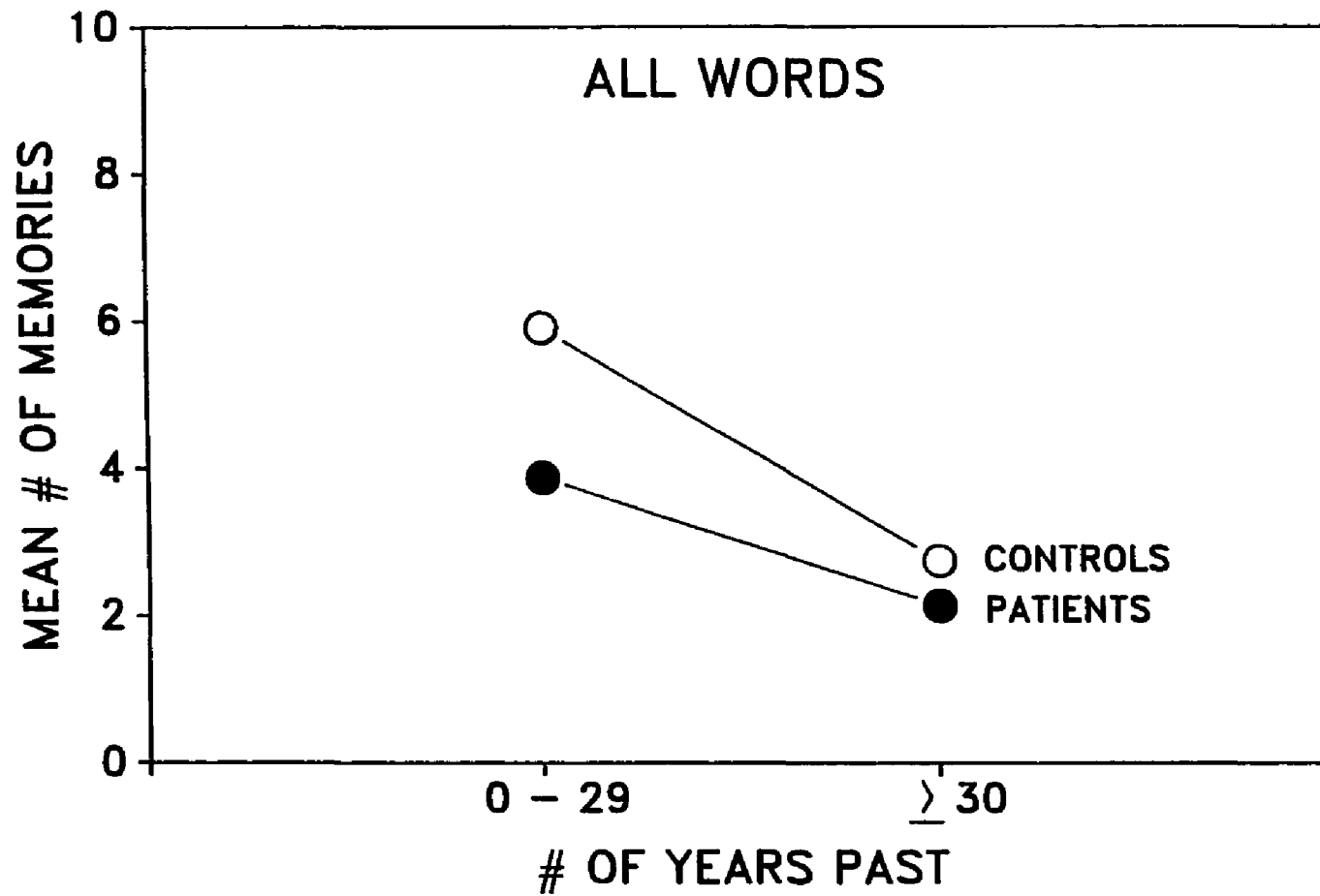


Figure 5

In an effort to examine more closely the distribution of number of memories for the recent time period, analysis of variance using decade as the dependent variable was performed. Figure 6 illustrates the number of memories across decades for both groups. Repeated measures-analysis of variance yielded main effects for group and time ( $F[1, 19] = 23.00, p < 0.0001$ ;  $F[3, 57] = 56.57, p < 0.0001$ , respectively), but the time x group interaction was not significant ( $F[3, 57] = 0.72, n.s.$ ). Because the main effect of group was significant, an analysis of variance comparing the groups at each time period was performed. The ANOVA revealed no difference between groups in the number of memories for the previous 9 years ( $F[1, 19] = 3.24, n.s.$ ); a significant difference between groups for the number of memories that occurred 10-19 years ago ( $F[1, 19], = 8.21, p < 0.01$ ); no difference between groups for events occurring 19-29 or more than 30 years ago ( $F[1, 19] = 3.08, n.s.$ ;  $F[1, 19] = 3.37, n.s.$ , respectively). Thus, while the patients recalled fewer memories overall, both groups recalled the greatest number of memories from the most recent 9 years. The overall pattern of the temporal distribution of the narratives was the same for both groups.

# NUMBER OF MEMORIES BY YEARS PAST

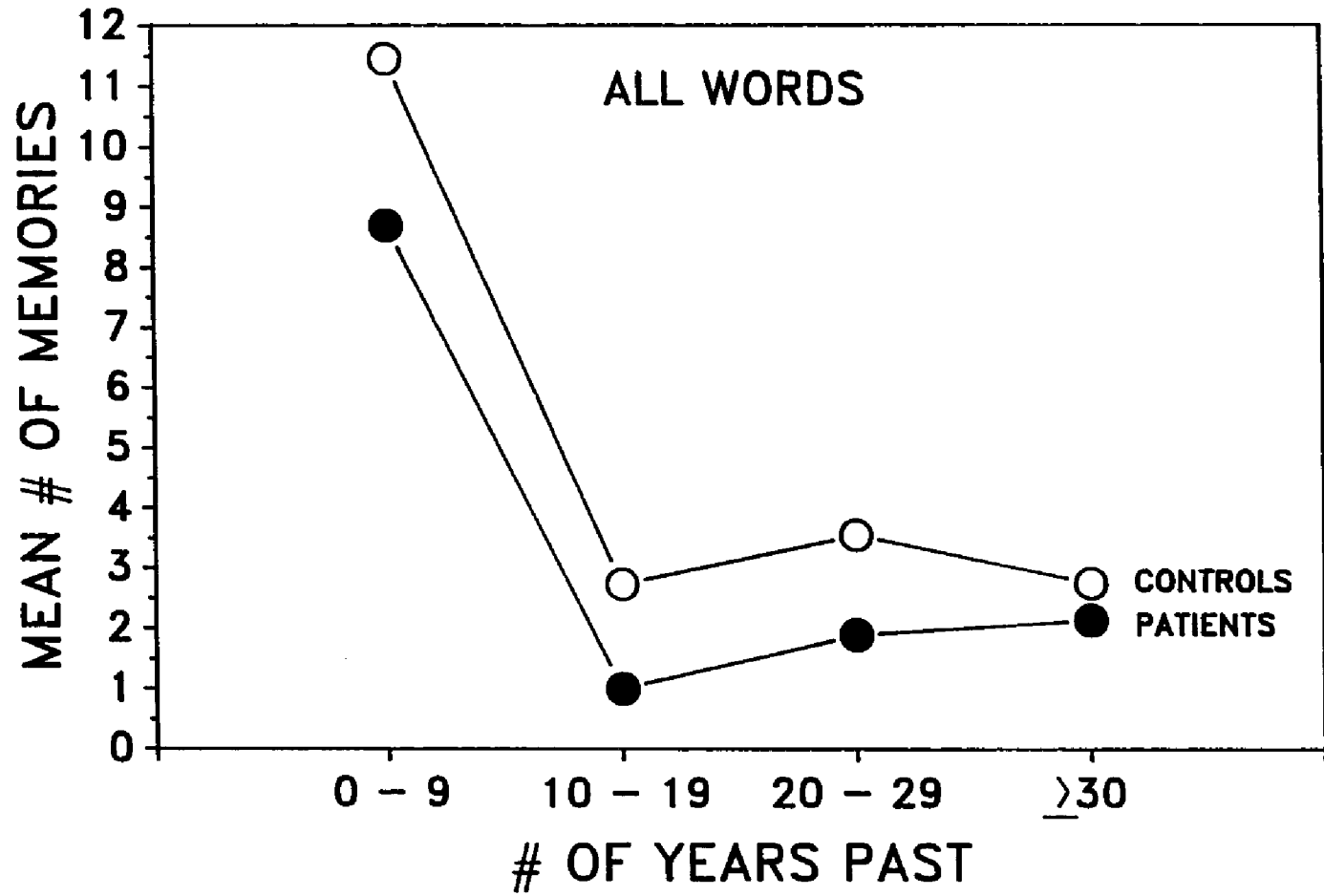


Figure 6

### 3.1.5.1.2 Memory Quality

The following analyses are based on the averaged item content scores from both raters to examine the quality of the memories.

The question of whether the quality of memory differs between controls and patients with regard to events that occurred earlier or later in life was examined for all words. As described above for the number of memories, the number of years past for each memory was grouped into two time periods ( $\leq 29$  years ago;  $\geq 30$  years ago). Figure 7 compares the mean content scores of both groups for all episodes that occurred during the recent and remote time periods.

Results of the ANOVA with diagnosis as the grouping factor and time as a within group (repeated measures) factor, revealed that patients had poorer recall overall ( $F[1, 19] = 16.91, p < 0.0006$ ). Events from remote times were recalled in more detail (i.e. higher content scores) than episodes from the recent time period ( $F[1, 19] = 38.23, p < 0.0001$ ). However, there was a significantly greater difference between patients and controls (i.e. patients more impaired) for the recent years than the remote time ( $F[1, 19] = 9.17, p < 0.007$ ).

Within group comparisons indicated that the patients' recollections were of better quality for the remote than the recent time period ( $F[1, 9] = 53.9, p < 0.0001$ ) whereas the quality of memory between time periods did not differ for the controls ( $F[1, 10] = 4.27, p < 0.07$ ).

Comparisons within time periods revealed significant differences between groups for both recent and remote time periods ( $F[1, 19] = 24.73, p < 0.0001$ ;  $F = 6.26, p < 0.02$ ), respectively.

# MEMORY QUALITY BY YEARS PAST

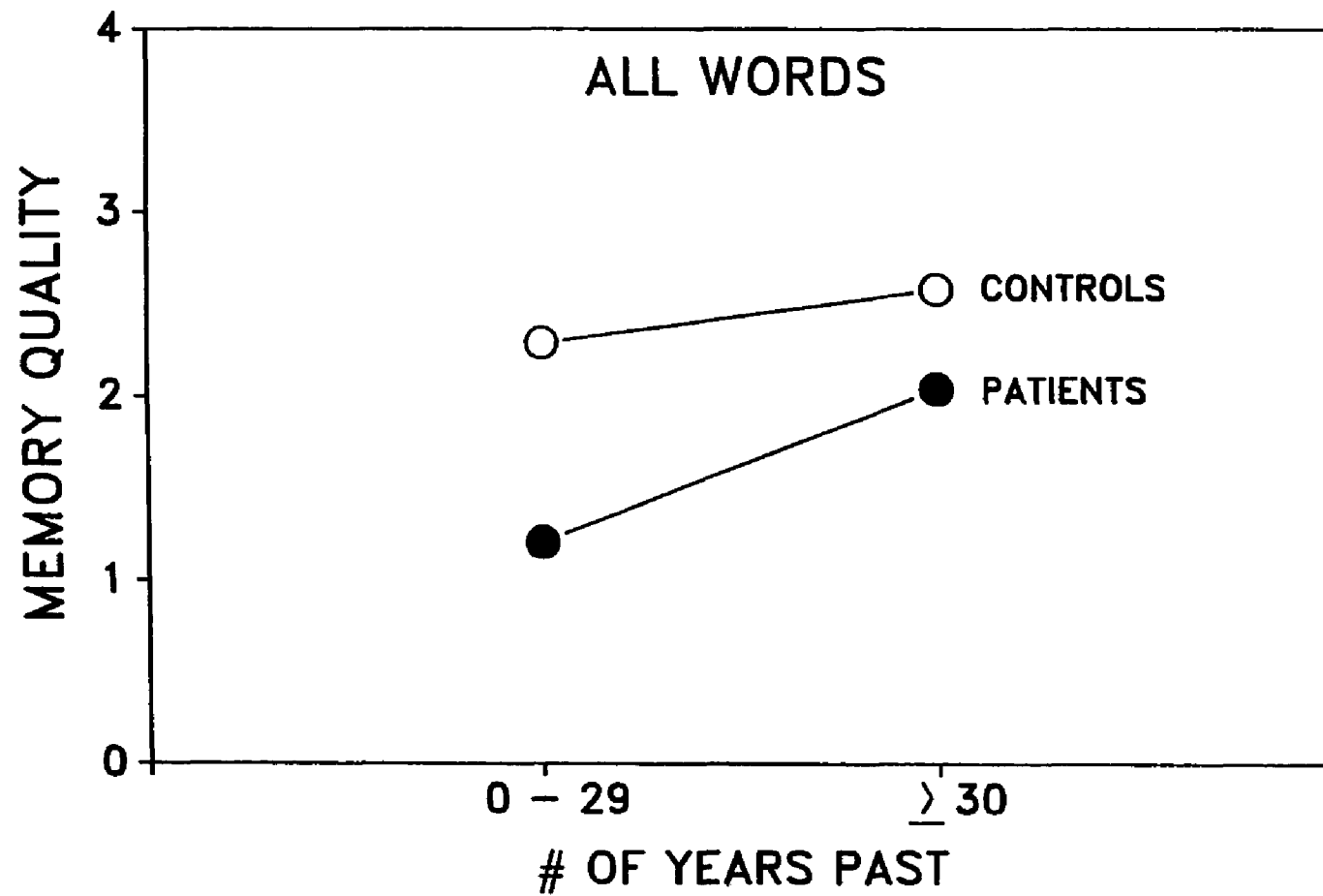


Figure 7

In order to examine more closely the pattern of memory loss for recent decades, this time period was subdivided into three 10-year groups (i.e. memories that occurred  $\leq$  9 years ago, between 10-19 years ago, between 20-29 years ago) and compared to events occurring more than 30 years ago. These scores are shown in Figure 8. Results of an analysis of variance indicated a main effect of group ( $F[1, 15] = 9.34$ ,  $p < 0.008$ ); and decade ( $F[3, 45] = 19.72$ ,  $p < 0.0001$ ); and an interaction between decade and group ( $F[3, 45] = 3.11$ ,  $p < 0.04$ ). Between group comparisons indicated significant differences for memories that occurred within the past 9 years ( $F[1, 15] = 18.50$ ,  $p < 0.0006$ ) and between 10-19 years ago ( $F[1, 15] = 10.24$ ,  $p < 0.006$ ), but not for events that occurred 20-29 years ago ( $F[1, 15] = 6.85$ , n.s.) or greater than 30 years ago ( $F[1, 15] = 1.95$ , n.s.). Therefore, while the quality of the patients' recollections were worse overall relative to the controls, the greatest impairment was for memories that occurred during the most recent 19 years.

# MEMORY QUALITY BY YEARS PAST

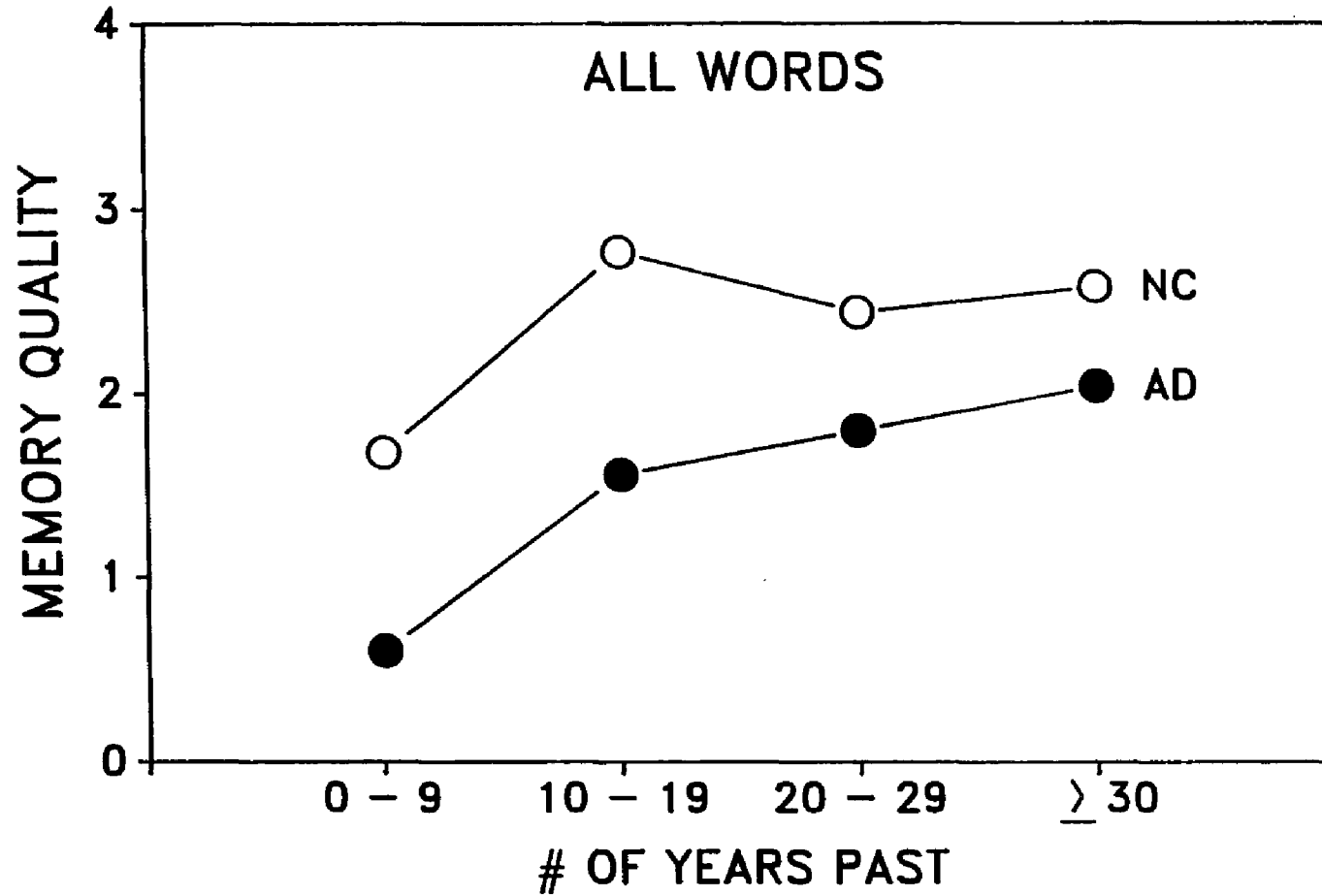


Figure 8

### 3.1.5.1.3 Summary

Overall, the patients recalled fewer number of memories and the events were recalled in less detail when compared to controls. However, the pattern of the temporal distribution across decades for the number of events was comparable between groups. Both groups recalled more memories from the recent time period. When the data were analyzed for the quality of the memory, greater differences emerged between the groups. While the patients recalled events in less detail than controls for the most recent time period, there was no difference between groups in the content of recollections that occurred earlier in their lives. Thus, a temporal gradient was found for Group AD for the content of memories but not for the number of memories.

### 3.1.5.2 Decade specific words only

The same analyses that were performed for all words were repeated with the memories elicited by the decade specific words only.

#### 3.1.5.2.1 Number of memories

The results are illustrated in Figure 9. Analysis of variance showed that the main effects of group ( $F[1, 19] = 30.43, p < 0.0001$ ) and time ( $F[1, 19] = 32.36, p < 0.0001$ ) remained significant. Thus, patients recalled fewer memories overall and both groups recalled more memories from the most recent time period. However, the interaction between time and group did not reach significance ( $F[1, 19] < 1$ ). Comparisons within time periods indicated that the difference between groups for the recent period remained significant ( $F[1, 19] = 12.39, p < 0.002$ ). There was, however, a change for the remote time period. Whereas there was no difference for the remote period when all words were included in the analysis, differences now emerged. When the prompts were limited to only those words strongly associated with a decade, the patients recalled fewer number of memories for the remote time period compared to controls ( $F[1, 19] = 8.44, p < 0.01$ ). However, within group comparisons indicated that both groups recalled more memories from the recent than the remote time period (controls  $F[1, 10] = 15.12, p < 0.003$ ; patients  $F[1, 9] = 25.2, p < 0.0007$ ).

# NUMBER OF MEMORIES BY YEARS PAST

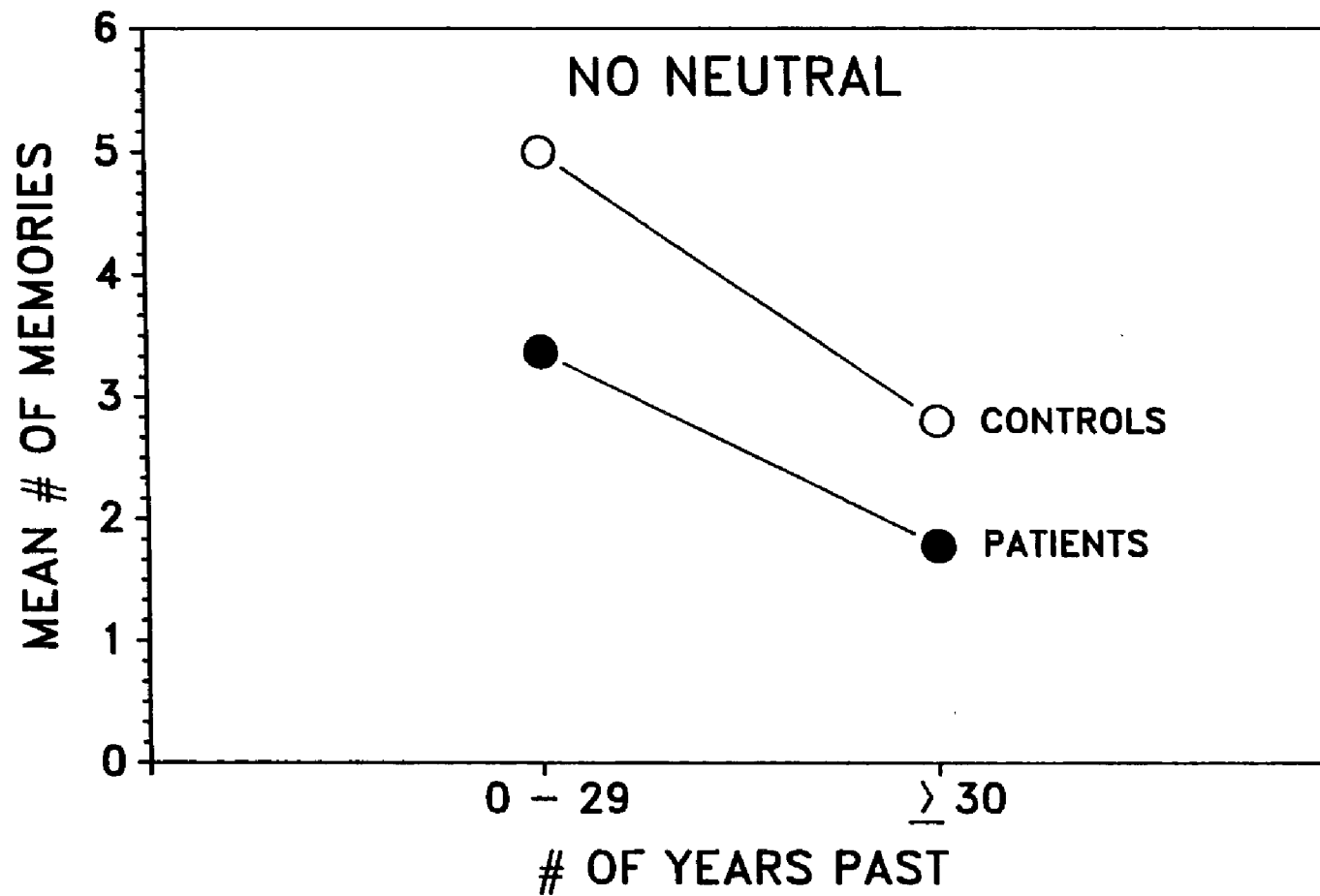


Figure 9

### 3.1.5.2.2 Memory Quality

The mean scores for quality of memory for decade specific words were subjected to a repeated-measures analysis of variance. The results, presented in Figure 10, illustrate a difference between groups overall ( $F[1, 19] = 18.47$ ,  $p < 0.0004$ ) as well as between the two time periods ( $F[1, 19] = 15.35$ ,  $p < 0.0009$ ). Thus, the patients continued to recall events in less detail than controls and both groups recalled events more clearly for the remote times. However, the interaction between group and decade was no longer significant ( $F[1, 19] = 2.26$ , n.s.). Thus, when the prompt words were strongly associated with a decade, the patients' performance declined specifically for the remote time period whereas the pattern of performance for the controls did not change. Within group comparisons indicated that there was no difference in the quality of memory between recent and remote times for the controls ( $F[1, 10] = 3.41$ , n.s.). In contrast, the patients recalled memories from the remote time period in greater detail than from the recent time period ( $F[1, 9] = 12.6$ ,  $p < 0.006$ ). Comparisons within time periods between groups revealed that the patients' recollections were poorer than the controls' for both recent and remote time periods ( $F[1, 19] = 2437$ ,  $p < 0.0001$ ;  $7.04$ ,  $p < 0.02$ ).

# MEMORY QUALITY BY YEARS PAST

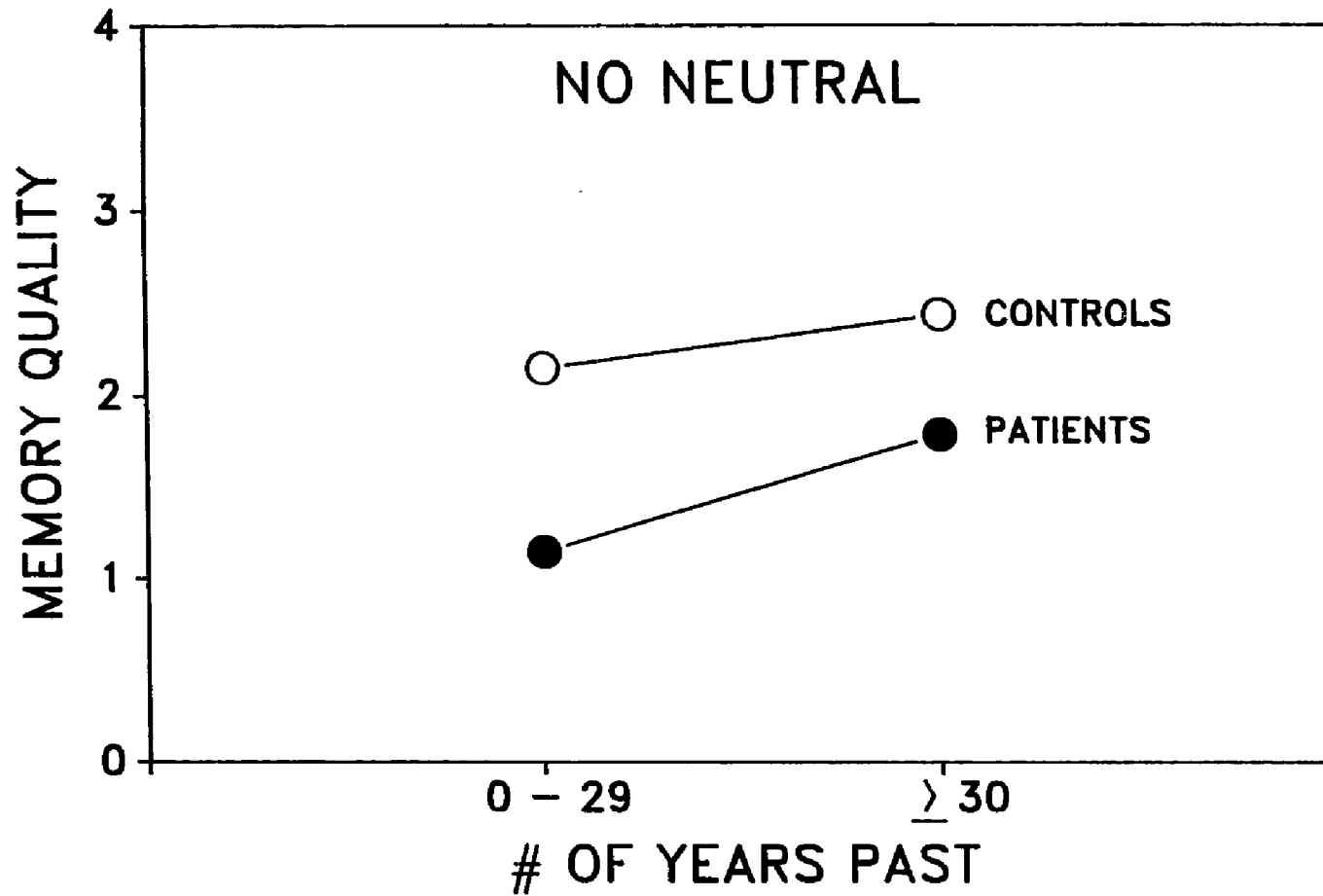


Figure 10

The same analyses were performed with the recent time period (i.e the past thirty years) subdivided. Analysis of variance resulted in highly significant main effects for group ( $F[1, 13] = 8.36, p < 0.01$ ); and decade ( $F[3, 39] = 16.01, p < 0.0001$ ). However, the decade x group interaction also disappeared ( $F[3, 39] = 1.36, n.s.$ ). Comparisons between groups within the individual decades revealed significant differences for events occurring within the last 9 years ( $F[1, 13] = 9.10, p < 0.01$ ) and between 10-19 years ago ( $F[1, 13] = 8.47, p < 0.01$ ). There was no difference between groups in events that occurred between 20-29 years ago ( $F[1, 13] = 2.85, n.s.$ ) and greater than 30 years ago ( $F[1, 13] = 2.01, n.s.$ ).

#### 3.1.5.2.3 Summary

When the prompt words involved only those words that were strongly associated with specific decades, patients recalled fewer memories than controls overall. Additionally, the patients' recollections contained less detail relative to the narratives of the controls. However, the temporal distribution of memories across decades was comparable for both groups. Both groups recalled the greatest proportion of memories from the recent decades. With regard to the quality of the memory, although patients recalled events in less detail than the controls for the most recent 19 years, the

group x decade interaction was not significant. Thus, the patients' content was inferior to controls across all time periods and no temporal gradient emerged.

### 3.1.5.3 Neutral Words Only

Because differences in the number and quality of memories emerged when the decade specific words were analyzed separately, the same analyses as described above were performed for the recollections elicited by the neutral words.

#### 3.1.5.3.1 Number of memories

The mean of the sum of memories for neutral words with regard to recent and remote time are presented in Figure 11. Analysis of variance demonstrated no difference in performance between patients and controls overall ( $F[1, 19] = 3.15$ , n.s.) nor was there a difference between recent and remote time periods overall ( $F[1, 19] < 1$ ). The interaction between group and time was also not significant ( $F[1, 19] = 3.78$ , n.s.). Comparisons between groups indicated that there was no difference for either the recent ( $F[1, 19] = 4.09$ ,  $p < 0.06$ ) or remote ( $F[1, 19] = 2.57$ , n.s.) time periods. However, the difference between groups for the recent years suggested a trend reflecting fewer memories for the patients.

# NUMBER OF MEMORIES BY YEARS PAST

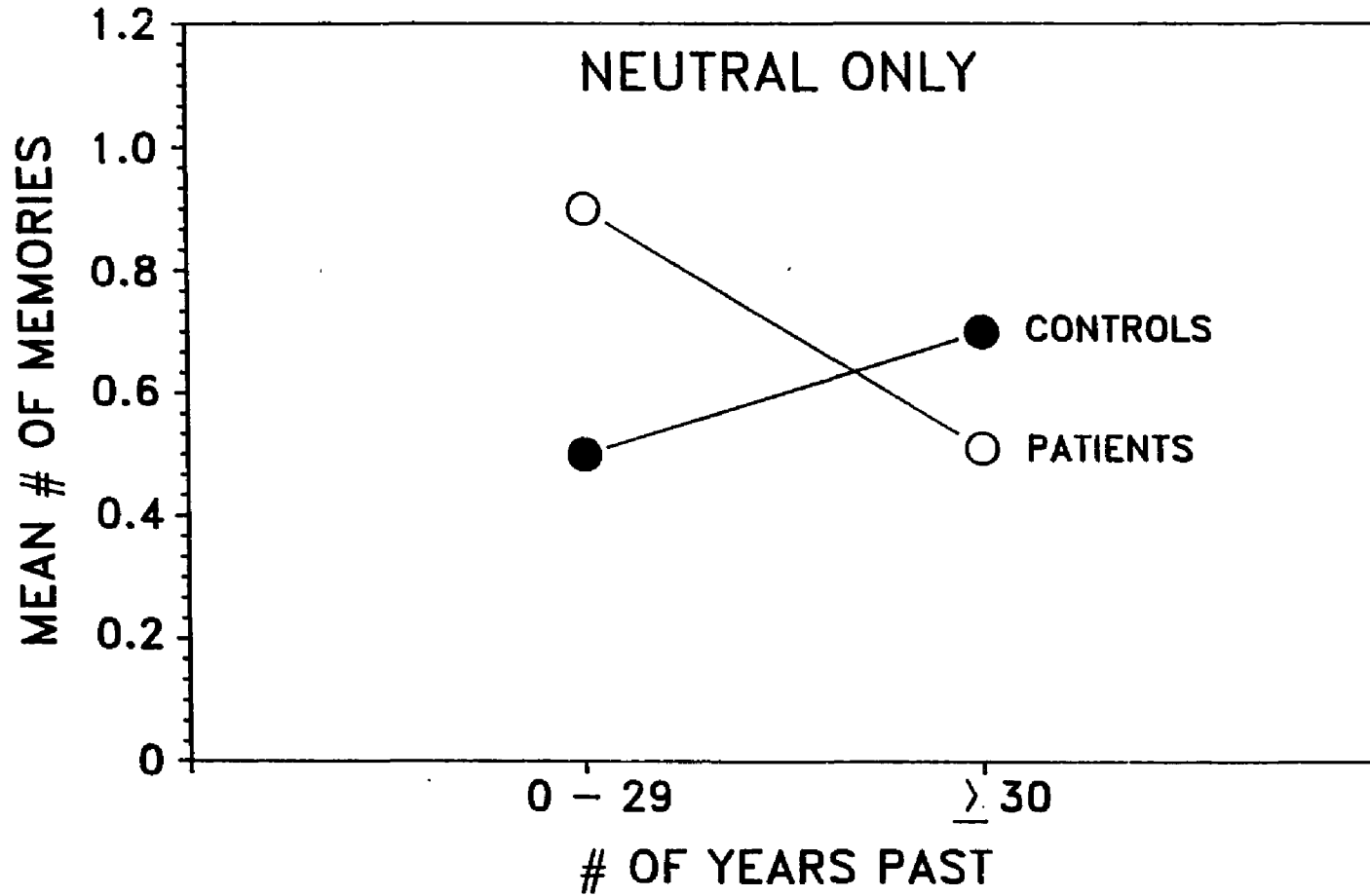


Figure 11

### 3.1.5.3.2 Memory Quality

Because it was demonstrated that patients recounted episodes in greater detail from earlier in their life when all words were analyzed together, the memory content in response to the only the neutral words was examined. Figure 12 presents the average quality of memory divided into recent and remote time periods for the patients and controls. Results of the ANOVA demonstrated main effects for both group and time period ( $F[1, 17] = 15.01, p < 0.001$ ;  $4.80, p < 0.04$ ) respectively. Overall, patients recalled memories in less detail than the controls. More memories were recalled from the remote decades than the recent decades overall. While the interaction between group and decade did not reach significance ( $F[1, 18] = 3.97, p < 0.06$ ), there was clearly a trend. Within group comparisons indicated that while the quality of memory did not differ for controls between recent and remote times, the patients recounted stories in more detail from the earlier time period than the recent time period in response to neutral words. However, although the patients' narratives were better for the remote time period, comparisons between groups indicated that the patients were impaired relative to the controls for both the recent and remote time periods (recent  $F[1, 18] = 12.76, p < 0.002$ ; remote  $F[1, 18] = 6.38, p < 0.02$ ).

# MEMORY QUALITY BY YEARS PAST

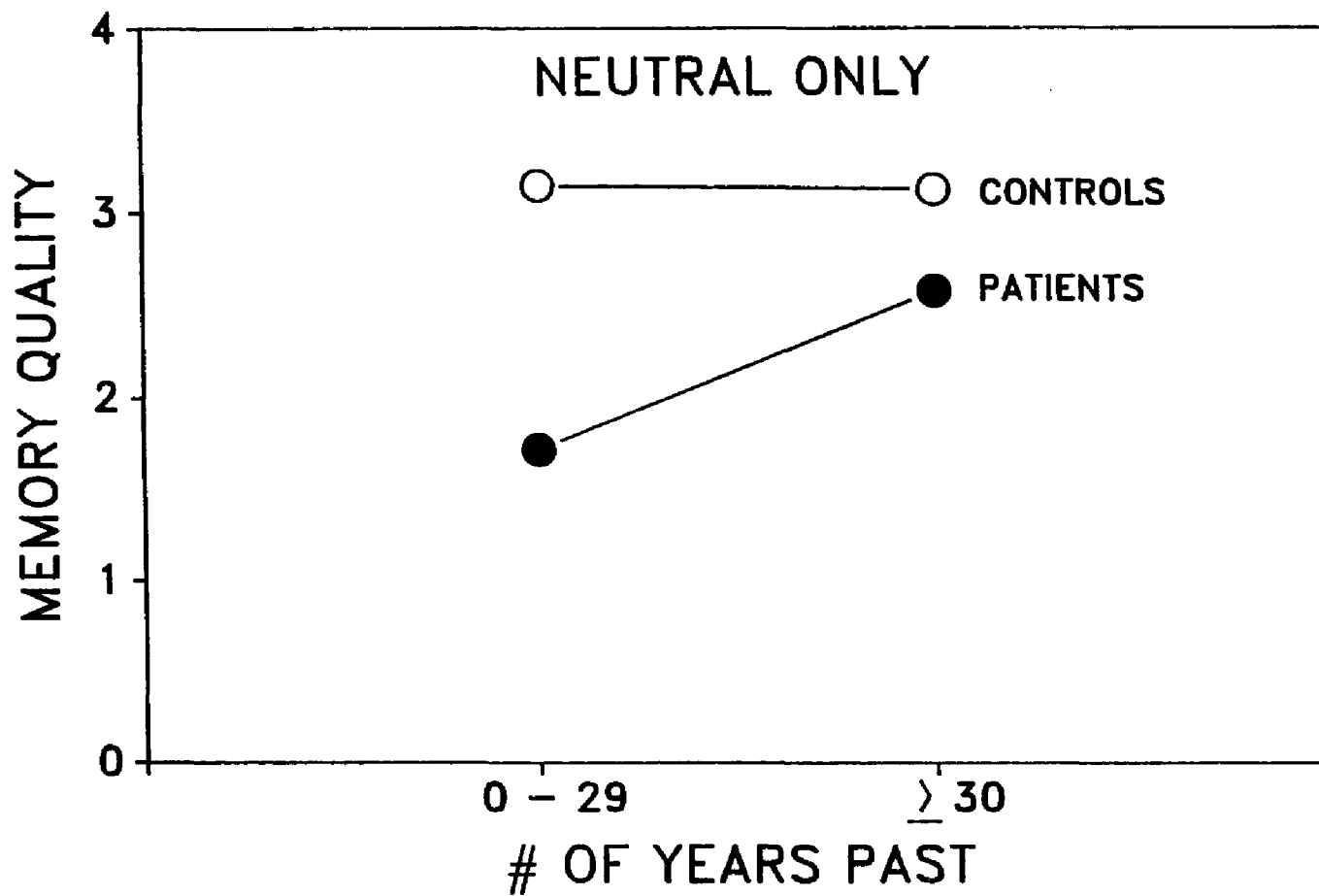


Figure 12

### 3.1.5.3.3 Summary

Patients and controls recalled a similar number of memories in response to neutral words. However, the quality of memory was worse for the patients for both time periods. The pattern of recall with regard to content was different for each group. While the quality of the memory was similar for recent and remote times for the controls, the patients recalled events in greater detail from the remote time period.

### 3.1.5.4 Neutral vs non-neutral words, a comparison

One-way analysis of variance was performed within each group separately to determine whether the quality of memory differed between neutral and non-neutral words. The results indicated that the narratives for both groups were significantly better in response to neutral words compared to the non-neutral words (controls  $F[1, 17] = 39.02, p < 0.0001$ ; patients  $F[1, 17] = 30.21, p < 0.0001$ ). However, the nature of prompt x decade interaction did not reach significance for either group (controls  $F[1, 17] = 1.06, n.s.$ ; patients  $F[1, 17] = 1.37, n.s.$ ).

### 3.2 Memory for Public Events

Results for public events were analyzed by repeated-measures analysis of variance for each test separately. Group, decade and difficulty of test items were independent variables. Administration of the recall test was discontinued because it was too difficult for the patients. Therefore, only results from the Famous Faces and Recognition tests are presented.

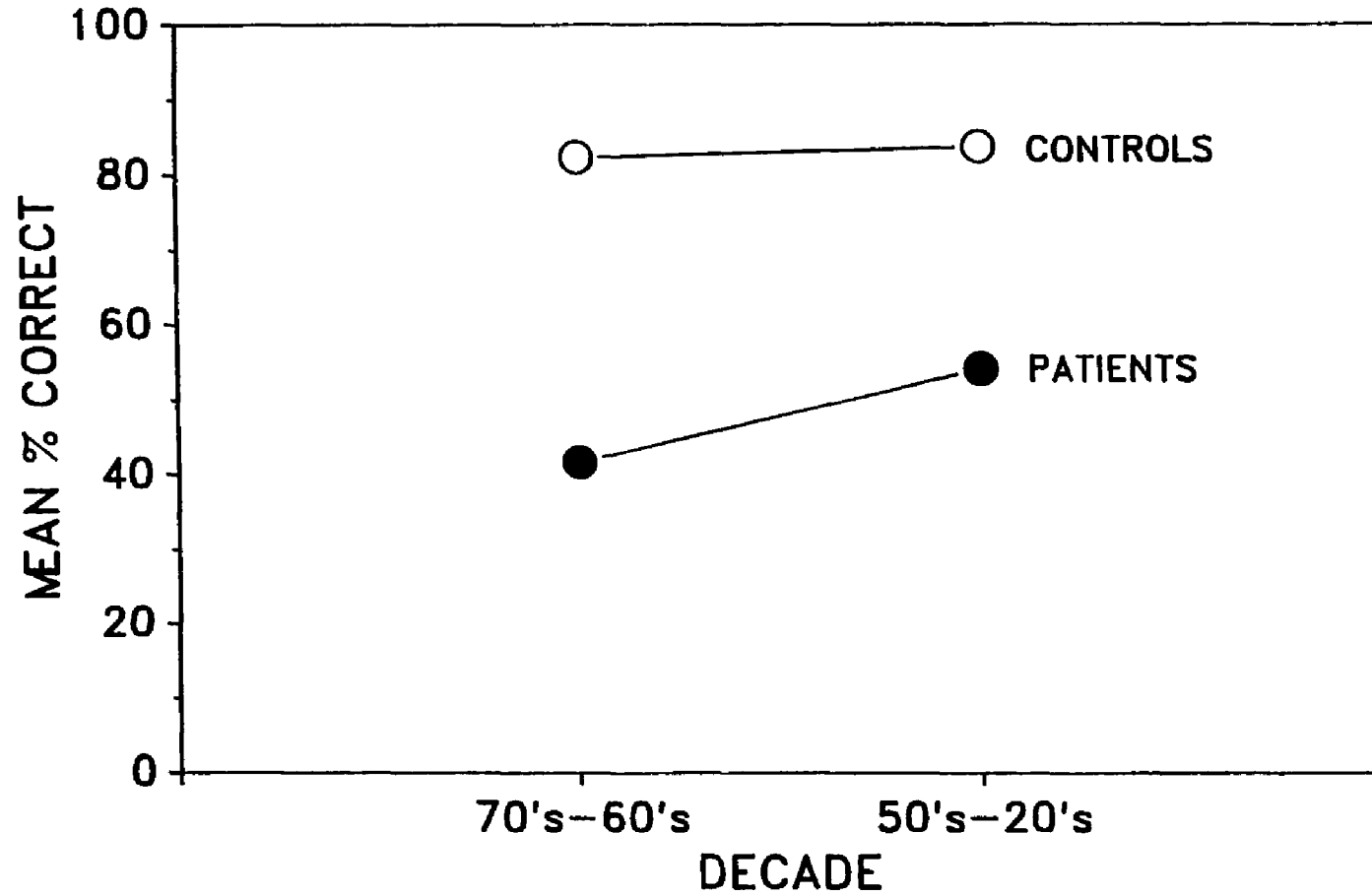
#### 3.2.1 Boston Famous Faces Test

Summary data for the performance of each group are reported separately for each decade and condition (without cue/with cue) in Table 5. A total of 11 controls and 9 patients received this task. The following analyses were performed on the subjects' scores after cueing.

##### 3.2.1.1 Performance by decade

The overall performance for each group was divided into recent (i.e. 60-70's) and remote (i.e. 20-50's) time periods to assess whether a temporal pattern for the patient's memory loss could be detected. As seen in Figure 13, there was a significant main effect of diagnosis ( $F[1, 18] = 23.90$ ,  $p < 0.0001$ ) and decade ( $F[1, 18] = 5.55$ ,  $p < 0.03$ ). However the decade x diagnosis interaction was not significant ( $F[1, 18] = 3.51$ , n.s.). Therefore, the patients' impairment was equal across decades relative to the controls for recent and remote time periods.

# FAMOUS FACES TEST

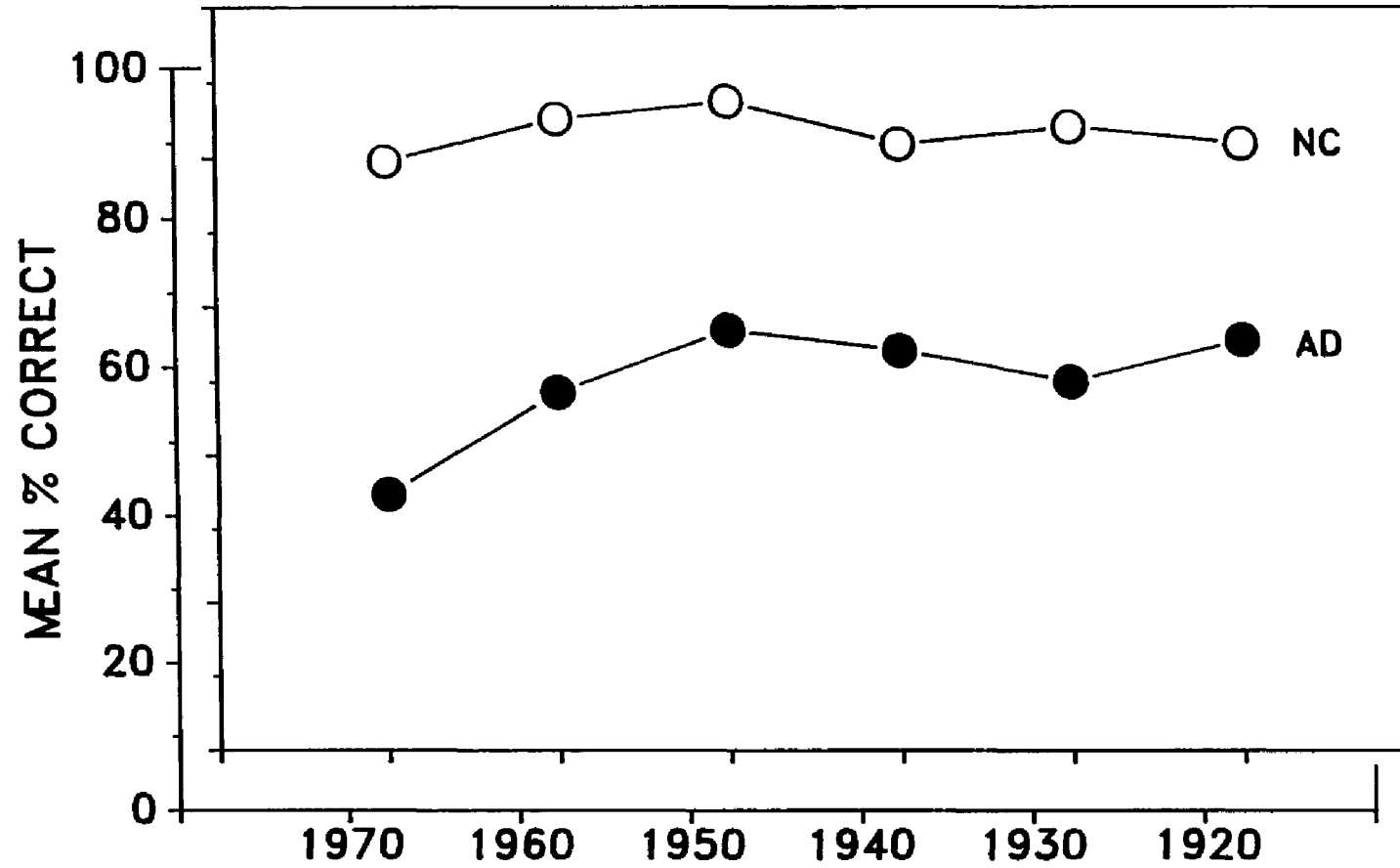


DECADE  
Figure 13

Since the patients demonstrated an impairment in autobiographical memory for the past 19 years, a second analysis was performed to examine more closely the most recent decades. This time, the scores from all decades were assessed individually.

The results, presented in Figure 14, were the same as above. The patients were significantly impaired overall relative to the controls ( $F[1, 18] = 20.59, p < 0.0003$ ). There was also a significant effect of decade ( $F[5, 90] = 2.31, p < 0.05$ ). However, there was no interaction of group by decade ( $F[5, 90] = 1.06, n.s.$ ). While the patients performed more poorly for the 1970's, the controls demonstrated a decline as well. Comparisons between groups for each decade revealed that the patients were impaired for every decade except the 1940's ( $F[1, 18] = 6.00, p < 0.02$ ).

# FAMOUS FACES TEST



DECADE  
Figure 14

Table 5

## Summary of Results for Famous Faces Test

## MEAN NUMBER CORRECT NO CUEING

	1920	1930	1940	1950	1960	1970
<u>EASY</u>						
NC	3.64(0.7)	3.00(1.3)	3.64(0.7)	3.36(0.9)	3.64(0.5)	2.91(0.8)
AD	2.44(1.1)	1.44(1.1)	2.00(1.3)	0.78(0.8)	1.44(1.4)	0.78(0.7)
<u>HARD</u>						
NC	2.36(1.3)	2.00(1.3)	2.18(1.5)	2.00(1.2)	2.36(1.2)	2.36(1.1)
AD	0.33(0.7)	0.33(0.5)	0.67(1.3)	0.33(0.7)	0.33(0.5)	0.22(0.4)
<u>TOTAL</u>						
NC	6.00(1.5)	5.00(2.5)	5.82(2.0)	5.36(1.9)	6.00(1.4)	5.27(1.7)
AD	2.78(1.5)	1.78(1.4)	2.67(1.9)	1.11(1.5)	1.78(1.4)	1.00(0.9)
<u>PERCENT</u>						
NC	75.00	62.50	72.73	67.05	75.00	65.91
AD	34.72	22.22	33.33	13.89	22.22	12.50

## MEAN NUMBER CORRECT WITH CUEING

	1920	1930	1940	1950	1960	1970
<u>EASY</u>						
NC	3.73(0.5)	3.55(0.7)	3.82(0.4)	3.73(0.7)	3.82(0.4)	3.45(0.7)
AD	3.00(1.0)	2.78(1.1)	2.78(1.2)	2.89(1.1)	2.56(1.1)	1.78(1.0)
<u>HARD</u>						
NC	2.82(1.2)	3.18(1.3)	2.73(1.4)	3.27(1.0)	3.00(1.2)	2.91(1.0)
AD	1.44(1.3)	1.22(1.0)	1.56(1.4)	1.67(1.3)	1.33(1.1)	1.00(1.1)
<u>TOTAL</u>						
NC	6.55(1.3)	6.73(1.7)	7.00(1.3)	6.82(1.3)	6.36(1.3)	6.36(1.4)
AD	4.44(1.9)	4.00(1.7)	4.33(2.4)	4.56(2.1)	3.89(1.9)	2.78(1.8)
<u>PERCENT</u>						
NC	81.82	84.09	81.82	87.50	85.23	79.55
AD	55.56	50.00	54.17	56.94	48.61	34.72

TABLE 5, Famous Faces cont.

EASY VERSUS HARD ITEMS (ALL DECADES)  
MEAN NUMBER CORRECT

		EASY	%	HARD	%
NO CUE	NC	20.18(3.0)	84.09	13.27(6.2)	55.30
	AD	8.89(5.1)	37.04	2.22(2.8)	9.26
WITH CUE	NC	22.09(2.0)	92.05	17.91(5.0)	74.62
	AD	15.78(4.7)	65.74	8.22(5.2)	34.26

### 3.2.1.2 Level of difficulty

A 2 (group) x 2 (easy/hard) x 5 (decade) repeated-measures ANOVA was used to assess whether patients differed from controls on the easy and hard questions. Figure 15 presents the performance of both groups. Patients performed worse than controls overall ( $F[1, 18] = 20.59, p < 0.0003$ ). Performance was better for the easy items compared to the hard items ( $F[1, 18] = 49.93, p < 0.0001$ ). In addition, the difficulty x group interaction was not significant ( $F[1, 18] = 4.12, p < 0.06$ ) although it did represent a trend. Comparisons between groups demonstrated that the patients were impaired on both the easy ( $F[1, 18] = 16.25, p < 0.0008$ ) and hard ( $F[1, 18] = 18.24, p < 0.0005$ ) test questions.

# FAMOUS FACES TEST BY EASY VS HARD

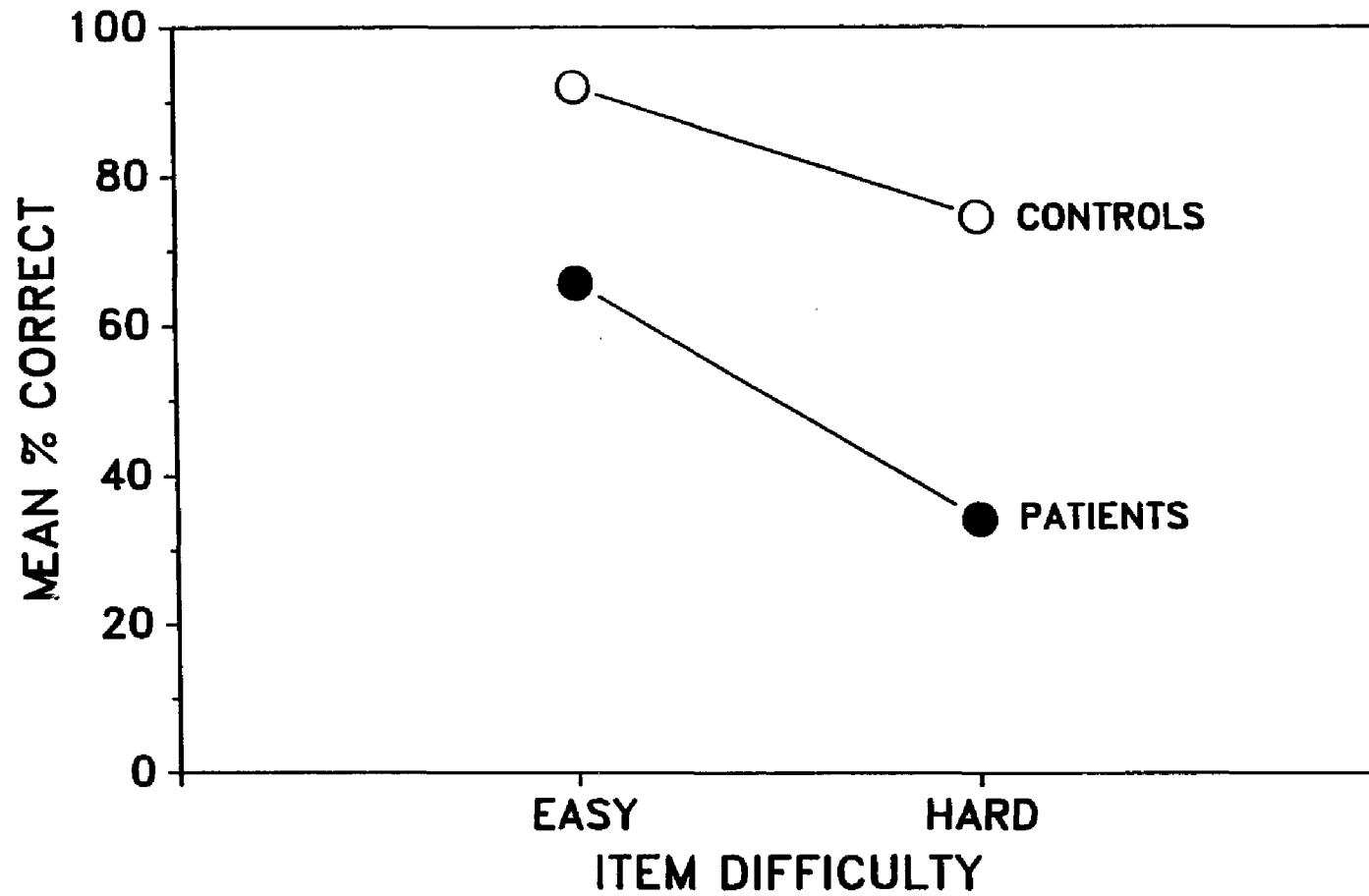


Figure 15

### 3.2.2 Boston Recognition test

Table 6 summarizes the data for the Boston recognition test for both groups.

#### 3.2.2.1 Effect of Decade

With one exception, the results for the recognition test were similar to that of the faces. When the decades were grouped into recent and remote time periods (Figure 16), there was a main effect of group ( $F[1, 19] = 22.01$ ,  $p < 0.0002$ ). However, in contrast to Famous Faces, performance for both recent and remote time periods did not differ overall ( $F[1, 19] < 1$ ). There was not a significant decade x diagnosis interaction ( $F[1, 19] < 1$ ). Comparisons between groups indicated differences for both recent and remote time periods ( $F[1, 19] = 17.71$ ,  $p < 0.0005$ ;  $F = 15.57$ ,  $p < 0.0009$ ).

When the decades were analyzed individually, there was a main effect of diagnosis ( $F[1, 14] = 11.09$ ,  $p < 0.005$ ) and decade ( $F[6, 84] = 2.44$ ,  $p < 0.03$ ) but the interaction was not significant ( $F[6, 84] < 1$ ). These results presented in Figure 17, are comparable to the Famous Faces test. However, in contrast to the faces where patients performed worse than controls for each decade, there were two decades on the recognition test (1930's and 1980's) where no difference between groups was detected ( $F[1, 14] = 3.15$ , n.s.;  $F = 1.76$ , n.s., respectively). The other decades yielded differences between groups similar to the faces test. It is important to

note that the 1980's were not represented in the faces test. While the greatest difference between groups occurred for events representing the 1950's, 1960's and 1970's ( $p < .01$ ), the patients' performance improved for events occurring during the 1980's. The performance of the controls was similar for all decades and they did not demonstrate the variability seen in the patient group.

#### 3.2.2.2 Level of difficulty

Figure 18 illustrates the mean performance on easy and hard items separately for each group. Analysis of variance indicated significant main effects for diagnosis ( $F[1, 19] = 24.39, p < 0.0001$ ) and item difficulty ( $F[1, 19] = 228.06, p < 0.0001$ ), but the difficulty x group interaction was not significant ( $F[1, 19] < 1$ ).

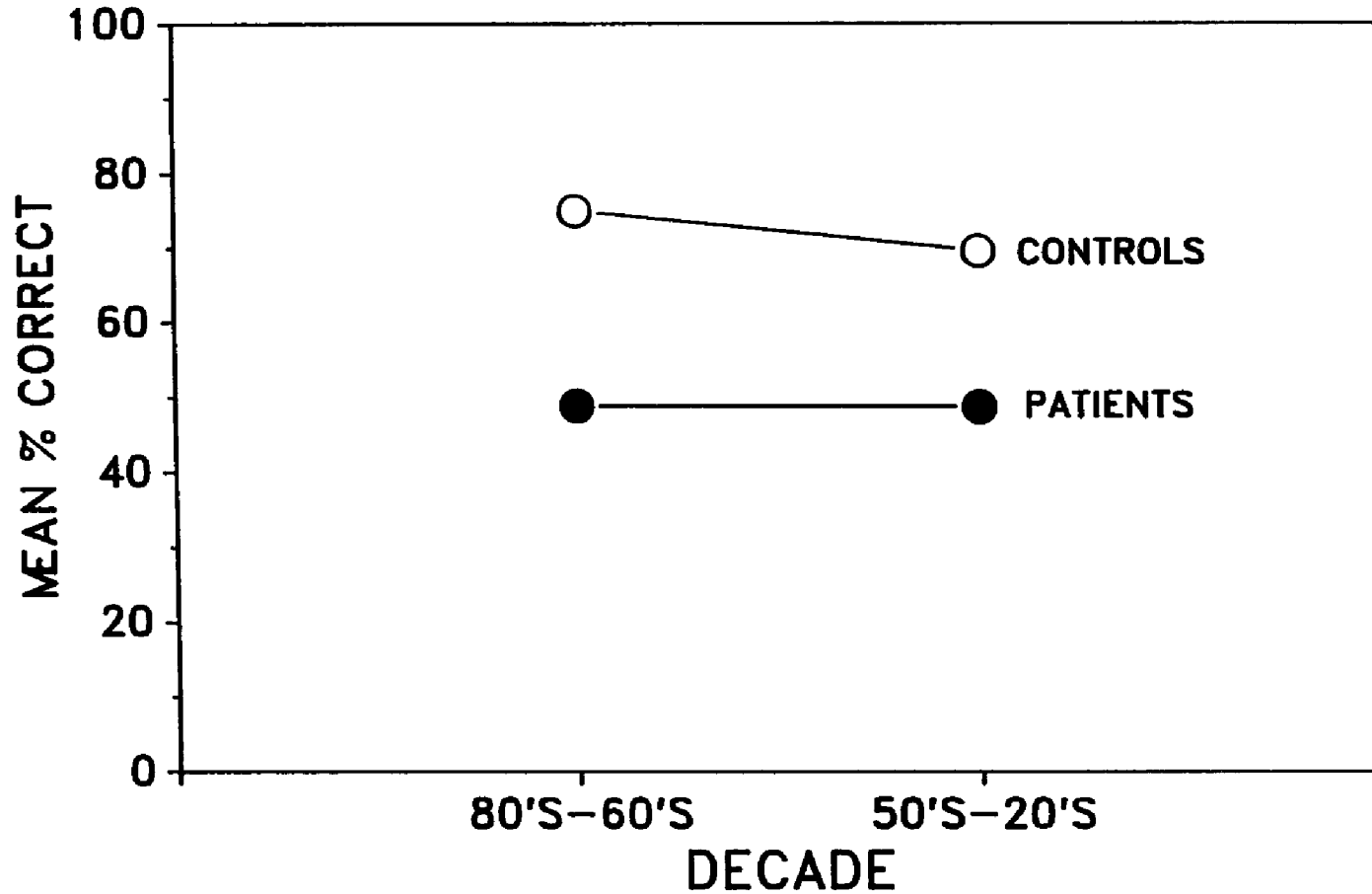
**Table 6**  
**Summary of Results for Recognition Test**

		MEAN NUMBER CORRECT						
		1920	1930	1940	1950	1960	1970	1980
<u>EASY</u>								
<u>NC</u>	3.73 (0.5)	3.82 (0.4)	3.00 (1.4)	3.27 (0.8)	3.82 (0.4)	3.73 (0.5)	3.50 (0.5)	
<u>AD</u>	3.20 (1.1)	3.30 (0.8)	2.50 (0.7)	1.80 (0.8)	3.20 (0.6)	2.30 (0.8)	2.78 (1.1)	
<u>HARD</u>								
<u>NC</u>	2.09 (1.2)	2.09 (1.0)	1.82 (1.3)	2.45 (0.8)	2.55 (1.1)	2.18 (1.1)	2.13 (1.4)	
<u>AD</u>	0.60 (0.7)	1.30 (1.0)	0.70 (1.0)	2.20 (1.2)	1.20 (0.8)	0.80 (0.8)	1.78 (1.1)	
<u>TOTAL</u>								
<u>NC</u>	5.82 (1.5)	5.91 (1.2)	4.82 (2.4)	5.73 (0.9)	5.36 (1.3)	5.91 (1.5)	5.63 (1.5)	
<u>AD</u>	3.80 (1.2)	4.60 (1.4)	3.20 (1.5)	4.00 (0.8)	4.40 (1.3)	3.10 (1.2)	4.63 (1.5)	
<u>PERCENT</u>								
<u>NC</u>	72.7	73.9	60.2	71.6	79.6	73.9	70.3	
<u>AD</u>	47.5	57.5	40.0	50.0	55.0	38.8	57.8	

**EASY VERSUS HARD ITEMS (ALL DECADES)**  
**MEAN NUMBER CORRECT**

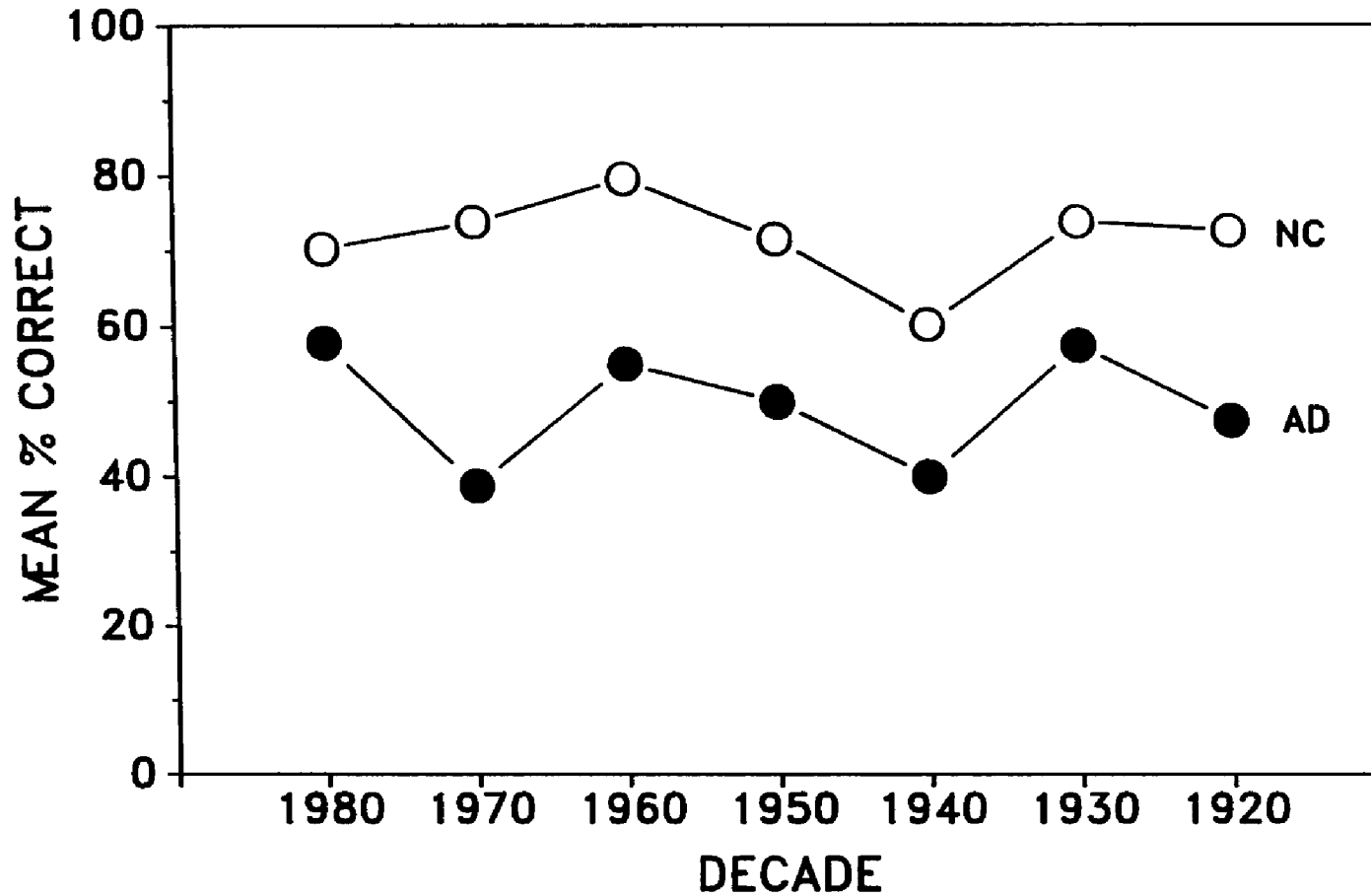
	<u>EASY</u>	<u>%</u>	<u>HARD</u>	<u>%</u>
<u>NC</u>	24.88 (3.4)	88.8	14.88 (5.8)	53.1
<u>AD</u>	19.00 (2.9)	67.9	8.7 (2.7)	31.0

# BOSTON RECOGNITION TEST



DECADE  
Figure 16

# BOSTON RECOGNITION TEST



DECADE  
Figure 17

# RECOGNITION TEST BY EASY VS HARD

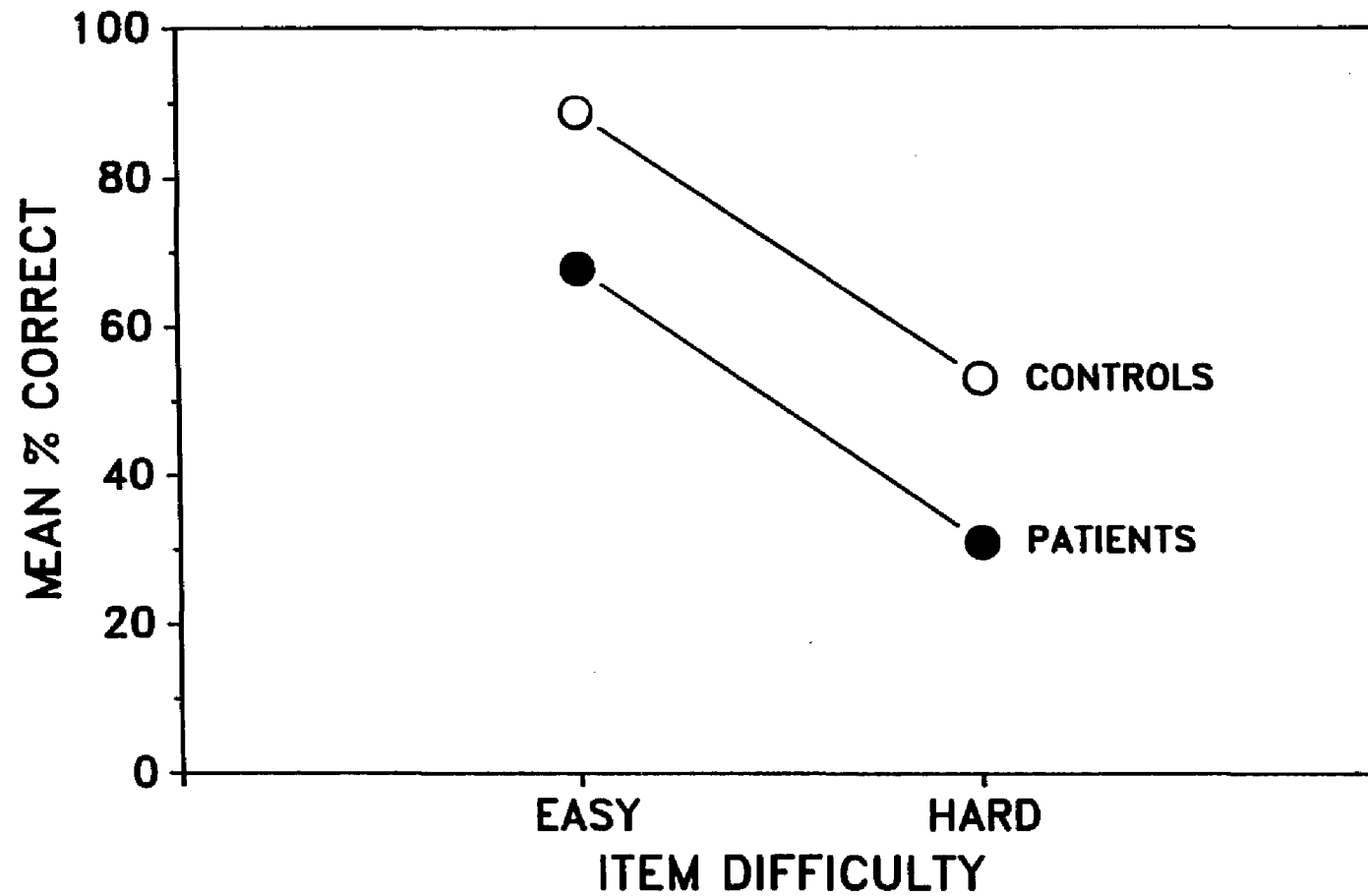


Figure 18

### 3.3 Neuropsychological Tests

The neuropsychological test results are presented in Table 7. Differences between the means for the control and patient groups were determined by T-tests for each test individually. When the variance estimates between groups were homogeneous, the pooled variance estimate was employed. When the variance estimates were not homogeneous, an approximate t was computed using separate variances.

1. Verbal Memory. As expected, the patients' performance on immediate and delayed recall of stories was significantly impaired compared to the controls. Similarly, the patients retained almost no information over the thirty minute delay, while the controls retained most of the information.

2. Verbal Learning. On paired associate learning, the patients were mildly impaired for the easy words immediately and after a delay. For the hard words, they were moderately impaired for immediate recall and mildly impaired after a delay.

Because the patients had a memory impairment, they received a modified list of only 8 words from the California Verbal Learning Test whereas the controls received all 16 words. Lists of different word lengths were used in an attempt to minimize the patients' frustration and avoid a floor effect. Similarly, the controls received a longer list

in order to avoid a ceiling effect. These results can not be compared directly, however, it is noteworthy that after a short delay, the patients were recalled an average of one word. After twenty minutes, the mean recall was 0.

3. Figural memory. These results are similar to those of verbal memory. The patients demonstrated severe impairment on immediate and delayed recall, as well as the percentage retained after thirty minutes.

4. Verbal intellectual skills. Differences were found between patients and controls on expressive vocabulary and fund of general information. Although the patients' scores most likely represent a decline in functioning, their performance was in the Average range. The controls were in the Superior range.

5. Verbal expressive skills. Overall, patients were impaired relative to controls on phonemic fluency, confrontation naming, and animal naming.

6. Verbal receptive skills. The patients performed worse than controls on verbal comprehension. This result is in part due to the memory component of the test. There were no differences between groups on phoneme and sentence repetition or reading single words.

7. Abstraction and mental flexibility. On the modified version of the Wisconsin Card Sorting Task, the patients were mildly impaired relative to controls on the number of categories obtained and the number of perseverative errors. They were moderately impaired on the number of total errors.

8. Visuospatial intellectual skills. The patients performed significantly worse than the controls on the Block Design subtest of the WAIS-R. While the patients were in the Average range, the controls scored in the Above Average range.

9. Perceptual speed and scanning. There was a significant difference between groups on the Digit Symbol subtest. The patients were in the Average range and the controls were in the Above Average range. While the performance of both groups was comparable on Trails A, the patients were mildly impaired on Trails B. It also took the patients significantly longer to complete the Letter Cancellation Test.

10. Attention. Patients were impaired overall on digit span relative to the controls. They were mildly impaired on digits forward and moderately impaired on digits backward.

11. Sensorimotor Functions. With the exception of mild impairment on left-hand graphesthesia, there was no difference between groups on right-hand graphesthesia or on finger tapping, bilaterally.

12. Mood. The mean scores of the two groups were alike. There was no evidence of depression as measured by the Zung.

**Table 7**  
**Neuropsychological Test Results by Diagnosis**

<u>Variables</u>	<u>Patients</u>	<u>Controls</u>	<u>Significance</u>
<b>1. Verbal Memory</b>			
Benton Orient.	8.3 ± 10.7	0	
WMS Stories Immed. Recall	9.1 ± 3.3	21.8 ± 4.1	***
WMS Stories Delay Recall	0.7 ± 1.9	14.6 ± 4.7	***
WMS Stories % Retained	7%	69.6%	***
<hr/>			
<b>2. Verbal Learning</b>			
WMS Paired Associates (total raw score)			
Easy (Immed.)	14.8 ± 2.3	17.0 ± 1.1	*
Easy (Delay)	4.8 ± 1.0	5.9 ± 0.3	*
Hard (Immed.)	1.3 ± 1.7	5.0 ± 2.9	**
Hard (Delay)	0.8 ± 1.2	1.8 ± 0.9	*
Total	8.7 ± 2.4	13.5 ± 3.2	**
 <b>California Verbal Learning Test</b>			
	<u>8-word list</u>	<u>16 word-list</u>	
Trial 1	3.6 ± 0.9	6.7 ± 2.7	
Trial 5	5.4 ± 1.6	12.0 ± 2.5	
Total 1 - 5	24.8 ± 7.5	50.4 ± 11.8	
List B	3.6 ± 0.9	5.8 ± 2.0	
Short Delay	0.9 ± 1.0	9.7 ± 2.7	
S.D. cued	1.9 ± 1.6	10.1 ± 2.5	
Long Delay	0.4 ± 0.5	9.6 ± 3.2	

L.D. cued	2.3 $\pm$ 2.3	10.3 $\pm$ 2.6
Recognition	6.2 $\pm$ 1.6	13.6 $\pm$ 1.7
False Pos.	5.8 $\pm$ 2.2	1.5 $\pm$ 1.6

---

### 3. Figural Memory

WMS Figures Immed Recall	3.2 $\pm$ 2.1	9.2 $\pm$ 2.6	***
WMS Figures Delay Recall	1.0 $\pm$ 1.6	8.2 $\pm$ 3.0	***
WMS Figures % Retained	29.2	88.9	***

---

### 4. Verbal Intellectual Skills

WAIS-R (Age Corrected) Vocabulary	11.6 $\pm$ 1.8	14.0 $\pm$ 2.4	*
Information	10.4 $\pm$ 2.3	14.1 $\pm$ 2.4	**

---

### 5. Verbal Expressive Skills

COWA (age-cor.)	39.2 $\pm$ 8.5	50.9 $\pm$ 14.3	*
Animal Naming	12.9 $\pm$ 3.5	22.3 $\pm$ 5.8	***
Boston Naming	43.9 $\pm$ 12.4	55.7 $\pm$ 4.2	*

---

### 6. Verbal Receptive Skills

BDAE Comp.	10.2 $\pm$ 1.0	11.5 $\pm$ 0.5	**
Luria Rep.	1.3 $\pm$ 0.8	1.2 $\pm$ 1.0	n.s.
WRAT-R Reading (SS)	107.9 $\pm$ 9.7	115 $\pm$ 6.2	n.s.

---

## 7. Abstraction and Mental Flexibility

MCST			
Categories	4.1 $\pm$ 1.6	5.5 $\pm$ 0.8	*
Errors	15.8 $\pm$ 8.8	6.4 $\pm$ 6.0	**
Perseverations	5.5 $\pm$ 4.5	2.0 $\pm$ 2.6	*

---

## 8. Visuospatial Intellectual Skills

WAIS-R (Age Corrected)			
Block Design	9.5 $\pm$ 2.6	13.4 $\pm$ 2.6	**

---

## 9. Perceptual Speed and Scanning

WAIS-R (Age Corrected)			
Digit Symbol	9.4 $\pm$ 1.9	13.5 $\pm$ 2.6	***
Trails A (sec.)	46.3 $\pm$ 8.2	39.2 $\pm$ 13.4	n.s.
Trails B (sec.)	179.9 $\pm$ 83.3	83.4 $\pm$ 35.4	*
Letter Cancellation			
Time	3.3 $\pm$ 0.9	2.2 $\pm$ 0.6	**
Errors R	4.0 $\pm$ 4.1	2.3 $\pm$ 1.9	n.s.
Errors L	3.1 $\pm$ 2.1	3.1 $\pm$ 3.0	n.s.

---

## 10. Attention

WAIS-R (Age Corrected)			
Digit Span	9.8 $\pm$ 1.7	12.4 $\pm$ 2.2	**
Forward	5.9 $\pm$ 1.1	7.3 $\pm$ 1.4	*
Backward	4.1 $\pm$ 0.9	5.3 $\pm$ 0.7	**

---

## 11. Sensorimotor Functions

FT#W			
Right	7.0 $\pm$ 4.1	4.2 $\pm$ 3.5	n.s.
Left	7.1 $\pm$ 4.2	2.8 $\pm$ 3.1	*
Finger Tap			
Right	40.4 $\pm$ 8.1	40.7 $\pm$ 5.6	n.s.
Left	34.7 $\pm$ 7.1	39.0 $\pm$ 5.1	n.s.
<hr/>			
12. Mood			
Zung Raw Score	35.9 $\pm$ 3.9	34.1 $\pm$ 6.7	n.s

Comparisons represent Two-tailed T-Tests.  
Asterisks denote significance levels.

Symbol	Significance Level
*	.05
**	.01
***	.001
n.s.	not significant

### 3.4 Remote Memory And Neuropsychological Functioning, a Comparison

For each group, Spearman rank correlation coefficients were calculated to determine the relationship between performance on individual measures of neuropsychological functioning and remote memory tests.

#### 3.4.1 Correlation between remote memory tests

The correlation coefficients for the three remote memory measures and GDS scores are presented in Table 8. The GDS scores were not correlated with any of the remote memory measures. The correlation between the quality of autobiographical memory to the number of episodes recalled was significant for the patients but not for the controls. The performance on other measures of factual memory tests was not significant for either group. Lastly, the Famous Faces Test was positively correlated with the recognition test for Group NC but not for the patients.

Table 8  
Spearman Correlation Coefficients - Remote Memory Tests

<u>GROUP NC</u>				
<u>TEST</u>	AUTOB. QUALITY	AUTOB. # MEM.	FACES	RECOG.
<u>AUTOB. QUALITY</u>		0.48	0.31	0.35
<u>AUTOB. # MEM.</u>			0.03	0.29
<u>FACES</u>				0.68*

<u>GROUP AD</u>				
<u>TEST</u>	AUTOB. QUALITY	AUTOB. # MEM.	FACES	RECOG.
<u>GDS</u>	-0.53	-0.53	-0.29	-0.47
<u>AUTOB. QUALITY</u>		0.81**	0.20	0.57
<u>AUTOB. # MEM.</u>			0.38	0.35
<u>FACES</u>				0.38

Significance levels  
\*  $p < .05$ , \*\* $p < .01$

#### 3.4.2 Remote memory vs new learning

Table 9 contains the results of the correlation analyses for performance on remote memory and new learning. The autobiographical memory test was not correlated with any other memory measures for either group. For Group NC, the faces test was correlated with immediate and delayed recall

of prose passages and delayed recall of the verbal list learning test. For Group AD, none of the correlation coefficients approached significance. The recognition test was positively correlated with immediate recall of stories for Group NC. For Group AD, the recognition test was correlated with the total learning score for the list of words. None of the other correlations approached significance for either group.

Table 9  
Spearman Correlation Coefficients - Memory Tests

	<u>GROUP NC</u>					
	SEM	S30	CVLTT	CVLT20	VIS	VIS30
AUTOB. QUALITY	0.27	0.04	0.51	0.23	-0.12	0.06
AUTOB. # MEM.	0.00	-0.41	-0.09	-0.28	-0.21	0.01
FACES	0.60	0.62	0.46	0.63	0.43	0.33
RECOG.	0.62	0.34	0.17	0.22	0.20	0.26

	<u>GROUP AD</u>					
	SEM	S30	CVLTT	CVLT20	VIS	VIS30
GDS	-0.36	-0.39	-0.51	---	-0.60	-0.21
AUTOB. QUALITY	-0.29	0.55	0.42	---	0.44	0.24
AUTOB. # MEM.	-0.46	0.55	0.07	---	0.30	0.50
FACES	-0.11	0.58	0.35	---	0.34	-0.03
RECOG.	-0.10	0.55	0.76	---	0.46	-0.09

Significance levels  
\*  $p < .05$ , \*\* $p < .01$

### 3.4.3 Remote memory vs language skills

The correlation matrix for performance on individual remote memory tests and measures of language ability, is presented in Table 10. For Group NC, tests for quality of autobiographical events and identification of faces were positively correlated to semantic fluency (i.e. animal naming) but not to other language tests. In contrast, the recognition test was positively correlated with both subtests of verbal intellectual functioning, naming and semantic fluency. For Group AD, the severity of dementia, as reflected in the GDS, was positively related to all language tests except phonemic fluency. In contrast to Group NC, the relationship between performance on either of the remote memory measures as well as all the language tests was not significant.

Table 10  
Spearman Correlation Coefficients  
Remote Memory vs Language Tests

	GROUP NC				
	INFO	VOCAB	NAMING	ANIMAL	CFL
AUTOB. QUALITY	-0.14	-0.09	0.32	0.72**	0.33
AUTOB. # MEM.	-0.01	0.21	0.04	0.17	0.44
FACES	0.23	0.19	0.49	0.64*	0.06
RECOG.	0.83**	0.69*	0.79**	0.70*	-0.01

	GROUP AD				
	INFO	VOCAB	NAMING	ANIMAL	CFL
GDS	0.83**	0.69*	0.79**	0.70*	-0.09
QUALITY	0.13	0.24	0.27	0.23	0.36
# MEM.	-0.09	-0.09	0.10	0.62	0.04
FACES	0.33	0.12	0.47	0.43	0.23
RECOG.	0.35	0.61	0.63	0.17	0.54

Significance levels

\*  $p < .05$ , \*\* $p < .01$

CHAPTER 4  
DISCUSSION

4.1 Remote Autobiographical Memory Test

The primary purpose of this study was to examine the pattern of remote memory functioning in Alzheimer's disease. A test was developed to sample autobiographical events that occurred throughout a person's life. The underlying assumption of the test was that words strongly associated with a specific decade would elicit memories from that same time period. To this end, the Remote Autobiographical Memory test succeeded. It was shown that the year that healthy control subjects reported events to occur was highly correlated with the decade to which the words were associated. Therefore, all decades of a subject's life up to the present were represented. Accordingly, comparisons between patients and controls with respect to the temporal distribution of autobiographical and factual memories were made.

#### 4.1.1 Episodic memory

Remote autobiographical memory was examined with regard to the number and quality of memories and related to the temporal distribution. Patients with Alzheimer's Disease demonstrated a selective sparing of memories from early in their life. Moreover, it was also found that this gradient was related to the nature of the prompt words. For both groups, the overall quality of recall was better in response to neutral words than to the words that were associated with specific time periods. Specifically, the findings were:

- 1) When the memories from all words were analyzed, the patients recalled fewer autobiographical memories overall than controls. However, the temporal pattern for the distribution of memories was comparable. Both groups recalled the greatest number of episodes from the previous 9 years, consistent with a forgetting curve.

When the responses from all words were assessed for quality of memory, the patients' recollections were impoverished relative to the controls, overall. Most interesting, was a significant decade by group interaction reflecting a difference between groups for the recent time period but not for the episodes drawn from earlier in their lives. This appeared to be due to differences within the patients. While the quality of memory was comparable across time periods for the controls, the patients recalled memories in less detail for the recent time period compared to the

remote time period. While the patients' impairment was extensive, it was most severe for the recent decades (i.e. temporally graded). To the extent that Alzheimer patients exhibited a selective sparing in very remote memories, Ribot's Law was upheld. Memories from the distant past were reported in more detail than memories from more recent time periods. These findings support the anecdotal reports that very early memories remain intact in early Alzheimer's Disease. While Sagar et al. (1988) also reported an impairment overall in the AD patients, they did not present enough data to determine the relationship between quality of memory and the temporal distribution.

2) When only the decade specific words were examined, the pattern of results did not change for number of memories. However, in terms of the quality of memory, the diagnosis x decade interaction was no longer significant. Thus, the patients were still impaired overall relative to the controls but their impairment was equal for all decades with regard to the quality of memory. This was explained by the next analysis that showed the neutral words improved the patients' quality of memory score for the remote time period only.

3) When the prompt words were limited to the neutral words, the difference between patients and controls in the number of memories recalled from either the recent or remote

time period did not reach significance. However, there was a trend suggesting that patients recalled more episodes for the remote times. Furthermore, the quality of the patients' narratives was better for the remote times than the recent times. In contrast, the controls did not show a difference with regard to either the number or quality of memory between time periods.

#### 4.1.2 Temporal patterns

The findings that most memories were reported from recent times is in agreement with the results of Sagar et al. (1988) for controls and AD patients and Franklin and Holding (1977) for healthy elderly subjects in the same age range. In the first study the majority of memories were drawn most readily from the last 5 years, and in the second study the memories were recalled from the last 20% of the subjects' lives.

Similar findings were reported in a study with Korsakoff patients using Crovitz technique with 10 neutral words (Zola-Morgan et al., 1983). The authors found an extensive impairment in remote memory that was most severe in recent times. Furthermore, the authors' observed that "they apparently accomplish this by reaching further into the past than alcoholic control subjects"(p. 495).

Temporally graded retrograde amnesia has also been found in a study with different types of amnesic patients

(McKinnon & Squire, submitted for publication). In this study, 5 patients who became amnesic on a specific date due to either anoxia or infarction, demonstrated intact recall of memories from childhood and adolescence, significant difficulty recalling events from the 1980s, and progressively less difficulty from earlier years.

Although the pattern of performance between patients with AD and amnesia are similar in that the greatest impairment occurs for the most recent decades, an important difference exists. The gradient of AD patients appears more extensive than in amnesia. In studies with amnesics, no difference was found between the amnesic patients and controls for events occurring early in life. In the present study, however, the overall performance between AD and the controls was significant for the early time periods although the difference was not as great as for the later time periods.

#### 4.2 Remote Memory for Public Events

The results of both the faces and recognition test demonstrated a severe impairment for the patients that was characterized by poorer performance across all decades. Two other studies have examined remote memory in Alzheimer's Disease using similar versions of the faces and recall tests from the Boston battery. For the faces test, in regard to a temporal gradient, this investigation agrees with the results of Wilson et al. (1981) who reported a temporally extensive loss in AD patients. However, these results were in question because the patients were of all levels of dementia and there was a possible floor effect. In the present study, the patients' level of dementia was more uniform and less severe. Their overall performance was better than that in Wilson's group, there was no floor effect and there was still no evidence of a temporal gradient when compared to controls.

These results appear to disagree with the those of Beatty et al. (1988) who reported that AD patients recalled significantly more items from the 1940's and 1950's than from the 1960's to 1980's. However, their performance measure was a combined score for faces and recall tests rather than the faces test score alone. In the present study, the recall test was discontinued because it was too difficult for the patients and in fact, Beatty excluded two patients from his analyses because they had no recall at all. Therefore, it is unclear how the results for just the faces test would compare

between studies.

The absence of a temporal gradient was also evidenced for the recognition test. Sagar et al. (1988) reported a temporally extensive impairment for AD patients when given Squire and Cohen's (1982) tests for recognition of famous public scenes (1940-1980's) and public events (1940-1970's).

One aspect of the present findings that was somewhat unexpected was the unimpaired performance of the patients for the 1980 questions on the recognition test. In this study, the difference between patients and controls for the 1980's did not approach significance while the difference between groups for the 1970's was significant. In light of the severe anterograde amnesia characteristic of Alzheimer's Disease, one would expect poorer performance for the events occurring in the 1980's. A temporally graded pattern has been well documented in Korsakoff's Disease (Cohen & Squire, 1981, Butters & Albert, 1982, Squire et al., 1989). Korsakoff's Disease, similar to AD, develops gradually over years and the memory loss for the most recent decade has been largely attributed to anterograde amnesia. Therefore, a temporally graded pattern of memory loss was also expected to be seen on this test with Alzheimer patients.

A possible explanation for this finding involves the methodological issue of equating prior learning and rates of forgetting among the test items from different decades. Since the 1980 questions were made up by myself, they may differ in

some way from those in the original Boston test. These items were chosen because the level of performance was similar to that reported for the other decades in the original Boston Remote Memory battery. However, as discussed by others (Squire & Cohen, 1928, Wilson et al., 1981), homogeneous performance for the controls across decades does not necessarily indicate that the questions are equated for difficulty. Similar performance across time periods can be interpreted in two ways; either the events were of equal saliency and were forgotten at the same rate; or the events from the most remote times were of greater saliency and forgotten at a rate slower than the more recent time periods. In either case, one could reason that performance for the most recent events should be higher than that of the earlier decades if one takes the process of forgetting into consideration. Thus, these questions may actually be easier than those from earlier decades. It is difficult to determine the durability of these current memories and therefore it is not known whether the 1980 information will be forgotten at a rate similar to those from prior decades.

Alternatively, the patients' relatively good performance in the 1980s could actually reflect retention of some information. Unlike many amnesic patients who have an abrupt onset of disease resulting in a dense anterograde amnesia and temporally limited retrograde amnesia from the time of the event, AD has an insidious onset characterized by

a progressive loss in memory. Therefore, it is plausible that patients with Alzheimer's Disease have retained some information about current events. While it is impossible to establish the onset of AD with certainty, the average duration of illness was 2.5 years. If these events occurred either before the onset of the disease or while the disease was in very early stages, then it is reasonable to expect some retention of current events to occur.

Further evidence that patients with AD retain recent information to some degree was found in the results of the autobiographical memory test. Not only was there was no difference between groups in the number of memories that occurred during the 1980's but both groups recalled the greatest number of memories from this decade. While the patients recalled many recent events, the quality of memory was more degraded than for more remote time periods. Likewise, because a recognition test does not require patients to spontaneously search and retrieve the facts, it is possible that accessibility to partial information is enough for recognition to occur. In this regard, it was occasionally noted that patients stated they did not know an answer but when forced to choose a response, they did so correctly.

Another important issue concerns the subjects' exposure to the information. The question is whether a memory from a specific decade actually represents information that was

acquired at the time or has been learned or repeated more recently. This issue has great relevance when comparing amnesics to healthy controls. While the controls have the advantage of relearning information through repeated exposure, the patients may be exposed to the material with equal frequency but they will not be able to retain it in light of their anterograde memory disorder.

#### 4.3 Episodic vs Semantic memory - a comparison

A primary purpose of this study was to make comparisons regarding the status of remote episodic and semantic memory in Alzheimer's Disease. The test of autobiographical memory measured episodic memory while tests of public events and famous faces measured semantic memory. This study showed that patients were impaired overall on all three tests and does not offer support for a distinction between episodic and semantic memory loss in AD. Moreover, the absence of a floor effect allows certain conclusions to be drawn regarding the temporal distribution of memories.

First, patients with AD were capable of recalling episodes that were autobiographical in nature. Part of their success can be attributed to rigorous probing that was used throughout the study. Nonetheless, the patients succeeded in recounting many personal episodes in temporo-spatial contexts. While the recollections from the patients were

easily distinguishable from the controls, this appeared to be due, in part, to qualitative differences in verbal expressive skills (i.e. dysnomia, fluency). The extent to which the patients' impairment can be attributed to a breakdown in the semantic network versus a loss of remote memory can not be determined directly. However, the fact that patients were able to recall some episodes in detail suggests that their impaired performance on this task can not be attributed to poor verbal skills alone. Furthermore, this study showed that the patients' clearest recollections (best quality) were from events that occurred earlier in life. It is also pertinent that the format of this task was chosen to minimize the effects of expressive verbal abilities by allowing the patients ample time and flexibility to express a memory. Furthermore, it would be difficult to explain how impairment in verbal skills would affect later memories more than earlier ones. Alternatively, it appears that the more parsimonious explanation is that the difficulties experienced by the patients actually reflects a loss of memory that is episodic in nature.

A memory impairment for factual information was also observed. The patients performed worse than the controls overall on both the faces and recognition tests. Moreover, a temporal gradient was not evidenced. Instead their memory loss was extensive, spanning across all decades. These results conflict with those of the autobiographical

memory test when all words were analyzed, but are in agreement with the temporal distribution that resulted when the neutral words were omitted. This difference in temporal patterns may be explained by the underlying premise of this study. That is, the absence of recollections from a specific decade does not necessarily prove that patients have a memory loss for that time period. Rather the temporal gradient could be secondary to the structure of the task instead of reflecting the temporal organization within a subject's memory profile. When the questions target the same time periods and each time period is equally represented, then AD patients exhibit a temporal gradient that is extensive and effects all decades equally. In the present study, this was true for both semantic memory tests and the autobiographical test when the decade-specific words were analyzed. On the other hand, when the questions are not targeted to specific times, a temporal gradient is found. Thus, when neutral words were included in the autobiographical memory test, the effect was such that the earlier decades had greater representation for the patients. It could be argued that a semantic memory test that would be more analogous to Crovitz' test with neutral words would ask patients to report any facts concerning public information from any time in their life. The results of this study would predict that patients would name facts that occurred in early adulthood and a similar temporal gradient would then be observed for semantic memory.

Since the structure of the questions in the semantic memory tasks were fixed in time, the episodic task developed in this study (i.e. with decade specific words) provided a more valid comparison between episodic and semantic memory functioning by sampling memories from the same time periods.

Another factor that may have influenced these test results is that the autobiographical test has greater sensitivity in scoring. While responses on the semantic memory tests could be either correct or incorrect, the scoring system for the autobiographical memory test permitted subjects to receive credit for memories that were partially recalled. In fact, the majority of patient responses received 0, 1, or 2 points with almost no memories receiving a 3 or 4.

Finally, the format of the autobiographical test is unstructured compared to the tests of public events. Differences in performance could be a reflection of differences in cognitive abilities other than memory. For example, the autobiographical test may require greater organizational and attentional resources to implement search strategies than a recognition test. This will be discussed in the next section.

#### 4.4 Remote Memory and Cognitive Functioning, A Comparison

The extent to which impairment in recall of remote memory can be attributed to a decline in cognitive functions can not be measured directly. However, the relationship may

be examined, qualitatively at least, by correlating the level of dementia with various neuropsychological functions and remote memory tests. The findings indicated that while GDS scores were inversely correlated with performance on language and immediate memory tests, they were not correlated with measures of remote memory. One possible reason is that, given the small number of patients of similar levels of severity, the range of performance was too restricted for the correlations to reach significance. Because deterioration of language skills is characteristic of AD (Rosen, 1980; Martin & Fedio, 1983; Ober, Dronkers, Koss, Delis, & Friedland, 1986; Butters et al., 1987; Salmon et al., 1988), the contribution of impaired expressive ability to poor performance on remote memory tests was also examined. The fact that performance on the autobiographical memory test was not directly correlated with measures of verbal intellectual functioning or any of the expressive language tests in the patient group may be viewed as evidence that difficulty in remote memory can not be due solely to impaired language skills.

#### 4.5 Retrieval Deficit vs Loss of Memory

While this study has demonstrated that patients with Alzheimer's Disease were impaired relative to controls in recall of both autobiographical and public information from all time periods, it is not known whether this impairment is

due to a depletion in the reservoir of memories or whether it may be attributed to difficulty in retrieval.

The fact that the patients were able to recall many memories from all time periods suggests that their memory impairment can not be attributed primarily to a retrieval deficit. However, it is possible that patients could be experiencing inconsistent accessibility of past memories secondary to impaired organization or inadequate search strategies. One way to answer this question in the future would be to retest patients on the same material at a later time. If the pattern of results are consistent for individual items among testings, (i.e. incorrect answers remain in error and correctly answered questions remain correct) then it is reasonable to assume that the memory impairment is due to a loss of memory. However, if the patients' poor performance is due to an erratic accessibility to memories, then one would expect differences among individual responses between testings, even though the overall score may remain the same. Evidence supporting the latter theory was found in a study by Sagar et al.(1988). Although discussed in a different context, the authors mentioned that AD patients reported autobiographical events inconsistently. In this study, the subjects were asked to recall and date the same memories in response to the prompt words on the following day. While they reported that the recollections of the controls were the same for both days, the patients performed worse on day 2. In

fact, some of the patients were unable to recall the same episodes even after they were provided with cues.

Unfortunately, the detailed description of the patients' responses on day 2 was not reported so it is unclear whether the patients recalled different autobiographical memories in response to the prompt words.

The consistency of impairment in remote memory has been reported in two other studies with amnesic patients. A single case study of remote memory (Cermak & O'Conner, 1983) in a patient with post-encephalitic amnesia showed inconsistent memory for factual information between test sessions one year apart. More recently, this issue was studied with a group of amnesic patients due to either Korsakoff's Disease or anoxia (Squire, Haist, and Shimamura, 1989). The results indicated that overall, the patients' memory loss for factual information was consistent when the patients were retested a year later.

Further studies are needed to answer this question in dementia. Because Alzheimer's Disease is a progressive disorder, the testings need to be closer in time so that the results are not confounded by a decline in intellectual functioning.

#### 4.6 Alzheimer's Disease versus Amnesia, a comparison

Differences in patterns of memory functioning in amnesia and dementia may be expected because of differences in the neuropathology. While cases of amnesia have been shown to involve circumscribed lesions to the mesial temporal structures or related pathways (Zola-Morgan et al., 1986; Teuber et al., 1968; Squire et al., submitted), Alzheimer's Disease alters brain functioning in a more global manner. Hyman et al. (1984) have shown that Alzheimer's Disease disrupts corticolimbic connections by damaging entorhinal and subicular cortices, thereby isolating the hippocampal formation from neocortical tissue. Other neuropathological studies have demonstrated damage to neocortex as well as damage to subcortical structures that provide cholinergic innervation to the forebrain (Pearson, et al., 1985; Whitehouse et al., 1982). However, it is not known at what point in the course of the disease this pathology occurs. Furthermore, longitudinal studies have indicated that while the progression of neuropsychological dysfunction remains relatively consistent, there is much variability in the rate of decline (Grady et al., 1988). In the earliest stages of the disease, the damage to the hippocampal region may not be complete so that some processing may occur, albeit sporadic and inefficient. If AD begins as a selective impairment similar to amnesic syndromes, then the pattern of performance on various memory tests should be comparable. If, however,

other kinds of memory processes are also affected at a relatively early stage of the disease, then differences between amnesics and demented patients in features of the memory impairment should emerge. Recent studies have demonstrated impairment in lexical priming in patients with mild to moderate AD but not in amnesic patients of various etiologies (Shimamura et al., 1987; Salmon et al., 1988). These findings have been viewed as evidence that damage to brain regions in addition to the mesial temporal region must also occur at early stages of the disease.

Findings from the present study have shown that remote memory functioning is also greatly affected in the early stages of Alzheimer's Disease. This may be due, in part, to damage outside of the temporal lobe. Neuropsychological studies with amnesic and ECT patients are consistent with the premise that consolidation of newly acquired material proceeds for several years after learning (Squire et al., 1975; Squire et al., 1984). Furthermore, findings from both animal and human studies agree that the mesial temporal region of the brain and in particular, the hippocampus, is crucial for consolidation to occur (Mishkin, 1980; Squire & Zola-Morgan, 1983). However, findings that amnesic patients with circumscribed damage to the mesial temporal region have a retrograde amnesia that is limited to years after the incident, has led researchers to conclude that the hippocampus is not necessary for retrieval or maintenance of

older memories (Squire et al., 1984).

Although the patterns of remote memory that result from various neuropathological conditions are still being delineated, reports from individual case studies suggests that extensive retrograde amnesia may be linked to extra damage in the cerebral cortex (Damasio et al., 1985; Cermak & O'Connor, 1983; Warrington & McCarthy, 1988). Additionally, remote memory functioning in patients with Huntington's disease, where the pathology primarily involves the caudate nucleus, has been characterized by equal losses for all decades (Albert et al., 1981). Furthermore, it has been suggested that the severity and extent of retrograde amnesia in Korsakoff's Disease may be directly related to the amount of extra-temporal damage (Squire et al., 1989). When considered together, these studies provide strong evidence that remote memory functioning can be greatly altered by damage to many different regions outside of the temporal lobe.

#### 4.7 Concluding Comment

It is over one hundred years since Ribot's insightful postulation that early memories are more resistant to disruption than memories from later in life. The present study provides further support for Ribot's Law. This investigation of remote memory functioning in the early stages of Alzheimer's Disease revealed a temporal gradient that was most severe for recent decades and a relative preservation of memories from early in the patients' lives. However, the origin of the preservation of very remote memories remains unexplained. What is it about memories from early in life that makes them more impermeable to disruption? One approach towards answering this question is to examine whether there is something unique about the organization of the young brain and the way it processes information during the first two decades of life. An alternative approach would be to examine the quality of the memories themselves. Perhaps, in order for memories to survive through the years, they must become remarkably 'durable'. It is postulated that durability can result from multiple encounters, rehearsal and reactivation. Thus, as memories are repeated, they are strengthened through greater association with more events and become more integrated within the cognitive system. Insofar as memories receive greater use (i.e. activation), they become further integrated and thus more durable.

An underlying premise of this discussion is that

memories from early in life are the foundation of later memories. Moreover, they provide the framework by which new information is acquired. These thoughts are related to Neisser's ideas on schemata and perception (1976). Early memories may be durable in that they form the basis of true schemata by which we mediate future perceptions and through further experience or repetition, they are strengthened even more. Therefore, memory retrieval is an active, constructive process that involves many systems in the brain simultaneously. Neisser states that a schema is

... some active array of physiological structures and processes: not a center in the brain, but an entire system that includes receptors and afferents and feed-forward units and efferents. Within the brain itself there must be entities whose activities account for the modifiability and organization of the schema: assemblages of neurons, functional hierarchies, fluctuating electrical potentials, and other things still unguessed. It is not likely that this physiological activity is characterized by any single direction of flow or unified temporal sequence. It does not just begin at the periphery and eventually arrive at some center, but must include many kinds of reciprocating and lateral patterns. Nor does it all begin at one moment and end at another; the continuities of different subsystems overlap in varying ways, providing for a host of different kinds of "information storage" (Neisser, 1976, pg 54).

Future studies need to delineate not only those functions that are impaired in AD, but also the functions that are preserved. The present study provided evidence that memories from early in the patients' lives remain relatively

intact in early stages of the disease. By focusing on the nature of the early memories that are preserved in AD, amnesia and in healthy elderly subjects, and relating these findings to differences in the pattern of cognitive functioning, we may gain greater insight into the functional organization of memory systems.

**Appendix I. The Neuropsychological Battery by Function**

- I. Abstraction and Mental Flexibility**
  - a. Modified Wisconsin Card Sorting Test
- II. Verbal Comprehension**
  - a. WAIS-R Vocabulary
  - b. WAIS-R Information
- III. Expressive Language Skills**
  - a. Controlled Oral Word Association
  - b. Animal Naming
  - c. Boston Naming
  - d. Repetition
- IV. Receptive Language Skills**
  - a. Sentence Comprehension (Complex Ideational Material)
  - b. Oral Reading (WRAT-R)
  - c. Repetition
- V. Verbal Memory**
  - a. Semantic Memory (WMS)
  - b. List Learning (CVLT)
- VI. Visual Memory**
  - a. Figural Memory (WMS)
- VII. Attention**
  - a. WAIS-R Digit Span
  - b. Stroop Test
- VIII. Visual Attention, Perceptual Speed and Scanning**
  - a. WAIS-R Digit Symbol
  - b. Letter Cancellation
  - c. Trails A & B
- IX. Visuo-spatial and Constructional Functions**
  - a. WAIS-R Block Design
  - b. Drawings to Copy and Command
- X. Motor Speed**
  - a. Finger Tapping Test
- XI. Sensory Perceptual Examination**
  - a. Fingertip Number Writing
  - b. Auditory Single and Double Simultaneous Stimulation
- XII. Zung Depression Scale**

## Appendix II. STUDY I. FREQUENCY DISTRIBUTION OF WORDS (N=20)

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
DOUGHBOY	14	2	2		1				1	
SINGLES BAR				1	4	6	6	2	1	
BROMO	3	1	4				6	4	1	
MALTSHOP	1	1	4	3	1			6	3	1
LUCKY STRIKE	4	8	5					1	1	1
POODLE SKIRT	1	1	3	1				2	12	
VALLEY GIRL					1	2	3	2	11	1
BAMBOOZLE	5	3				1	6	5		
CHAUVINISM	1	1	2	1	6	4	2			3
LUNAR MODULE		1		2	6	6	1	3		1
SUSHI		1		3	4	3	3	5	1	
TIDDLY WINKS	5	5	2		1	1		4	0	2
JOY-RIDE	2	7	4	1		1		2	1	2
CHICKS	1	4	5	3	3			3		1
MALT SHOP1	1	2	4	1		1	7	2	1	
STUDEBAKER	3	9	4	1		1				2
SCAT	1	1	5	3				7	2	1
MICROCHIP				3	5	4	3	4	1	
TROLLEYCAR	9	6	2					2		1
MEATWAGON	2	3	3	1				5	5	1
PEACE	3	3	4	3	1	1		2		3
FRISBEE	1	2	2	5	6		3		1	
ZOOT SUIT	1	5	8	2		1		1	1	1
EDSEL	3	3	5	6	2					1

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
LSD			4	7	2	1	2			4
HOTROD	2		4	7		2		1	0	4
BOOTLEGGER	8	9	2							1
QUIFF						1	5	13	1	
BEATNIK	1	2	7	3	3		1		2	
ANKLE BY	1							6	11	2
FLOWER POWER	1			4	6	4		1	2	2
ASTRONAUT		1		10	6	2			1	
SPEAKEASY	14	5								1
JITTERBUG	1	6	11	1	1					
JERRY	2		9		1			3	4	1
AIR RAID	1	19								
AFRO	1	1	3	9	3		3			
LUNAR MODULE			1		5	5	5	4		
23-SKIDOO	7	4					1	4	4	
CONGA	3	8	2				6	1		
HALLUCINOGEN				3	3	5	1	4	4	
JEEPERS-CREEPERS		2	4	9	1				4	0
STREAKER	1		2	4	6	4			2	1
BIRDMAN	2	1	6		3		3	3	2	
POP ART		1	4	4	3	1	5	1	1	
LA SALLE	2	3	2	1	2	1		7	1	1
DIGITAL			3		9	5	3			
MINISKIRT		1	1	12	3		2		1	
PRICEBUSTER				2	1	2		11	3	1

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
SATELLITE			3	5	4	5	2	1		
SADSACK	3	9	4		1			3		
GHOSTBUSTER	1			1		2	6	6	4	
HOKEY COKEY		1	1					5	12	1
DRUG ABUSE				1	7	4	6	1		1
LINDY	4	8	5						2	1
WOMAN'S LIB.		1	1	1	8	7		1		1
SHOPPING MALL				6	2	10	2			
KILROY	1	14						3	2	
FRAILS	2	2						4	11	1
DRIVEIN MOVIE		3	4	11	1			1		
ROSIE THE RIVETER		1	14	1					3	1
BURR HEADS		2	3	1				6	8	
TOFU							5	10	1	4
CHEMISE	5	2	4	4	1			2	2	
*ASTRONAUT				4	7	6	1	2		
*SUSHI				1	5	4	5	3	2	
PIEDMONT CIG.	3	4	3	1		1		6	1	1
RUNNING BOARD	5	7	2		1			3	1	1
VCR					1	1	17	1		
CROONER	1	11	4	1				2		1
*MICROCHIP					3	4	6	3	4	
HONKY-DORY	1	9	3	2		1		2		2
JOGGING			1	1	3	7	3	3		2
SODA JERK	1	8	8		1			2		

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
FUSELAGE		3	8	1	2	1		3	2	
LETTER SWEATER	3	3	3	2				6	3	
IRON LUNG		3	5	6	2	1		3		
FLAPPER	9	5	2					2	1	1
PAC-MAN				1	3	4	6	3	2	1
SWING BAND	1	5	12					2		
TESTTUBE BABY				1	3	7	6	2		1
LEISURE SUIT				2	4	8		5		1
DUSTUP			1	1				6	9	3
CREWCUT	2	2	6	5	1			2		2
MEATGRINDER	3	1	2	4	2			6	1	1
CHARLESTON	9	6	2					2		1
TV DINNER			2	3	5	5	2	2		1
DO-DO	2	1	1					8	6	2
CB RADIO	1		1	2	4	4	3	3	1	1
BUNNYNUTS			1					4	14	1
DISCOTHEQUE			1		7	6	2	2		2
COCAINE			2	2		4	6	4		2
PSYCHEDELIC				3	7	4	1	2	1	2
FOLIO	1	2	10	3				2		2
HIPPIE		2	1	2	11			2		2
ISH KABIBBLE	2	3	5	1				5	1	3
AUSTEN	2	2	2	1	1			5	4	3
ECOLOGY			2	2	4	4	1	3	2	2
ICEBOX	10	7						2		1

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
POLYESTER			2	4	5	6		2		1
SHORTSKATE		1	1		1			4	12	1
YUPPIE			1		1	1	12	3		2
VELCRO			1		1	4	3	3	7	1
APOLLO		1	1	2	2	6	4	3		1
JELLYING			1	1				4	13	1
JARVIK-5							5	5	9	1
HOOCH	4	7	2			1		4	1	1

APPENDIX III. STUDY II. FREQUENCY DISTRIBUTION ACROSS DECADES FOR FINAL WORDS (N=40).

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
NUCLEAR POWER	1	3	16	7	6	3	3	1		
FOUNTAIN PEN	19	14	2					4		1
BARBIE DOLL		1	5	22	10	1		1		
LETTER	12	6	1	2			17	1	1	1
HULA HOOP	2	2	7	17	11					1
SANITARIUM	10	10	3	5			1	10		1
RUMBLE SEAT	22	14	3	1						
STAR WARS		1	1	2	2	10	24			
AIDS					1	39				
STEAM IRON	5	4	8	14	7			1		1
FROZEN FOOD	1	7	10	14	6	2				
HI-FI		10	13	9	7	1				
BOOK	19	3	1					17		
TEST TUBE BABY			1	1	7	13	18			
HOOCH	17	7	4		1		1	3	7	
NYLON STOCKINGS <sup>4</sup>		13	19	3	1					
HONKY-DORY	11	10	4	3	1			9	1	1
BALL-POINT PEN		3	14	16	5			1		1
SMOKE DETECTOR		2	1	5	8	18	6			
VA MORTGAGE		2	17	14	4	1		1		1
FLOWER	13		4	1		1		20		1
MICROWAVE OVEN			2		5	16	17			
FLIVVER	24	5		1		1		9		

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
SOCIAL SECURITY <sup>1</sup>		23	11	4	1					
PACEMAKER		1		7	7	18	6	1		
LUCKY STRIKE	16	14	6	1				2	1	
GAME	14	3	1					18	4	
DOUGHBOY	26	2	7	2				3		
CONGA	1	6	19	6		1		1	5	1
PIZZA	3	1	7	9	12	3		4	1	
CD PLAYER		1	1	1	8	18	10	1		
AUTOM. TRANSMISSION		5	7	17	6	2	2			1
BREAK DANCING	2				3	11	23			1
CROONER	7	14	11	6				1	1	
ASTRO-TURF			1	2	14	17	2	1	1	2
GI BILL	1		25	8	4	2				
LATEX PAINT	1		4	17	9	6		3		
DOLLAR	13	5					2	19	1	
FRISBEE		1	3	9	14	12	1			
TIDDLY WINKS	15	8	3	2	2			10		
PSYCHEDELIC		2	2	3	13	12	2	4	2	
STUDEBAKER	14	16	5	2	1			2		
CRACK	3	1	1		1	2	29	1	1	1
ASTRONAUT				4	21	13	2			
ZOOT SUIT	1	10	17	7	3					2
BAGGIES	1	4	1	6	10	10	1	3	3	1
RIVER	15	1			1			21	2	
SUPERBOWL	1	3	3	4	15	9	2	3		

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DR	NR
SPEAKEASY	27	9	1	1				1		1
NEHRU JACKET	1	1	8	9	13	1		2	3	2
23-SKIDOO	21	8	3	1				3	2	2
BIRTH CONTROL PILL			1	2	4	22	9	2		
YUPPIE				1		10	25	2		2
MACHINE	11	6		1				19		3
BOOTLEGGER	29	6	2					1		2
ENRICHED BREAD	2	2	5	11	11	7		1		1
POLIO	9	12	10	5				4		
TEFLON	1	2	4	15	14	2		2		
JITTERBUG	4	8	17	7	2			1		1
LINDY	18	11	3	1				3	1	3
TOFU					1	7	20	4		8
SINGLE'S BAR	1			3	3	22		8	1	2
KILROY	2	5	22	3	2	1		2	2	1
RUNNING BOARD	22	11	2		1		1	1		2
DOG	16	1			1		1	20		1
SODA JERK	15	13	7	3				1		1
JOGGING	2	1		5	9	17	6			
SADSACK	3	5	20	6	1	2		2		1
COCAINE	5	2	1	5	6	11	5	4		1
FLAPPER	29	7		1	1			1		1
TRANS. RADIO	1	2	1	6	16	12	1	1		
IRON LUNG	4	6	9	13	6			2		
JEEPERS CREEPRS	5	9	15	5	2			2	1	1

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
CHARLESTON	28	8	2							2
CREDIT CARD	2	2	4	14	11	6		1		
CAR	21	4	1					11		3
DRIVEIN MOVIE	2	8	13	15	2					
MICROCHIP	1		4		16	15	2	2		
ROSIE THE RIVETER		2	2	31	2		2	1		
HEALTH CLUB	1	2	2	5	12	12	5	1		
ICE BOX	33	6						1		
HOTROD	5	7	9	10	5	2		1		1
COLOR TV	1	2	8	10	6	1	1	1		
PICTURE	11	5			1	1		21		1
PAC-MAN				1	4	14	16	2	2	1
AIR-RAID	2	3	31	2		1		1		
DIGITAL	2	1	2	5	4	14	10	2		
SWING BAND	4	16	14	4			1	1		
VCR	1					6	26	6		1
WOMAN'S LIB.	2	1	1	3	8	16	6	1		2
BEATNIK	2	2	3	10	16	4	1	1		1
SAFETY BELT			3	4	3	23	7			
HAND	12	3			1		1	22		1
TROLLEY CAR	30	7	1							2
DRUG ABUSE	1	1	4	7	8	12	5	2		
XEROX			4	10	13	10	2	1		
LEISURE SUIT		1	3	5	16	13		1		1
WINDOW	12	3			1			23		1

WORDS	1920	1930	1940	1950	1960	1970	1980	ND	DK	NR
SHOPPING MALL			4	12	12	12				
HIPPIE		1	2	8	22	5		1		1
TREE	12	2	1			1		23		1
LSD			2	4	15	13	2		2	2
POLAROID CAM.			4	6	19	11				
BOBBY SOCKS	4	10	14	8	2	1				1
USO DANCE	1	2	34	2						1
STREAKER		1	4	6	11	10	1	4	1	2
MINISKIRT		2	1	7	19	7	2			2
BELL	13	4		1		1		20		1
PET ROCK	1		1	2	7	19	3	2		5
ASSASSINATION	5	6	1	1	18	2		7		

APPENDIX IV. RESULTS OF STUDY II. Frequency distribution  
when words are grouped by time periods.  
1920 - 1930

WORDS	# OF RESPONSES	TOTAL RESPONSES	% TOTAL	SUM OF NO DEC & D.K.	% TOTAL
FOUNTAIN PEN	33	39	84.6	4	10.3
SANITARIUM	20	39	51.3	10	25.6
RUMBLE SEAT	36	40	90.0	0	0.0
BOOK	22	40	55.0	17	42.5
HOOCH	24	40	60.0	10	25.0
HONKY-DORY	21	39	53.8	10	25.6
FLIVVER	29	40	72.5	9	22.5
LUCKY STRIKE	30	39	76.9	2	5.1
DOUGHBOY	28	40	70.0	3	7.5
TIDDLY WINKS	23	40	57.5	10	25.0
STUDEBAKER	30	40	75.0	2	5.0
SPEAKEASY	36	39	92.3	1	2.6
23 SKIDOO	29	38	76.3	5	13.2
BOOTLEGGER	35	38	92.1	1	2.6
LINDY	29	37	78.4	4	10.8
RUNNING BOARD	33	38	86.8	1	2.6
SODA JERK	28	39	71.8	1	2.6
FLAPPER	36	39	92.3	1	2.6
CHARLESTON	36	38	94.7	0	0.0
CAR	25	37	67.6	11	29.7
ICE BOX	39	40	97.5	1	2.5
TROLLEY CAR	37	40	92.5	2	5.0

## 1930 - 1940

WORDS	# OF RESPONSES	TOTAL RESPONSES	% TOTAL	SUM OF NO DEC & D.K.	% TOTAL
NYLON STOCKING	32	40	80.0	0	0.0
SOCIAL SECURITY	34	40	85.0	0	0.0
CONGA	25	39	64.1	6	15.4
CROONER	25	40	62.5	2	5.0
ZOOT SUIT	27	38	71.1	0	0.0
POLIO	22	40	55.0	4	10.0
JITTERBUG	25	39	64.1	1	2.6
KILROY	27	39	69.2	4	10.2
SAD SACK	25	39	64.1	2	5.1
JEEPERS CREEPERS	24	39	61.5	3	7.7
ROSIE RIVETER	33	40	82.5	1	2.5
AIR RAID	34	40	85.0	1	2.5
SWING BAND	30	39	76.9	0	0.0
BOBBY SOCKS	24	39	61.5	0	0.0
USO DANCE	36	39	92.3	0	0.0

## 1940 - 1950

WORDS	# OF RESPONSES	TOTAL RESPONSES	% TOTAL	SUM OF NO DEC & D.K.	% TOTAL
STEAM IRON	22	39	56.4	1	2.6
FROZEN FOOD	24	40	60.0	0	0.0
HI-FI	23	40	57.5	0	0.0
BALL-POINT PEN	30	39	76.9	1	2.6
VA MORTGAGE	31	39	79.5	1	2.6
AUTO. TRANSM.	24	39	61.5	0	0.0
GI BILL	33	40	82.5	0	0.0
SAD SACK	26	39	66.7	2	5.1
IRON LUNG	22	40	55.0	2	5.0
DRIVEIN MOVIE	28	40	70.0	4	0.0
NUCLEAR POWER	20	40	50.0	0	0.0

1950 - 1960

WORDS	# OF RESPONSES	TOTAL RESPONSES	% TOTAL	SUM OF NO DEC & D.K.	% TOTAL
BARBIE DOLL	32	40	80.0	1	2.5
HULA HOOP	28	39	71.8	0	0.0
PIZZA	21	39	53.8	4	10.3
LATEX PAINT	26	40	65.0	3	10.3
NEHRU JACKET	22	38	57.9	5	13.2
ENRICHED BREAD	22	39	56.4	1	2.6
CREDIT CARD	25	40	62.5	1	2.5
BEATNIK	26	39	66.7	1	2.6
XEROX	23	40	57.5	1	2.5
SHOPPING MALL	24	40	60.0	0	0.0
HIPPIE	30	39	76.9	1	2.6
MINISKIRT	26	38	68.4	0	0.0

1960 - 1970

WORDS	# OF RESPONSES	TOTAL RESPONSES	% TOTAL	SUM OF NO DEC & D.K.	% TOTAL
SMOKE DETECTOR	26	40	65.0	0	0.0
PACEMAKER	25	40	62.5	1	2.5
ASTRO-TURF	31	38	81.6	2	5.3
FRISBEE	26	40	65.0	0	0.0
PSYCHEDELIC	25	40	62.5	6	15.0
ASTRONAUT	24	40	60.0	0	0.0
BAGGIES	20	39	51.3	6	15.4
SUPERBOWL	24	40	60.0	3	7.5
BIRTH CONTROL P.	31	40	77.5	0	0.0
TEFLON	29	38	76.3	0	0.0
JOGGING	26	40	65.0	0	0.0
TRANSISTOR RAD	28	40	70.0	1	2.5
HEALTH CLUB	24	40	60.0	1	2.5
WOMAN'S LIB.	24	38	63.2	1	2.6
SAFETY BELT	26	40	65.0	0	0.0
LEISURE SUIT	29	39	74.4	1	2.6
LSD	28	38	73.7	2	5.3
POLAROID CAMERA	30	40	75.0	0	0.0
STREAKER	21	38	55.3	5	13.2
PET ROCK	26	40	65.0	7	17.5
ASSASSINATION	20	40	50.0	7	17.5

1970 - 1980

WORDS	# OF RESPONSES	TOTAL RESPONSES	% TOTAL	SUM OF NO DEC & D.K.	% TOTAL
STAR WARS	34	40	85.0	0	0.0
AIDS	40	40	100	0	0.0
TEST TUBE BABY	31	40	77.5	0	0.0
MICROWAVE OVEN	33	40	82.5	0	0.0
PACEMAKER	24	40	60.0	1	2.5
CD PLAYER	28	40	70.0	1	2.5
BREAK DANCING	34	40	85.0	1	2.5
CRACK	31	39	79.5	2	5.2
YUPPIE	35	38	92.1	2	5.3
TOFU	27	40	67.5	12	30.0
SINGLE'S BAR	30	38	78.9	1	2.6
MICROCHIP	21	40	52.5	4	10.0
PAC-MAN	30	39	76.9	4	10.3
DIGITAL	24	40	60.0	2	5.0
VCR	32	39	86.1	6	15.4
SAFETY BELT	30	40	75.0	0	0.0

## Appendix V. Directions for Remote Autobiographical Memory Test

**DIRECTIONS:** People often sit around and reminisce about events from different times in their lives. One of the things we are interested in is how we remember things that happened at different times in our lives. Today, I am going to ask you to think back and tell me different memories you have. This is how we are going to do it.

First, I am going to say a word and I want you to think of an experience or event in your life which the word reminds you of. There are two rules I would like you to keep in mind. First, the experience should be one that you were directly involved in rather than something which a friend or relative had experienced. Second, try to be as specific as possible in reporting the event. Your memories can be from any time in your life and can be significant or not so important. It doesn't matter as long as it was something that you were directly involved in and in which the word plays a role. There are no right or wrong answers. Any questions?

Okay, let me give you an example. The other day I asked a woman to recall an event in her life that came to mind after I said 'flower'. She told me about the first time she ever received flowers. She was 16 years old and it was Valentine's Day. When she came home from school she was surprised to find a dozen red roses from her boyfriend. Now, what experience do you remember when I say the word 'flower'?

Very good. Let's try another word. What event in your life comes to mind when I say doctor?

If subject gives an incorrect response such as a definition or a general statement, remind him/her that they are to think of a specific event in their own life that the word reminds them of.

Other sample words:

3. DOG
4. BIRTHDAY
5. OCEAN

## APPENDIX VI. NUMBER OF MEMORIES BY PROBE CONDITION

CONTROLS			PATIENTS		
<u>SUBJ.</u>	<u>NO PROBE</u>	<u>PROBE</u>	<u>SUBJ.</u>	<u>NO PROBE</u>	<u>PROBE</u>
N1	29	31	A1	16	28
N2	24	33	A2	12	18
N3	31	34	A3	15	20
N4	34	34	A4	14	20
N5	25	30	A5	12	21
N6	29	32	A6	7	14
N7	31	31	A7	17	23
N8	28	32	A8	20	25
N9	30	30	A9	16	24
N10	23	29	A10	29	34
N11	23	31			

Appendix VII. Distribution of Content Rating Scores (no probe)  
for each word for CONTROL SUBJECTS (N=11).

WORDS	# of RATINGS	RATING SCORE (% OF TOTAL)				
		0	1	2	3	4
FOUNTAIN PEN	22	18.2	18.2	13.6	22.7	27.3
LUCKY STRIKE	22	18.2	13.6	18.2	45.5	4.5
STUDEBAKER	22	36.4	9.1	22.7	13.6	18.2
SODA JERK	20	10.0	10.0	30.0	20.0	30.0
DOUGHBOY	22	50.0	22.7	22.7	4.5	—
RUNNING BOARD	12	50.0	—	50.0	—	—
ROSIE RIVETER	20	20.0	40.0	30.0	10.0	—
NYLON STOCKING	20	20.0	15.0	35.0	25.0	5.0
SWING BAND	22	18.2	4.5	27.3	13.6	36.4
ZOOT SUIT	22	22.7	13.6	36.4	22.7	4.5
KILROY	22	4.5	18.2	59.1	9.1	9.1
JITTERBUG	10	20.0	20.0	40.0	—	20.0
GI BILL	20	20.0	—	20.0	30.0	30.0
VA MORTGAGE	22	37.3	9.1	9.1	22.7	31.8
BALLPOINT PEN	20	10.0	15.0	10.0	10.0	55.0
DRIVEIN MOVIE	22	63.6	—	13.6	9.1	13.6
SADSACK	22	54.5	31.8	13.6	—	—
AUTO TRANS.	10	80.0	—	—	—	20.0
BARBIE DOLL	20	30.0	10.0	20.0	40.0	40.0
HIPPIE	22	18.2	—	22.7	27.3	31.8
HULA HOOP	22	18.2	22.7	45.5	13.6	—
MINISKIRT	18	16.7	27.8	16.7	22.2	16.7
BEATNIK	22	100.0	—	—	—	—
LATEX PAINT	10	20.0	—	40.0	30.0	10.0
TEFLON	22	22.7	27.3	50.0	—	—
POLAROID CAM.	22	18.2	9.1	13.6	13.6	45.5
LEISURE SUIT	20	60.0	—	—	5.0	35.0
TRANSISTOR RAD	22	27.3	9.1	22.7	31.8	9.1
SMOKE DET.	22	9.1	—	13.6	36.4	40.9
WOMEN'S LIB.	15	33.3	20.0	40.0	6.7	—
BREAK DANCING	22	45.5	4.5	18.2	4.5	27.3
MICROWAVE OVEN	22	—	9.1	18.2	27.3	45.5
SINGLE'S BAR	16	68.8	6.3	25.0	—	—
SAFETY BELT	22	—	13.6	13.6	31.8	40.9
PACEMAKER	22	36.4	9.1	22.7	18.2	13.6
DIGITAL	8	25.0	—	—	—	75.0
TREE	22	—	4.5	27.3	27.3	40.9
WINDOW	22	—	—	9.1	45.5	45.5
PICTURE	22	—	—	18.2	22.7	59.1
RIVER	20	—	10.0	10.0	45.0	35.0
LETTER	22	—	—	18.2	45.5	36.4
BELL	2	—	—	—	—	—

Appendix VIII. Distribution of Content Rating Scores (with probe)  
for each word for CONTROL SUBJECTS (N=11).

WORDS	# OF RATINGS	RATING SCORE (% OF TOTAL)				
		0	1	2	3	4
FOUNTAIN PEN	22	—	22.7	27.3	22.7	27.3
LUCKY STRIKE	22	18.2	13.6	18.2	45.5	4.5
STUDEBAKER	22	31.8	13.6	22.7	13.6	18.2
SODA JERK	20	—	5.0	35.0	30.0	30.0
DOUGHBOY	22	50.0	22.7	22.7	4.5	—
RUNNING BOARD	12	50.0	—	50.0	—	—
ROSIE RIVETER	20	25.0	35.0	30.0	10.0	—
NYLON STOCKING	20	10.0	25.0	35.0	25.0	5.0
SWING BAND	22	9.1	9.1	18.2	27.3	36.4
ZOOT SUIT	22	18.2	18.2	36.4	22.7	4.5
KILROY	22	—	22.7	59.1	9.1	9.1
JITTERBUG	10	—	40.0	40.0	—	20.0
GI BILL	20	10.0	5.0	25.0	30.0	30.0
VA MORTGAGE	22	22.7	13.6	9.1	22.7	31.8
BALLPOINT PEN	20	20.0	15.0	10.0	10.0	55.0
DRIVEIN MOVIE	22	13.6	18.2	40.9	13.6	13.6
SADSACK	22	50.0	36.4	13.6	—	—
AUTO TRANS.	10	40.0	20.0	20.0	—	10.0
BARBIE DOLL	20	—	15.0	25.0	20.0	40.0
HIPPIE	22	18.2	—	22.7	27.3	31.8
HULA HOOP	22	9.1	27.3	50.0	13.6	—
MINISKIRT	18	5.6	38.9	16.7	22.2	16.7
BEATNIK	22	90.9	9.1	—	—	—
LATEX PAINT	10	20.0	—	40.0	30.0	10.0
TEFLON	22	4.5	50.0	45.5	—	—
POLAROID CAM.	22	—	13.6	27.3	13.6	45.5
LEISURE SUIT	18	22.2	16.7	11.1	11.1	38.9
TRANSISTOR RAD	22	18.2	—	22.7	50.0	9.1
SMOKE DET.	22	—	—	22.7	36.4	40.9
WOMEN'S LIB.	14	28.6	21.4	42.9	7.1	—
BREAK DANCING	22	18.2	18.2	27.3	9.1	27.3
MICROWAVE OVEN	22	—	9.1	18.2	27.3	45.5
SINGLE'S BAR	16	56.3	18.8	25.0	—	—
SAFETY BELT	22	—	13.6	13.6	31.8	40.9
PACEMAKER	22	36.4	9.1	22.7	18.2	13.6
DIGITAL	8	—	25.0	—	—	75.0
TREE	22	—	4.5	27.3	27.3	40.9
WINDOW	22	—	—	9.1	45.5	45.5
PICTURE	22	—	—	18.2	22.7	59.1
RIVER	20	—	10.0	10.0	45.0	35.0
LETTER	22	—	—	18.2	45.5	36.4
BELL	2	—	—	—	—	—

Appendix IX. Distribution of Content Rating Scores (no probe)  
for each word for Group AD (N=10).

WORDS	# OF RATINGS	(RATING SCORE (% OF TOTAL))				
		0	1	2	3	4
FOUNTAIN PEN	20	45.0	25.0	—	15.0	15.0
LUCKY STRIKE	20	65.0	30.0	5.0	—	—
STUDEBAKER	20	50.0	10.0	10.0	15.0	15.0
SODA JERK	20	70.0	5.0	15.0	10.0	—
DOUGHBOY	16	75.0	12.5	12.5	—	—
RUNNING BOARD	8	50.0	50.0	—	—	—
ROSIE RIVETER	10	80.0	20.0	—	—	—
NYLON STOCKING	18	16.7	22.2	38.9	5.6	16.7
SWING BAND	20	60.0	10.0	20.0	5.0	5.0
ZOOT SUIT	18	94.4	5.6	—	—	—
KILROY	18	55.6	44.4	—	—	—
JITTERBUG	7	100.0	—	—	—	—
GI BILL	14	71.4	14.3	14.3	—	—
VA MORTGAGE	20	70.0	5.0	20.0	5.0	—
BALLPOINT PEN	20	30.0	60.0	—	10.0	—
DRIVEIN MOVIE	17	35.3	35.3	17.6	11.8	—
SADSACK	16	62.5	31.3	6.3	—	—
AUTO TRANS.	8	50.0	50.0	—	—	—
BARBIE DOLL	17	35.3	41.2	11.8	11.8	—
HIPPIE	20	70.0	20.0	5.0	5.0	—
HULA HOOP	16	50.0	18.8	12.5	18.8	—
MINISKIRT	16	50.0	31.3	18.8	—	—
BEATNIK	16	75.0	25.0	—	—	—
LATEX PAINT	8	100.0	—	—	—	—
TEFLON	16	50.0	12.5	18.8	18.8	—
POLAROID CAM.	16	62.5	—	25.0	12.5	—
LEISURE SUIT	10	100.0	—	—	—	—
TRANSISTOR RAD	18	72.2	5.6	11.1	11.1	—
SMOKE DET.	18	44.4	27.8	22.2	5.6	—
WOMEN'S LIB.	10	60.0	10.0	20.0	10.0	—
BREAK DANCING	8	75.0	—	12.5	12.5	—
MICROWAVE OVEN	20	60.0	10.0	15.0	15.0	—
SINGLE'S BAR	16	87.5	—	12.5	—	—
SAFETY BELT	18	33.3	44.4	16.7	5.6	—
PACEMAKER	20	60.0	20.0	10.0	—	10.0
DIGITAL	10	80.0	20.0	—	—	—
TREE	20	20.0	10.0	25.0	40.0	5.0
WINDOW	20	30.0	10.0	30.0	20.0	10.0
PICTURE	20	0.0	10.0	35.0	40.0	15.0
RIVER	18	11.1	5.6	38.9	33.3	11.1
LETTER	20	30.0	5.0	15.0	30.0	20.0
BELL	4	50.0	25.0	25.0	—	—

Appendix X. Distribution of Content Rating Scores (with probe)  
for each word for Group AD (N=10).

WORDS	# OF RATINGS	RATING SCORE (% OF TOTAL)				
		0	1	2	3	4
FOUNTAIN PEN	20	15.0	30.0	15.0	25.0	15.0
LUCKY STRIKE	18	44.4	44.4	11.1	—	—
STUDEBAKER	20	20.0	15.0	25.0	25.0	15.0
SODA JERK	20	10.0	20.0	40.0	30.0	—
DOUGHBOY	18	66.7	11.1	22.2	—	—
RUNNING BOARD	8	25.0	50.0	25.0	—	—
ROSIE RIVETER	14	57.1	28.6	14.3	—	—
NYLON STOCKING	18	11.1	22.2	44.4	5.6	16.7
SWING BAND	20	20.0	15.0	50.0	10.0	5.0
ZOOT SUIT	18	55.6	44.4	—	—	—
KILROY	18	44.4	55.6	—	—	—
JITTERBUG	7	66.7	33.3	—	—	—
GI BILL	18	66.7	16.7	16.7	—	—
VA MORTGAGE	20	60.0	15.0	20.0	5.0	—
BALLPOINT PEN	20	10.0	60.0	30.0	—	—
DRIVEIN MOVIE	17	23.5	47.1	17.6	11.8	—
SADSACK	16	50.0	37.5	12.5	—	—
AUTO TRANS.	8	25.0	25.0	50.0	—	—
BARBIE DOLL	17	35.3	41.2	11.8	11.8	—
HIPPIE	20	40.0	50.0	5.0	5.0	—
HULA HOOP	20	30.0	30.0	25.0	15.0	—
MINISKIRT	18	50.0	33.3	16.7	—	—
BEATNIK	16	62.5	37.5	—	—	—
LATEX PAINT	8	100.0	—	—	—	—
TEFLON	16	37.5	25.0	18.8	18.8	—
POLAROID CAM.	16	37.5	6.3	37.5	18.8	—
LEISURE SUIT	13	100.0	—	—	—	—
TRANSISTOR RAD	20	60.0	15.0	15.0	10.0	—
SMOKE DET.	18	44.4	27.8	22.2	5.6	—
WOMEN'S LIB.	10	60.0	10.0	20.0	10.0	—
BREAK DANCING	15	33.3	53.3	6.7	6.7	—
MICROWAVE OVEN	20	45.0	5.0	25.0	25.0	—
SINGLE'S BAR	17	88.2	—	11.8	—	—
SAFETY BELT	20	15.0	55.0	20.0	10.0	—
PACEMAKER	20	52.6	21.1	15.8	10.0	10.0
DIGITAL	10	60.0	20.0	10.0	10.0	—
TREE	20	10.0	10.0	25.0	50.0	5.0
WINDOW	20	—	25.0	35.0	30.0	10.0
PICTURE	20	—	10.0	35.0	40.0	15.0
RIVER	18	10.0	10.0	40.0	30.0	10.0
LETTER	20	15.0	5.0	15.0	50.0	15.0
BELL	4	50.0	25.0	25.0	—	—

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