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ENCODING DEFICITS IN PERSONS WITH SENILE DEMENTIA OF THE ALZHEIMER TYPE

By

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ABSTRACT

ENCODING DEFICITS IN PERSONS WITH SENILE DEMENTIA OF THE ALZHEIMER TYPE

By

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Research on the nature of memory deficits in patients with Senile Dementia of the Alzheimer Type (SDAT) is limited. Studies suggest that memory impairment in these patients increases as the disease progresses and as the memory task changes. It is unclear whether the patterns of memory loss are uniform in all persons with SDAT and at all stages of the disease. The present study attempts to address some of these issues by isolating one aspect of memory processing -- encoding.

The purpose of this study is to examine the effects of different levels of encoding on recognition memory in mild and moderate SDAT patients. Eighteen SDAT patients were paired with twelve normal controls, matched for sex and age. SDAT patients were equally divided into two groups based on their Mini-Mental Status Examination (MMSE) scores. Subjects with a score of $\geq$ 20 were categorized as mildly cognitively impaired, and subjects with a score < 20 were categorized as moderately cognitively impaired. All subjects were diagnosed medically by a geriatric assessment team as "probable SDAT". Stimuli for the experiment consisted of 30 pictures of household objects presented in

the learning phase and an additional 30 pictures of non-household objects mixed in with the original 30 items presented in the test phase. A pre-task screening was used to focus the subject to the task to be presented.

The learning phase of the task involved processing information at one of three different levels of encoding. An equal number of subjects from the two SDAT groups and the normal group were selected to participate in each of the three levels of encoding. All subjects were given the same yes/no recognition task during the test phase. Data collected were analyzed using parametric and nonparametric statistical procedures.

Analysis of the data indicated that SDAT subjects did not benefit from semantic processing even with elaboration. Normal subjects performed better than SDAT subjects on all tasks, but the error patterns of the two groups were qualitatively similar across tasks. Finally, discriminability scores suggested that problems in encoding did not contribute significantly to SDAT memory deficits.

DEDICATION

To my parents: The last Kadasami Sadasivan
and Kamala Sadasivan

All the aim of learning is to achieve consciously what to youth is given freely

....Turgenev in Rudin

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CHAPTER I

INTRODUCTION

Senile Dementia of the Alzheimer Type (SDAT) is now recognized as a serious public health problem in the United States. Both presenile (occurring before age 65) and senile (occurring after age 65) forms of the disease make up about 50 to 60 percent of all dementias. This degenerative cortical dementia affects between 1.2 and 4 million Americans (U.S. Office of Technology, 1985; Doyle, 1987) and is the fourth leading cause of death in the United States accounting for over 100,000 deaths annually (Katzman, 1976).

Dementia is the most common nursing home diagnosis given to approximately two thirds of all nursing home residents. It is estimated that the U.S government spends over 6 billion dollars annually in nursing home costs on SDAT patients alone. This represents 30 percent of the total Federal Health Care budget (Terry and Katzman, 1983; Bayles & Kaszniak, 1987).

Although SDAT is not an inevitable consequence of normal aging, the incidence (frequency of occurrence of new cases) of SDAT is strongly age-related (i.e., the risk of developing this disorder increases as one grows older).

Given the steadily rising proportion of elderly individuals in the United States, it is predicted that by the year 2000 there will be 32 million people over age 65 years or 12% of the nation's population and anywhere from 12 million to 18 million people over age 75 years (Fredrickson, 1981). The estimated incidence of SDAT is approximately 1 percent of the elderly population per year (Mortimer, 1983). We are therefore talking about a very substantial number of people and about the emotional, social and economic realities of caring for this population of older adults. Aronson (1982) reported that some degree of cognitive impairment was evident in approximately 15% of the population over age 65. The cognitive decline in SDAT is an insidious global deterioration of abilities characterized by memory loss (amnesia), learned motor skill dysfunction (apraxia), perceptual deficits (agnosia) and language problems (aphasia). SDAT can be distinguished from other syndromes characterized by cognitive deficits, such as mental retardation in which cognitive impairment is life long, aphasia and amnesia in which language and recent memory are specifically and disproportionately affected, and delirium in which cognitive impairment occurs in the setting of clouded consciousness (Folstein and Whitehouse, 1983; Miller, 1981; Folstein and Breitner, 1981; Folstein et al., 1985).

SDAT is a slow disease process that can last from three to 15 years and shorten the patient's remaining life expectancy by half. One challenge for health care professionals is to identify specific cognitive impairments and monitor cognitive skills that remain intact at various stages of the disease process. It is expected that such information will facilitate effective intervention to arrest and cope with the cognitive impairments of the disease.

Importance of the Study

Speech-language pathologists assess and treat a greater variety of communication problems today than ever before (ASHA, June 1987). One neglected, emerging population that could benefit from an understanding of the management of cognitively based communication deficits is Senile Dementia of the Alzheimer Type (SDAT). In order to serve this population effectively, it is important to understand what underlies the communication breakdown in SDAT.

The relationship between cognition and language serves as the basis for normal effective communication. Neisser (1967) defined cognition as "the processes by which sensory input is transformed, reduced, elaborated, stored, recovered, and used" (pg. 4). One primary process of cognition is memory. Tulving (1983) stressed the interaction between memory and other cognitive processes; and this has particular implications for the study of SDAT, which is characterized by widespread deficits in cognitive functioning. Furthermore, memory loss is the most common and dramatic symptom of SDAT. Researchers have emphasized that a critical determinant of how information is remembered is the manner in which it is processed, suggesting that in SDAT there will be an interaction between impairments in memory and other cognitive processes (Baddeley, 1976; Tulving, 1983). This fact alone would suggest that memory might be a good starting base to understand the global communication deficit in SDAT.

Research on the nature of the memory deficit in these patients is limited. Debate on an encoding deficit versus a retrieval deficit to explain the memory loss in SDAT continues. "Memory deficit" is a relative term used in comparison to normal memory performance; however, normative information on normal memory function in the elderly is limited. The literature suggests the memory impairment of SDAT patients increases as the disease worsens and as the memory task changes. It is unclear whether these patterns of memory loss are uniform in all persons with SDAT and at all stages of the disease. Research is needed to explain the memory deficit in SDAT so that further studies might explore the benefits of treatment with this population. Based on the research literature on processing deficits, there is evidence to suggest that poor initial encoding may contribute to impaired recall (Becker et al., 1987; Martin et al., 1985) and recognition (Wilson et al., 1982; Martin et al., 1985) in SDAT patients. The present study attempts to address some of these issues by isolating one aspect of memory processing -- encoding. Encoding processes are defined as interpretations of the stimulus pattern in terms of qualitatively different types of past experiences. Thus, an event can be analyzed in terms of its sensory qualities or, in addition, in terms of its meaning.

Purpose of the Study

There is a paucity of literature on encoding and recognition memory. This is particularly true of studies utilizing a hierarchy of processing levels design from "shallow" with little information to "deep" with multiple information.

Jacoby and Dallas (1981) distinguished "perceptual" memory from "autobiographical" memory. Perceptual memory is sensitive only to the physical (shallow) properties of stimuli and does not appear to be dependent on conscious processing of semantic information during the process of learning for later identification. Autobiographical memory involves encoding of the "meaningfulness," or semantic characteristics, of stimuli. This form of memory involves the conscious processing of information and the context in which the information is presented and, if intact, produces recall superior to that produced by non-semantic methods of encoding information.

The importance of elaboration of encoding at the semantic level was demonstrated by Klein and Saltz (1976). They used various semantic tasks, all of which required the subject to rate nouns in terms of semantic attribute dimensions, such as, pleasant-unpleasant. Recall was better for words rated on two dimensions than for words rated on a single dimension. A different but related interpretation of the superiority of "depth" of encoding, where semantic-elaboration is superior to semantic which is superior to physical processing, was offered by Lockhart et al. (1976). They proposed the following hypothesis: "Both recall and recognition are superior when 'deeper', 'richer', 'more semantic' traces are formed at input..." (p.86). Therefore, the deeper, richer encodings have a beneficial effect on depth of encoding because they are more distinctive and unique.

Based on this information and the research findings of the literature review, it is expected that SDAT subjects would show a decrease in deficits as the hierarchy of task dimensions change from "shallow" to "deep" to "deep-elaborate."

Researchers have indicated significant relationships between various cognitive measures and behavioral functioning (Vitaliano et al., 1984; Winogrond & Fisk, 1983). Therefore, it is expect that age-matched control subjects would perform better than SDAT subjects on all tasks. In addition, we would expect SDAT subjects to perform worse on the tasks the more advanced their dementia.

Finally, rate-of-forgetting studies using verbal and non-verbal material (Kopelman, 1985; Corkin et al., 1984; Becker et al., 1987) suggest that SDAT subjects exhibit similar rates of forgetting as normal subjects. Thus, it is expected that the difference in performance of SDAT subjects and normal subjects is quantitative and not qualitative across tasks.

The purpose of the present study was to investigate the patterns of memory loss in patients with SDAT from the perspective of information processing. In addition, this study explored the effects of different levels of initial encoding on memory performance. To address these issues, the following hypotheses were formulated:

1. Subjects with SDAT show more deficits on tasks involving non-semantic (physical) methods of encoding than on tasks encoding semantic characteristics of the stimuli.

2. Subjects with SDAT perform better on tasks encoded on semantic elaboration than on tasks encoded on semantic or physical processing.

3. Normal subjects perform better than SDAT subjects on all tasks.

4. The performance of SDAT subjects worsens the more advanced their disease.

5. The difference in performance of SDAT subjects and normals is quantitative and not qualitative in nature across tasks.

Organization of the Study

Chapter I has introduced the study with a brief discussion of the importance and purpose of the research.

Chapter II provides a review of a wide range of research literature focused on memory processing. A general discussion of information processing models including the "level of processing" framework used in the present study is presented. Information on processing deficits in normal aging individuals, the neuropathological and related cognitive changes in patients with SDAT, and the processing deficits in patient with SDAT are also reviewed.

Chapter III presents information on subject selection, screening tests, experimental procedures, and experimental design.

Chapter IV displays the statistical results and relates this information to the questions posed in Chapter I. A discussion of the results is also presented.

Chapter V briefly summarizes the study with conclusions derived from the results and recommendations for future research.

CHAPTER II

REVIEW OF LITERATURE

This review of the nature of the encoding deficit in patients with SDAT explores a wide range of research literature focused on memory processing. The first section provides a general discussion of information processing models including the "level of processing" framework used in this study. The second section looks at the processing deficits in normal aging individuals, followed by a section on the neuropathological and related cognitive changes in patients with SDAT. The final section concludes the review by focusing on processing deficits in patients with SDAT.

Information Processing Models of Memory

The human memory system is extremely complex. Contained in the small volume of the human brain, memory is powerful enough to capture the image of a face in a single encounter, ample enough to store the experiences of a lifetime and so versatile that the memory of a scene can summon associated recollections of sights, sounds, smells, tastes, tactile sensations and emotions (Mishkin, and Appenzeller, 1987).

Until fairly recently, a "linear" model of information processing dominated memory research. This model assumed that information flowed from input to output through a series of sequential stages, or memory "stores" (i.e., sensory store, short-term store, long-term store) containing memory traces whose information content varied as a function of the store they occupied. A review by Murdock (1967) showed that research utilizing this model focused on capacity of store, rate and mechanism of forgetting, and coding characteristics of the traces within the various stores; and some research focused on the processes utilized to transfer information from one store to another. Although this model was attractive in many respects, it had a basic limitation. That is, evidence from Craik and Lockhart (1972) suggested that the characteristics of the hypothesized stores varied considerably with changes in tasks, materials, and strategies; and it seemed implausible that stores varied with context. This model of information processing is schematically represented in Figure 1.

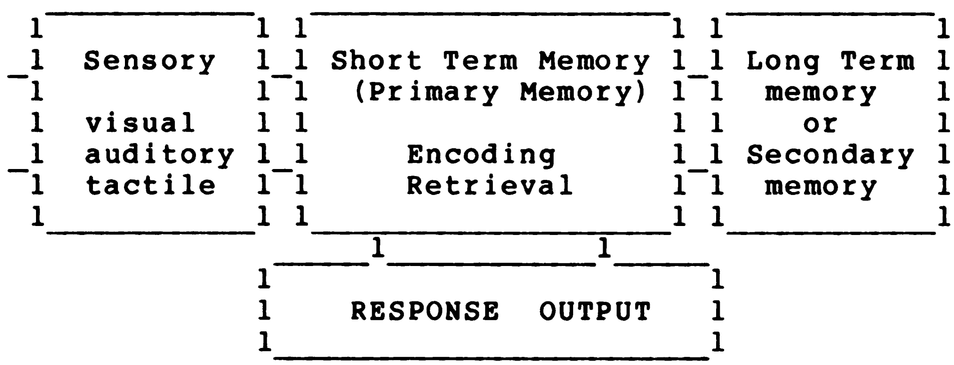


Figure 1. Information processing through the memory system. (Modified from Atkinson, R. and Shiffrin, R., 1971)

More recently, research has shifted to a more process-oriented information-processing model such as the "levels of processing" view. This viewpoint proposed by Criak and Lockhart (1972) embodies the idea that the subject's activity at the time of stimulus input determines how well an item is encoded and, therefore, remembered. Thus, "semantic" processing of a stimulus should promote better recall than mere attention to its surface details ("sensory" or "physical").

Similarly, the notion of elaboration or "spread" of encoding (Craik and Tulving, 1975) provides a better description of the stimulus item (i.e., greater degree of semantic involvement) and therefore should support higher retention in the subsequent test. This concept of hierarchy of processing stages on a continuum from "sensory" or "physical" to "semantic" and "semantic elaboration" was referred to by Craik and Lockhart as "depth of processing" in which greater "depth" implied a greater degree of semantic or cognitive analysis.

Baddeley (1978) criticized this "depth of processing" position on various grounds, including the circularity of the notion of "depth," the lack of an independent measure of depth, the suggestion of a fixed series of analyzers, and the fact that retrieval processes were left unspecified. This framework is represented schematically in Figure 2.

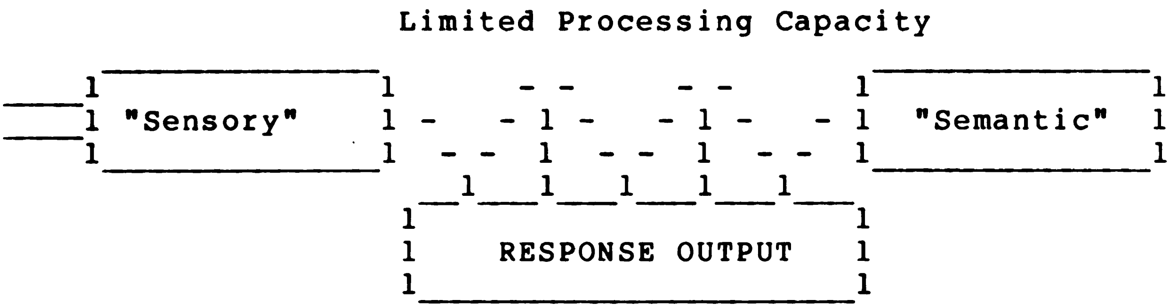


Figure 2. Levels of Processing (Adapted from Wingfield (1987) Memory and Aging Conference)

In a more "general processing" view, which stems partly from the levels of processing position, Criak (1979, 1981) proposed that memory can be understood in terms of encoding processes, retrieval processes, and their interactions.

Criak (1984) comprehensively described the process of encoding as interpretations of the stimulus pattern in terms of qualitatively different types of past experience (or in terms of innate analyzing procedures, in the case of basic pattern-recognition operations). Thus, an event can be analyzed in terms of its sensory qualities or (in addition) in terms of its meaning and significance in various different dimensions (Craik, 1984).

Retrieval processes, within this view, are seen as being similar to encoding processes. It can be thought of as a process by which the cognitive system returns to the same configuration or state it was in at the time the event was originally encoded. In the performance of some types of tasks, such as those involving recognition memory paradigms, stimulus conditions at the time of retrieval are very similar to those at the time of encoding. Within a typical recognition memory paradigm, a series of words or other stimuli are presented for memorization. Either immediately afterwards or at a later time, a recognition list is presented containing the original stimuli ("targets") mixed among new stimuli ("distracters"). The subject's task is to indicate those stimuli that were originally presented for memorization. The similarity between the material within the recognition targets and the originally presented material is so high that the recognition stimuli can be thought to "drive" the system back into the original configuration (Bayles and Kaszniak, 1987). This memory process from input to output can be represented schematically in Figure 3.

```
    INPUT      Question to   PROCESSING      OUTPUT
               manipulate    ENCODING      (RETRIEVAL)
               encoding      LEVEL
   _________                 _________    _____________
 l         l---physical ---l shallow l    l             l
 l picture l---semantic ---l    l    l \  l picture/word l
 l  word   l---semantic ---l   deep  l    l recognition  l
 l_________l   expansion   l____l____l /  l_____________l
```

Figure 3. Schematic Illustration showing the Process of Encoding from Input to Output.

It is evident from this discussion that the general "level of processing" framework provides a systematic understanding of the function of encoding as a process of memory. A recognition task serves as an ideal retrieval mode to drive the system back to its encoding condition in order to isolate the effects of encoding on memory. The present study is based on this framework of memory processing.

Processing Deficits in Normal Aging

The cause of memory impairment in SDAT patients may involve a disturbance in the processing of information. The extent to which processing deficits are understood in the normally functioning older adult sets the limit to understanding the same processes as they operate in the older adult with SDAT. The process of memory is thought to involve encoding, storage, and retrieval of information. Several hypotheses have been formulated to explain the deficits in these processes, and some researchers have attempted to isolate the locus of age-related deficits to one or a combination of these processes.

Encoding-Deficit Hypothesis

This hypothesis concentrates on the initial encoding operations that are performed on a stimulus item; and memory is viewed as a sort of by-product of the extent, or depth, to which that item is analyzed.

In a study by Thomas and Ruben (1973) young, middle-aged and elderly adults were tested on retrieval of 12 paired-associates at one hour and at 4, 8, 12 and 16 months after asymptotic learning was demonstrated. The paired associates were learned under one of three conditions: 1) standard no-instruction condition, 2) interacting imagery condition, or 3) cartoon mnemonics condition with bizarre interactions relating stimulus and response items. They found that older subjects performed at a lower level than young subjects in the standard no-instruction condition. When organizational aids such as visual imagery or cartoon mnemonics were provided at acquisition, no age difference in retrieval was observed for up to 16 months. These results are typical of studies examining the encoding-deficit hypothesis.

Smith (1980) used information-processing procedures to study three types of encoding deficits: a) verbal elaboration, the degree to which each item is distinctly coded; b) visual elaboration, the degree to which imagery is used in encoding; and c) organization, the degree to which stimulus items are related to each other during acquisition. To investigate the possibility of a deficit in verbal elaboration in older adults, Eysenck (1974) employed an incidental orienting task in which varying levels of elaboration of words were required. Subjects were required to count letters of words, to generate rhymes, or to generate appropriate adjectives. A control group received no elaborate instructions. In a free-recall test, older subjects who generated adjectives performed worse than those who made up rhymes, who performed worse than those who counted letters. These results suggest that tasks requiring elaborate processing will show larger age differences in later recall.

Studies have demonstrated age deficits in visual elaboration using imagery mnemonics and recall performance (Poon, Walsh-Sweeney, and Fozard, 1980). Imagery has been found to facilitate the recall performance of older adults and thereby reduce the magnitude of deficit as a function of age. Finally, organizational deficits in terms of grouping items at acquisition was investigated by Hultsch (1969). He provided subjects with either general or specific instructions to organize a list of words, whereas a control group received no instructions. The results showed that the decrements observed as a function of age in the no-instruction condition were reduced in the general-instruction condition; the decrements were further reduced in the specific-instruction condition.

Storage-Deficit Hypothesis

The underlying premise of the storage-deficit hypothesis is that prior proactive interference or subsequent retroactive interference learning interferes with the strength of the memory traces and that this interference is more prominent during the retrieval phase for the older adult. However, the research literature does not support this view (Craik, 1977). Older people were not more vulnerable to proactive interference (Craik, 1968; Fozard, and Waugh, 1969) or retroactive interference (Smith, 1974, 1975). This research did not equate the levels of acquisition; therefore, the differences in forgetting could be due to differences in the original level of learning (Kausler, 1970). Later studies equated the original learning levels but continued to find no age differences in forgetting rates (Poon and Fozard, 1980; Forzard, Waugh, and Thomas, 1975).

Retrieval-Deficit Hypothesis

This hypothesis attributes memory difficulties to a failure to access stored information during retrieval. Evidence in support of this retrieval deficit comes from comparison studies of young and elderly adults on recall and recognition performance (Schonfield, 1965; Schonfield and Robertson, 1966; Erber, 1974) and cued and free recall (Hultsch, 1975; Laurence, 1967). The well-replicated findings of small age deficits for recognition, compared to the large deficits found for recall, suggested that information is being stored in memory and retrieval rather than storage is thus the locus of the age deficit. If age effects are due to retrieval differences, then retrieval cues should minimize the age effect. Hultsch (1975) and Laurence (1967) found that when category cues were provided, age effects were greatly reduced.

A major problem with the retrieval hypothesis is that retrieval and encoding processes cannot be isolated. Data that supports a retrieval explanation might also support an encoding hypothesis. For instance, studies by Griffith (1975), Winograd and Smith (1978) have shown that recall and recognition are differentially affected by different encoding strategies. For example, they found that organization of the input stimuli was of benefit on a recall test but not on a recognition test. When the recognition test provided the possible alternatives during retrieval, encoding strategies may not have been as critical. Therefore, one explanation for the large age differences observed in free recall, but not in recognition, might be the inefficient encoding strategies used by older adults.

Smith (1977) provided an encoding explanation for the small differences he found between three age groups on cued recall. He showed that in order for the category cues to be effective, the stimuli had to be organized during acquisition. Category cues provided at acquisition were sufficient to minimize age differences, whereas cues at retrieval alone did not improve performance. Burke and Light (1981) suggested that it is likely that there is a retrieval deficit in older adults; however, retrieval alone cannot account for all the processing deficits observed.

In summary, although the different processing stages of memory appear to be intertwined, the literature cited above suggests that both encoding and retrieval deficits are implicated in older adults, whereas there are minimal age-related deficits in storage.

Neuropathological and Cognitive Changes in Alzheimer's Disease

Senile Dementia of the Alzheimer Type (SDAT) is a pervasive dementing process of progressive neuronal degeneration that may manifest itself as varying degrees of impairment in cognitive function and personality. Although a clinical diagnosis of SDAT can be made on the basis of the type of symptoms and the progression of the symptoms over time, confirmation of the diagnosis requires histopathologic evidence from biopsy of brain tissue.

The neuropathological changes associated with SDAT include the formation of senile plaques, neurofibrillary tangles and granulovacular degeneration in the frontal, parietal and temporal lobes of the cerebral cortex, the hippocampus and the amygdala. In addition, SDAT patients have been found to have abnormal levels of certain neurotransmitters, notably acetylcholine. Cerebral atrophy resulting in diminished brain weight, loss of cortical neurons and dynamic metabolic alterations occurring in the dementing brain are other well-identified changes (Cummings & Benson, 1983; Blessed, 1984; Yamaguchi, Meyer, Yamamoto, Sakai & Shaw, 1980).

Blessed et al. (1968) found the neuropathologic changes in the demented brain to be significantly correlated with the cognitive symptoms of the dementia syndrome (i.e., in a group of SDAT patients, he found a strong correlation between mental-status and function scores obtained 1 to 11 months before death and the number of neuritic plaques in the cerebral cortex). The severity of degeneration in the cerebral cortex varies from one region to another (Brun & Englund, 1981). The pattern of abnormality corresponds closely to the areas of involvement in the brain. For theoretical purposes the behaviors that are believed to be affected by focal lesions in specific brain regions are listed in Table 1.

Table 1. Neuropathology of Alzheimer's Disease

Brain regions affected	Associated behaviors
Frontal lobe	Problem solving, fluency, temporal ordering.
Temporal lobe	Visual and auditory perception, language.
Parietal lobe	Language, praxis, spatial abilities.
Hippocampus and amygdala	Memory, affect, spatial abilities.
Basal forebrain	Memory and other cognitive functions
Locus coeruleus	Attention, arousal, spatial memory.

Reproduced from Corkin et al. (1986) p. 157

The extent to which an SDAT patient shows impairment in each of these capacities depends on the neuropathological changes in the brain.

Behaviorally, patients with SDAT undergo steadily progressive cognitive deterioration. Reisberg et al. (1985) noted that the progression of symptoms in SDAT occurs in the reverse order to that of development. The patients always lose the ability to walk after they have lost the ability to utter words. In general, the course of the disease can be divided into three stages. In the initial stage, the disease manifests itself as short-term memory deficits, spatial and temporal disorientation, apathy and suspiciousness. These symptoms reflect frontal lobe and hippocampal dysfunction.

As the disease progresses, aphasia, apraxia, and agnosia appear along with other cognitive deficits reflecting parietal cortical involvement. In the terminal stage there is impairment of virtually all intellectual capacities; motor disabilities become evident. Although localization of pathological changes can explain certain symptoms seen with dementia, Karl Lashley (1929) emphasized that other symptoms such as difficulty in abstraction and reasoning have not been so clearly tied to circumscribed sites of brain lesion.

Tomlinson and Henderson (1976) have pointed out that the morphological changes observed in SDAT patients may be seen in the brains of normal aging people but to a far lesser degree. In the majority of normal senescents, senile plaques were both few in number and widely separated, neurofibrillary tangles were either absent or sparse, and ninety percent of those individuals having more than 9% of the hippocampal neurons damaged by granulovacular degeneration were demented. Because the difference between normals and dementia patients appears to be principally quantitative, Terry's (1978) description of SDAT as a threshold phenomenon (i.e., the clinical symptoms of dementia do not appear until a certain number of changes occur) seems appropriate. According to Corkin et al.

(1986), in normal aging minimal involvement occurs in the frontal lobe; moderate involvement is evident in the temporal and parietal neocortex; and the most severe involvement occurs in the medial temporal-lobe structures, specifically the hippocampus and amygdala. This pattern of abnormality corresponds closely to areas of involvement revealed by PET scans and neurochemical studies (Chase, 1984; Rossor et al., 1984).

Processing Deficits in Patients with SDAT

An early symptom of SDAT is the deterioration of memory functioning. A main concern of studies has been to determine the stage in memory the deficits occur, separating impairments in acquisition or encoding, retention or storage, and retrieval (Miller, 1975, 1978; Wilson et al., 1983; Kopelman, 1985). Several hypotheses have been formulated to explain deficits in these processes.

Encoding Deficit Hypothesis

Wilson, Kaszniak, Bacon, Fox, and Kelly (1982) investigated the role of encoding on verbal and facial recognition memory in SDAT. These researchers administered a verbal and a facial recognition memory test along with semantic orienting cues to noninstitutionalized SDAT subjects and to healthy older adult subjects. A facial matching test was also included to evaluate the effect of perceptual factors. Their findings showed that persons with SDAT have both facial memory and verbal memory deficits and that semantic cues had no statistically significant effect on encoding for either the control group or the SDAT group. Their findings also suggested the verbal memory impairment in SDAT involves linguistic and encoding abilities in addition to memory proper. However, the facial memory deficit is relatively uncomplicated by perceptual factors, response bias, or linguistic ability. They concluded that persons with SDAT may lack the semantic network needed to reliably encode and retrieve verbal information. It is also worth noting that the pattern of cognitive decline was not uniform across the subjects in this study, suggesting that premorbid cognitive abilities and distribution of degenerative changes in the brains of the subjects may have been factors causing the differences.

Corkin (1982) compared normal, amnesic, and SDAT groups of older adults on sensory, phonological, and semantic levels of processing using verbal recognition memory. In this study, "depth" of processing was manipulated using three types of questions presented orally: "Does a man/woman say the word?"; "Does the word rhyme with __________?"; and "Is the word a type of ____________?" In the group of controls, recognition memory was enhanced most by semantic orienting and least by sensory orienting questions, as expected. There was no such difference for the SDAT patients, who performed poorly with all three types of questions.

Larner (1977) studied the extent of disorganization in the encoding process of 19 demented, 18 depressives and 10 physically ill elderly subjects. He used a continuous false recognition technique (FRt) to discriminate targets (words previously presented) and distracters (words presented for the first time) from a list of words. He found that demented patients made more errors, possibly because of the changing criteria and also because of their greater loss of encoding characteristics as compared to depressives and normals.

Storage Deficit Hypothesis

The distinction between encoding and storage deficits has been investigated by comparing forgetting rates. The rationale is that impaired encoding will alter the performance by an equal amount at each delay interval, whereas impaired storage alters the slope of the forgetting curve with a more rapid decline in memory performance over time (Loftus, 1978; Huppert and Piercy, 1979; Slamecka and McElree, 1983).

Two studies (Kopelman, 1985; Corkin et al., 1984) address this issue in relation to SDAT, both using the picture recognition technique devised by Huppert and Piercy (1978, 1979). In this paradigm patients are shown a series of colored slides of pictures and subsequently their yes/no recognition memory is tested after ten minutes, twenty-four hours, and seven days. The performance of patients and controls was matched at the 10-min delay by varying the initial exposure time of the pictures.

Kopelman (1985) reported parallel forgetting across the retention interval when comparing SDAT, alcoholic Korsakoff patients and age-matched controls. Similarly, Corkin et al. (1984) reported parallel forgetting between ten minutes and seventy-two hours. A potential criticism of Kopelman's (1985) study is that the levels of performance of the SDAT and control groups were not exactly equated. However, the SDAT group was equated in initial performance with a Korsakoff group who showed the same rate of forgetting. Taken together, the two studies conclude that forgetting rates are unaffected in SDAT and suggest a deficit in encoding rather than storage.

Another study by Becker et al. (1987) investigated the normal rate of forgetting of verbal and non-verbal material in SDAT patients. In their study, 62 patients with mild to moderate SDAT and 64 elderly controls were tested for their immediate and delayed recall of a short verbal passage and a modified complex figure. The results showed that although SDAT patients recalled less than controls, they did not forget at a faster rate during the 30 minute retention interval, thus supporting the finding that these memory impaired patients do not have an abnormal rate of forgetting. The data also suggest that poor initial encoding of the stimuli may be the cause of the SDAT patients' impaired recall.

In an attempt to determine how well SDAT patients were able to retain new information, Little et al. (1986) used a paired associate learning task of repeated and changing items on 26 SDAT subjects. Learning and memory performance was assessed at baseline, 1, 2, 4, and 6 months. They found that performance on changing items progressively declined, whereas performance on repeated items was maintained at initial levels. These results suggest that patients with SDAT are able to retain the same information over one- and two-month intervals.

Retrieval Deficit Hypothesis

The retrieval-failure hypothesis has largely been supported by studies which show that cuing improves a patient's retrieval abilities.

Martin et al. (1985) employed the "level of processing" model to evaluate word recall and recognition in patients with SDAT. Their study differed from Corkin (1982) because it was designed to investigate the possibility that SDAT patients suffer from a retrieval deficit (Miller, 1978). In Martin's study, subjects were required to generate word associates to names of objects during the study phase. To manipulate the depth of encoding, they were required to produce a rhyming word (rhyme), to say where the object could be found (semantic), or to demonstrate how it could be used (semantic-praxic). For example, for the word "car" a subject might respond "tar" for a rhyme, "garage" for where it was found, and demonstrate the act of driving when asked to show how it is used. Subjects were then asked to free recall the names of the objects (condition where there was no orientation or cuing), and then they were cued for those names that had not been recalled by using the response generated in the study phase. Martin et al. (1985) claimed that without cuing there is the same advantage of semantic versus phonemic encoding in the SDAT patients and controls. They also claimed that the SDAT patients benefit as much as the controls from selective cuing in all three conditions. They concluded that despite an overall lower performance, the SDAT patients showed a qualitatively similar pattern to the controls.

Morris, Wheatley and Britton (1983) investigated the use of cued recall from long-term memory in SDAT. Their results showed that cuing differentially aids the recall of verbal information in mild and moderate SDAT. They found that more information was registered and stored in long-term memory than was previously thought. They suggest that manipulating external conditions might be useful in tapping this residual ability.

This cued recall technique was also used by Davis and Mumford (1984) with 18 SDAT and 18 age-matched cognitively unimpaired subjects. Each subject learned three lists of eight words, with recall of each list tested by either 1) free recall, 2) category cuing, or 3) letter cuing. Their findings showed that controls benefited from both types of cues but SDAT subjects only gained from letter cues. The researchers concluded that since SDAT subjects were unable to use semantic cues, they must not have originally processed the information at the semantic level. Based on this information, they suggested the disruption in processing must involve the acquisition of new information rather than a retrieval deficit.

Warrington and Weiskrantz (1970) suggested that disinhibition might account for the partial information effect. Especially where the stimuli to be remembered form a subset of a large range of familiar stimuli (common words in this case), successful performance may depend not only on the ability to recall the correct words but also on the ability to inhibit the recall of incorrect words. If this inhibitory function is lost, the subject may do badly because he recalls too much and he may then produce the wrong responses. Partial information would then enhance recall because it gives a cue for the correct word without providing an alternative which may be incorrectly recognized, as is the case with the conventional type of recognition test.

Miller (1978) used the disinhibition hypothesis to study retrieval from long-term memory in SDAT. This hypothesis posits that recall depends on the ability to inhibit the retrieval of irrelevant information as well as the capacity to retrieve what is required. The experimental and control groups in his study consisted of 12 subjects. Their mean ages were 60 and 80 years respectively. Each subject was required to read each of 12 common monosyllabic words aloud. Retention was tested by recognition conditions involving choosing a correct word from two, four or eight alternatives. The critical finding is that demented subjects do tend to be much more affected than the controls by the increase in the number of response alternatives.

Encoding-Retrieval Deficit Hypothesis

Diesfeldt (1984) looked at the importance of encoding instructions and retrieval cues in the assessment of memory in SDAT. In his study, 16 SDAT patients and 12 cognitively unimpaired older adults learned a categorized word list under different encoding and retrieval conditions. He found that recall increased only when explanation of the category structure during encoding was combined with category cuing at retrieval. Encoding instructions and retrieval cues did not, by themselves, facilitate recall. The recall performance of the normal elderly differed quantitatively and qualitatively from the performance of the SDAT patients. However, patients suffering from SDAT could, under certain conditions, benefit from the organization in a categorized list.

In summary, although studies have attempted to identify the memory processing deficits in SDAT, the understanding of the nature of these processing deficits is still in the exploratory stage. While some studies support the encoding-deficit hypothesis, others prefer the retrieval-deficit explanation for the memory impairment in SDAT. It has also been suggested that since encoding and retrieval functions are difficult to isolate, it might be that both functions are implicated in the memory impairment. There is some evidence that SDAT subjects are able to retain new information and that under the right conditions they are able to improve encoding and retrieval of information.

CHAPTER III

METHODOLOGY

Subjects

Thirty volunteer subjects 65 years of age or older participated in this study. 18 of the subjects had SDAT; of these 9 had mild impairment and 9 had moderate impairment. In addition, 12 cognitively unimpaired older adults served as a matched control. All subjects were noninstitutionalized and living in the Lansing and Greater Lansing areas of Michigan. SDAT subjects were matched with normal subjects for gender, age and educational level, allowing for comparison of performance characteristics between the two matched groups.

Most of the diagnosis of SDAT in this study was made by a geriatric assessment team at an university-affiliated community hospital geriatric assessment center. The team consisted of two Geriatricians, a Medical Resident, a Geopsychiatrist, a Registered Nurse, a Physical Therapist, an Occupational Therapist, a Social Worker, and a Speech Pathologist. A weekly team case conference was scheduled to review the diagnosis of SDAT based on clinical criteria (history of progressive intellectual decline, examination, and physical investigation) implicit in which was the exclusion of other possible causes of dementia. In a few instances, SDAT subjects were referred by other physicians to a Neuropsychologist to confirm dementia. In these cases the diagnosis of SDAT was determined by the Neuropsychologist through a review of the medical records and results from the neuropsychological assessment. All SDAT patients met diagnostic criteria as found in the Diagnostic and Statistical Manual of Mental Disorders (DSM III) (see Appendix A).

Subjects were further screened for conditions that might interfere with cognitive performance such as chronic health problems, history of neurological and/or psychological problems, medications and sensory deficits. Subjects with severe dementia or depression were also excluded from the study. Depression in the elderly often is accompanied by subjective experiences of memory loss and cognitive impairment (Kahn et al., 1975). It also has a worsening effect on the cognitive impairment of a "true" dementia (Reifler et al., 1982; Shraberg, 1978). Very severe dementia patients were expected to have significant comprehension deficits which might interfere with their understanding of the recognition task.

Instruments

Interview Check List

All subjects were interviewed to obtain answers to items on a subject check list. For SDAT patients referred through the Geriatric Assessment Center, the check list was completed by reviewing the patient's file; and the interview was used to verify answers. The check list consisted of items important for subject selection and group matching (see Appendix B). For those subjects selected to participate in the study, the following tests were administered: Mini-Mental State Examination (MMSE), Dementia Behavior Scale (DBS), Geriatric Depression Scale (GDS), Sensory Deficit Screening, and Memory Recognition Task.

Mini-Mental State Examination

The Mini-Mental State Examination (MMSE) developed by Folstein et al. (1975) is a brief screening device used to detect cognitive impairment. The test is divided into two sections, the first of which requires verbal responses only and covers orientation, memory, and attention; the maximum score obtainable is 21. The second part tests ability to name, to follow verbal and written commands, to write a sentence spontaneously, and to copy a complex polygon similar to a Bender-Gestalt Figure; the maximum score obtainable is nine. The total maximum score is 30 (see Appendix C). The test is not timed and requires only 5-10 minutes to administer. It is easily scored and gives a quantitative estimate of the severity of cognitive impairment in patients. A mild SDAT subject has a MMSE score of 20 points and above, and a moderate SDAT subject has a score less than 20. This criterion for classifying the severity of SDAT subjects was recently used by Salmon et al. (1987) to study the recognition memory span in early and advanced stages of the disease. In the present study, 9 of the 18 SDAT subjects scored in the mild cognitively impaired range and 9 scored in the moderate cognitively impaired range.

The Dementia Behavior Scale

The Dementia Behavior Scale (DBS) developed by Haycox (1984) was used to rate all subjects in order 1) to evaluate the severity of dementia in the SDAT subjects and 2) to confirm the absence of dementia in the normal cognitively unimpaired elderly control subjects. This scale is easy to administer and demonstrates interrater reliability ($r = 0.90 + 0.05$) and intrarater consistency ($r = 0.97 + 0.02$). It correlates well with clinical impressions of disability and also with the Blessed et al. (1968) scale ($r = 0.64$, $p < 0.001$) for rating demented patients. Since the Blessed et al. (1968) scale correlated well ($r = 0.64$, $p < 0.001$) with the finding of Alzheimer's disease at autopsy, Haycox (1984) suggested a probable positive correlation between the Dementia Behavior Scale and autopsy findings.

This dementia scale assesses patients' behavior deficits in eight categories: 1) language-conversation, 2) social interaction, 3) attention, 4) spatial orientation, 5) motor performance, 6) bowel and bladder behavior, 7) eating/nutrition, and 8) dressing/grooming. A list of symptoms in each category is arranged in order of increasing severity. Normal behavior in any category is scored 0; deficit behavior scores range from 1 to 6, where a score of 6 indicates total disability. Thus a person's aggregate score can range from 0 (no disability) to 48 (total disability). In this study, the aggregate score of the normal cognitively unimpaired subject was not to exceed 1 and the total score of the SDAT subjects were between 2 and 40. An upper limit of 40 was used to eliminate subjects in the severe dementia category (see Appendix D).

Depression Scale

The Geriatric Depression Scale (GDS) is a 15-item screening device developed and specifically tailored for use with the elderly. The subject is asked to choose the best answer for how he felt over the past week by circling the "Yes" or "No" response at the end of each of the 15 statements. Five of the items (numbers 1, 5, 7, 11 & 13) count 1 point each with a negative response, and the remaining 10 items count 1 point each with a positive response (see Appendix E). A total score greater than 5 indicates a probable depression. Yesavage et al. (1983) reported on data from a study by Gallagher et al. (1983) which showed that the GDS differentiated the depressed demented from the nondepressed demented elderly subject. His subjects (n=43) were classified as demented by criteria of Folstein's Mini-Mental Status Exam (Folstein et al., 1975). In the present study, the GDS served as a screening device to identify persons with a probable depression who needed to be excluded from the study because their depression would have interfered with their performance on the memory recognition task.

Sensory Deficit Screening

All subjects passed a pure tone hearing screening at 30dB ISO for 500, 1000 and 2000 Hz. unilaterally. It has been well documented that the average pure-tone response for these frequencies is a relatively valid predictor of listening intelligibility of normal speech under quiet listening conditions (Martin, 1986).

A color recognition screening test was developed by the researcher to exclude subjects with a visual sensory deficit. Subjects were expected to meet a 90 percent criterion in order to "pass" the screening and be included in the study. The screening test used feature dimensions of the memory recognition task and served as a practice item to determine whether the subject had adequate comprehension to participate in the study. (See Appendix F for screening test.)

Memory Recognition Task

The memory recognition task consisted of a learning phase and a test phase. The learning phase involved encoding information at one of three levels of processing; physical, semantic and semantic elaboration. These levels were identified as Recognition Memory (RM) learning tasks 1, 2, and 3 respectively. The levels of processing required for the RM tasks were manipulated experimentally by requiring the subject to answer the following types of questions presented orally: [RM1] "Do you see an "x" on the object?" (physical); [RM2] "Can you carry this object easily?" (semantic); [RM3] "Where in the house would you most likely find this object and place it there." (semantic elaboration).

The test phase involved recognition of items presented during the learning phase which were mixed in with an equal number of items the subjects had not seen before. Subjects were asked to respond to the question "Have you seen this object before?" (See Appendix G).

Experimental Stimuli

The stimuli used in this study consisted of thirty carefully selected pictures of personally relevant household objects (e.g. television) and an equal number of pictures of non-household objects (e.g. cow). This was done to satisfy Mandler's (1980) claim that recognition memory is partly dependent on the perceptual familiarity of the stimulus material. Fifty items were selected from the set of standardized line drawing pictures of Snodgrass and Vanderwart (1980) and ten items were taken from the Peabody Picture Vocabulary Test (PPVT). All 60 pictures were enlarged to a size of approximately 2" X 3" and pasted on to 3" X 5" cards. To ensure recognizability of stimuli, 5 college students were asked to name the pictures quickly as each stimulus card was presented.

Learning Phase - The thirty line-drawing pictures of household objects were duplicated to create three identical sets for use in the learning tasks (RM1, RM2, and RM3) of the experiment (See Appendix H for list of pictures used). To accomodate RM1 ("Do you see an "x" on the object?) fifteen of the pictures from one set were randomly picked and marked with a small inked-in ("x") for use with this group. In the case of RM2 (Can you carry this object easily?) fifteen of the items were initially chosen because they were small household objects that could easily be carried, such as "toothbrush". Finally in RM3 (Where in the house would you mostly likely find this object and place it there) the same thirty household pictures were of items you would typically find in one or more of five rooms in a house. An additional feature in RM3 was a model of a house (12" X 24"). This house was constructed with five designated rooms of equal size (4"X6") and labeled "bedroom", "bathroom", "livingroom", "kitchen" and "garage" identifying each of the rooms. Subjects in learning task RM3 were asked to place the pictures of the household objects in one of the rooms of the model.

Test Phase - In addition to the items used in the learning phase, thirty pictures of non-household objects not typically found in a house (e.g., monkey, train) were used in this phase. (See appendix I for listing of all sixty test items.) Subjects were asked to respond to the question "Have you seen this object before?"

Procedure

The researcher presented the study to the Geriatric Assessment Team at St. Lawrence Hospital in order to obtain approval to contact several of their recently diagnosed SDAT patients about the study and to recruit volunteers to serve as subjects. A few patients were tested as an initial intake for a complete neuropsychological assessment in collaboration with a Neuropsychologist. Subjects for the control group (cognitively unimpaired elderly) -- who were matched by age and gender with the experimental group (SDAT patients) -- were recruited from senior citizen and retirement organizations. All subjects were noninstitutionalized. Normal subjects were functionally independent and living in their own homes. SDAT subjects were mild to moderately independent and living in the community either in their own homes or with significant caregivers.

All subjects signed an informed consent after the nature of the study and the content of the Informed Consent Form (Appendix J) was explained to them. The subjects then participated in a brief interview to help the researcher complete the subject checklist. Information from the checklist was used for group matching and elimination of subjects from the study (see Appendix B).

Subjects who satisfied the criteria of the interview checklist were given the Mini-Mental Status Examination (MMSE) to identify the presence of cognitive impairment and to classify SDAT subjects into mild and moderately cognitively impaired. SDAT subjects with a score ≥20 on the MMSE were classified as mildly impaired and a score <20 on the MMSE was classified as moderately impaired (see Appendix C).

Although the diagnostic criteria found in the Diagnostic and Statistical Manual of Mental Disorders (DSM III) was followed to identify and exclude subjects with other causes of dementia, it was possible that a small number of subjects had dementias other than Alzheimer's or a dementia that was too severe for this study. To provide a reliability measure on severity of dementia, subjects were given the Dementia Behavior Scale (DBS). This scale correlates well with the Blessed et al. (1968) scale ($r = 0.64$, $p < 0.001$). The normal subjects in this study had a score of 0 on this scale and none of the SDAT subjects had a score greater than 40, a score which would indicate severe dementia (see Appendix D). Since only mild and moderate SDAT patients were included, the majority of the screening measures, which contain higher-level tasks involving integration of cognitive skills, were accurate in documenting the existence of cognitive impairment in the SDAT patients.

Depression has been found to be associated with cognitive deficits (Miller, 1975; Zelinski, Gilewski, and Thompson, 1980). In order to screen for depression in the subjects participating in this study, the Geriatric Depression Scale (GDS) was administered. As explained earlier, a total score greater than 5 on this scale indicates a probable depression (see Appendix E). Most of the subjects passed this screening. In two instances, the subjects refused to participate in this screening because of the nature of the questions asked (see Appendix D). Two other subjects failed to complete all items on the screening because they felt it was impossible for them to respond to certain questions with just a "yes" or a "no" response and the screening did not provide for other answers. In these four cases the experimenter made a clinical judgment to rule out depression based on the subject's participation on the rest of the screening tests.

As a last measure all subjects were screened for hearing and visual sensory deficits which might interfere with the study. All subjects exhibited hearing of at least 30 dB ISO unilaterally for the speech frequencies and adequate visual skills to complete the task.

Subjects were randomly assigned to one of three Recognition Memory learning tasks (RM1, RM2, or RM3) within each of the mild and moderate SDAT groups. The learning tasks entailed a 5-second display of each stimulus picture (total of 30 pictures) and a 5-second interval during which time the subject responded to one of the three questions. RM1: "Do you see an "x" on the object?"; RM2: "Can you carry this object easily?"; and RM3: "Where in the house would you most likely find this object?" Although the data collected during this phase were not used for group analysis, it provided information on individual patterns of responding on the three tasks.

The recognition memory test was administered immediately following the learning tasks. The sixty test items were presented at the same 5-second presentation rate as the learning task items. Subjects responded to the question "Have you seen this object before?" In a few cases the subject was unsure of his answer, and the experimenter re-phrased the question to "Do you think you saw this object or do you think you did not see this object?" It was only necessary to re-phrase the question once to elicit a response.

All subjects were tested in the quiet environment of their homes or in an examining office where they had completed earlier physical or neuropsychological testing. All stimuli were presented at a comfortable pace to allow the subject adequate time to respond to the question orally presented by the experimenter. Confidentiality was maintained during the study by using a numerical code to represent each subject's file.

Figure 4. Flow chart of Experimental Protocol (n=30)

```
 ____________________________________________
1                                            1
1            Interview Check list            1
1____________________________________________1
 ______________________1_____________________
1                                            1
1   Mini-Mental State Examination (MMSE)     1
1____________________________________________1
              /        1          \
  (MMSE ≥ 20)/     (MMSE < 20)     \
            /          1            \
  Mild SDAT        Moderate SDAT     Normal
    n=9                n=9           n=12
 _____1________________1______________1______
1                                            1
1     Dementia Behavior Scale (DBS)          1
1____________________________________________1
 _____1________________1______________1______
1                                            1
1    Geriatric Depression Scale (GDS)        1
1____________________________________________1
 _____1________________1______________1______
1                                            1
1         Sensory Deficit Screening          1
1____________________________________________1
    / 1 \            / 1 \         / 1 \
   /  (Recognition Memory (RM) Learning Tasks)
  /   1   \        /   1    \     /   1    \
RM1  RM2  RM3    RM1  RM2  RM3  RM1  RM2  RM3
n=3  n=3  n=3    n=3  n=3  n=3  n=4  n=4  n=4
__1____1____1______1____1____1____1____1____1_
1                                              1
1            RECOGNITION MEMORY TEST           1
1______________________________________________1
```

Design

The study consisted of three encoding tasks: RM1 looked at the influence of physical perception on recognition memory; RM2 looked at the influence of semantic perception on recognition memory; and RM3 looked at the influence of elaborate semantic perception on recognition memory. Each encoding task tested six subjects from the two SDAT groups (i.e., a mildly cognitively impaired group of 3 subjects and a moderately cognitively impaired group of 3 subjects) and four normal control subjects matched for sex and age. All subjects participated in a learning phase and a test phase which evaluated the strength of recognition memory immediately following the different learning tasks (RM1, RM2 and RM3) using the same stimuli. This study utilized a post-test only controlled group design with the exception that subjects were not randomly assigned to each group. Table 2 depicts the basic design.

Table 2. Between Subjects ANOVA Design (n = 30)

		(A) Between-Subjects Variables			
		RM1	RM2	RM3	Total
Between-Subjects Variables					
	Mild SDAT	3	3	3	(9)
(B)	Moderate SDAT	3	3	3	(9)
	Normal	4	4	4	(12)
	Total	(10)	(10)	(10)	(30)

The independent variable (learning) was manipulated in order to measure its effects on the dependent variable (recognition memory). In addition, the effects of the controlled independent variable (severity) on the dependent variable (recognition memory) was analyzed. Analysis of variance (ANOVA) computations were required to measure the effects of severity and learning on the recognition memory score. Post Hoc (Tukey's method) comparisons were used to look at individual differences between the severity groups (Glass and Stanley, 1970). Mean and standard deviation scores on the number of error items observed on household and non-household items were analyzed to explain differences in the patterns of performance by SDAT and normal subjects. Finally, because of the small sample sizes used in this study, a non-parametric discriminability index was calculated for each subject to verify the results obtained using parametric statistics.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter presents a descriptive analysis of the subjects and results pertinent to the hypotheses. The purpose of this study was to investigate the patterns of memory loss in patients with SDAT using an information processing model. Because of the complexity of the disease being investigated -- Senile Dementia of the Alzheimer Type (SDAT), it was first necessary to describe the subjects who participated in the study. Since severity of dementia in this study was determined by scores on the Mini-Mental State Examination (MMSE) which measures cognitive performance, the Dementia Behavior Scale (DBS) was administered to provide a reliability measure to confirm the diagnosis of SDAT and to exclude subjects with severe forms of the disease.

The next section will analyze the influence of levels of processing and severity on recognition memory by means of a two-way, 3 X 3 analysis of variance (ANOVA) using a SPSS-X statistical program. To explain the statistically significant findings derived from the ANOVA, pair-wise comparisons using a modified Tukey method (Glass and Stanley, 1970) for almost equal means were computed. The mean, variance and standard deviation scores were computed to show the similarities and differences between the groups. Finally, because of the small sample size of this study, a non-parametric discriminability index was calculated as a measure of reliability to look at the error responses in terms of household and non-household items.

Descriptive Analysis

Two experimental groups with a total of eighteen SDAT subjects and a control group of twelve normal subjects were matched on gender and age. Nine of the SDAT subjects were classified as "mildly demented" based on MMSE scores (MMSE $\geq$ 20). These subjects had a mean age of 75 years with a standard deviation of 3.06. There were 2 males and 7 females in this group. Nine SDAT subjects were classified as "moderately demented" (MMSE < 20). This group had a mean age of 75.8 with a standard deviation of 8.63. The male:female ratio in this group was 2:7. The twelve normal subjects represented a mean age of 77 years with a standard deviation of 7.02. There were two males and ten females in this group. The male:female ratio in this study is less than the ratio of the two groups at age 65+. According to Cox(1984), there are 69 males for every 100 females at age 65+; this figure drops to 58 males for every 100 females for age 75+. Table 3 shows the mean, variance, standard deviation, and ranges for age and MMSE scores for both SDAT groups and the normal group.

Table 3. Descriptive Analysis of Sample within Classifications

Severity	Mildly Demented (MMSE $\geq$ 20)	Moderately Demented (MMSE < 20)	Normal
Sample size	9	9	12
Male:Female ratio	2:7	2:7	2:10
Age (yrs/mo) $\bar{x}$	75/00	75/09	77/05
v	9.33	74.56	49.25
S.D.	3.06	8.63	7.02
Age range (yrs)	71-79	57-85	68-88
MMSE Score $\bar{x}$	25.22	12.56	29.75
(Max.= 30) v	3.06	14.03	0.36
S.D.	1.75	3.75	0.60
MMSE range (Max=30)	22-27	6-17	28-30

In spite of the similar mean ages, there was considerable variance in the distribution of ages in the three groups. For instance, the subjects in the mild SDAT group were all in the eighth decade, but the moderate SDAT group had a wide age range from 57 years to 85 years. The age range of the normal group was from 68 years to 88 years. The wide distribution of ages in the SDAT groups suggests that severity of SDAT does not follow a set age pattern, where Mild SDAT subjects are younger than moderate SDAT subjects. In fact, one moderate SDAT subject was 57 years and two were in their sixties, whereas all the mild SDAT subjects were in their seventies.

Similarly, the mean MMSE scores for the mild SDAT, moderate SDAT and the normal groups were 25.22, 12.56 and 29.75 respectively. However, the variance in the distribution of scores was once again different in the three groups. The variance for the mild SDAT group was only 3.06, whereas the moderate SDAT group had a variance of 14.03. The distribution of scores reported for the SDAT groups were the result of the criteria used to initially classify subjects based on cognitive impairment. The normal group had a very small variance of 0.36 due to a ceiling effect.

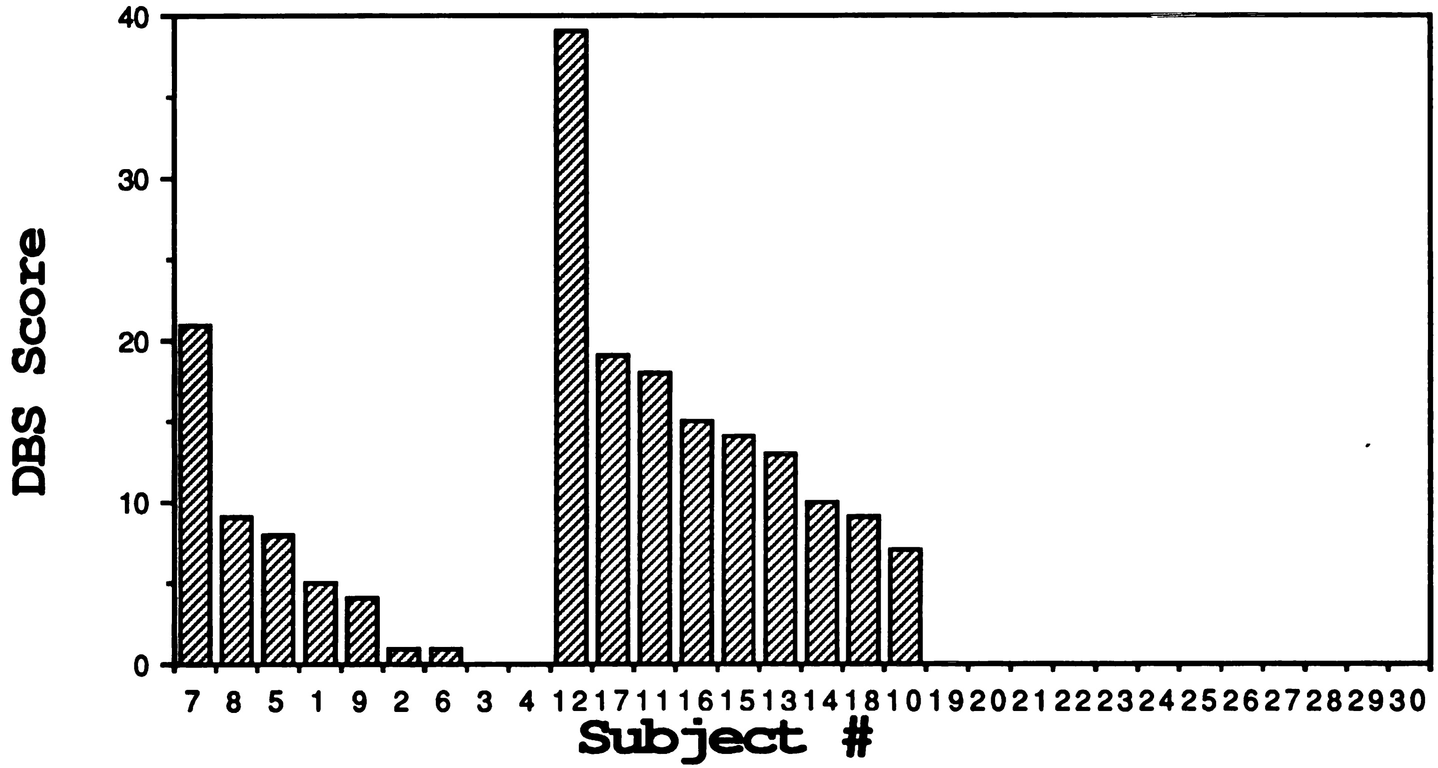
Reliability Measure for Accuracy and Severity of SDAT

An initial judgment of pure SDAT excluding other dementia conditions was made by a Geriatric Assessment Team and, in a few instances, when the subjects were referred by other physicians, the diagnosis of SDAT was confirmed through a review of the medical charts by a neuropsychologist.

To provide a reliability measure for the diagnosis of SDAT and to exclude subjects with severe forms of the disease, all subjects were administered the Dementia Behavior Scale (DBS). This scale assesses behavior deficits in eight categories of functional and psychosocial skills (see Appendix D) A subject's aggregate score can range from 0 to indicate no disability to 48 to indicate total disability. A score of greater than 40 was considered a severe dementia. As reported in the literature review, this scale correlates well with clinical impressions of disability and with the Blessed et al. (1968) scale ($r = +0.64$, $p < 0.001$). The SDAT groups obtained higher scores on this scale than the normal subjects, a fact suggesting greater functional and psycho-social dependence in the former groups. In addition, the moderate SDAT subjects had higher scores than the mild SDAT subjects. Figure 5 displays the rank ordered performance on the Dementia Behavior Scale by SDAT and normal subjects.

The data suggest that the MMSE classification of mild and moderate SDAT placed subjects in their reasonable order. One mild SDAT subject had a score greater than 10 on the DBS. A review of the medical records on this subject revealed functional dependence on Activities of Daily Living (ADL) skills such as eating, dressing and bathing. Two moderate SDAT subjects had DBS scores of less than 10. Both of these subjects had the highest MMSE scores of 17 in the moderate SDAT group. Based upon this information, it was concluded that these three subjects probably exhibit borderline mild to moderate dementia. The subjects in the normal group scored 0 on the DBS, indicating no observable signs of dementia.

Figure 5: Rank Ordered Dementia Behavior Scores - SDAT and Normal Subjects



Levels of Encoding and Recognition Memory

A two-way, 3 X 3 analysis of variance was computed using a SPSS-X statistical program to determine the influence of severity and level of encoding (RM) on recognition memory.

Main effects: The results indicated severity (mild SDAT, moderate SDAT and Normal) had a statistically significant effect on recognition memory ($F = 15.787$, $p < .001$). However, because there were three groups, it could not be determined whether each group had an equally significant effect on recognition memory.

Analysis of subject performance based on the initial level of encoding (RM1, RM2 and RM3) revealed no statistically significant difference in performance on the recognition memory test ($F = 1.917$, $p < .001$). These findings suggest that based on severity, the performance of the three groups was different but that the initial level of encoding (RM1, RM2, and RM3) did not significantly influence their performance on the recognition memory test.

Interactions: There was no statistically significant interaction between severity and level of encoding ($F = .707$, $p > .001$) as revealed by this analysis of variance. Table 4 summarizes the data.

Table 4. Summary Table: 3 x 3 ANOVA for Severity and RM on Memory Recognition (n = 30)

Source	SS	DF	MS	F
Severity	258.978	2	629.489	15.787*
RM	152.867	2	72.433	1.917
Severity x RM	112.689	4	28.172	.707
Error	837.333	29	39.873	
TOTAL	2361.867	29		

*p < .001

Based on the data, it was evident that the first hypothesis that subjects with SDAT show more deficits on tasks involving non-semantic (physical) methods of encoding than on tasks encoding semantic characteristics of the stimuli would be rejected. The subjects in this study did not benefit from semantic elaboration (RM3) which involved deeper encoding than semantic (RM2) or physical (RM1) encoding. Therefore, the second hypothesis that subjects with SDAT perform better on tasks encoded on semantic elaboration than on tasks encoded on physical or semantic processing was also rejected.

Severity of Dementia and Recognition Memory

Since the analysis of variance from Table 3 demonstrated that severity significantly influenced recognition memory performance, a post hoc, modified Tukey method (Glass and Stanley, 1970) was used to analyze pair-wise comparisons between groups. Because the groups had unequal means, a harmonic mean n was calculated by the formula:

$$\tilde{n} = \frac{n1 + n2 + n3}{k}$$

Therefore, in this study

$$\tilde{n} = \frac{9 + 9 + 12}{3}$$

$$\tilde{n} = 10$$

The procedure to test the significance of the pair-wise comparisons for k = 3 groups used the degrees of freedom corresponding to MSw represented by error from the ANOVA (Table 3) and an experimental error rate of 0.005. For each pair-wise comparison, the significance test looked at the difference

$$\bar{x}i - \bar{x}i' > q_{1-\alpha}\sqrt{\frac{MSw}{\tilde{n}}}$$

These results are represented in Table 5.

Table 5. Pair-wise comparisons of almost equal means (modified Tukey T-method) for Mild SDAT ($\bar{x}1$), Moderate SDAT ($\bar{x}2$) and Normal ($\bar{x}3$) groups. (n=30)

$\bar{x}i - \bar{x}i'$	$q_{1-\alpha}\sqrt{\frac{MSw}{\tilde{n}}}$	$\bar{x}i - \bar{x}i' > q_{1-\alpha}\sqrt{\frac{MSw}{\tilde{n}}}$
$\bar{x}2 - \bar{x}1$ = 0.2	(4.49)(1.997) = 9.705	0.2 > 9.705
$\bar{x}3 - \bar{x}1$ = 13.3	9.705	13.3 > 9.705*
$\bar{x}3 - \bar{x}2$ = 13.1	9.705	13.1 > 9.705*

(k = 3; MSw = 29) *p < .005

The Tukey pair-wise comparison of means revealed statistically significant differences between the normal group and the two SDAT groups. These results support the third hypothesis that normal subjects perform better than SDAT subjects on all tasks. The pair-wise comparison of means of the two SDAT groups was not statistically significant. It is possible that the normal group when combined with the SDAT groups caused the significant findings reported in the ANOVA analysis. Based on this information, the fourth hypothesis that the performance scores of SDAT subjects decrease the more advanced their disease, was rejected. Since the differences in performance between SDAT groups and the normal group on recognition memory was statistically significant, the mean scores and standard deviations were calculated for each group. Table 6 presents a summary of these data.

Table 6. Mean Scores and Standard Deviations on Memory Recognition by Mild SDAT, Moderate SDAT and Normal groups. (n = 30)

Group	n	$\bar{x}$	v	SD
SDAT-Mild	9	43.7	62.89	7.93
SDAT-Moderate	9	43.9	45.21	6.72
Normal	12	57.0	10.83	3.29

The mean recognition memory score for the normal group was 57.0 with a standard deviation of 3.29., whereas the two SDAT groups had a mean score of 43.7 with a standard deviation of 7.93 for the mild SDAT group, 43.9 with a standard deviation of 6.72 for the moderate SDAT group. This would suggest that the two SDAT groups performed in a similar manner on the recognition memory test.

Error Responses and Discriminability Index

The literature review suggested that SDAT and normal subjects exhibit similar patterns of forgetting (Kopelman, 1985; Corkin et al., 1984; Becker et al., 1987). Using a rate-of-forgetting paradigm, these studies demonstrated that the difference in performance of SDAT and normal subjects was quantitative and not qualitative in nature. In the rate-of-forgetting paradigm subjects were shown a series of slides of pictures and subsequently their yes/no recognition memory was tested following a delay. It was generally agreed that SDAT subjects recalled less than controls, but they did not forget at a faster rate (Kopelman, 1985; Corkin et al., 1984; Becker et al., 1987). In the present study, analysis of error responses on household and non-household items using a level of processing paradigm, showed that SDAT and normal subjects had similar error pattterns, although normal subjects did considerably better than SDAT subjects. This finding is similar to that reported in the literature (Kopelman, 1985; Corkin et al., 1984; Becker et al, 1987). The mean, variance and standard deviation of household and non-household errors for the three groups show the differences and similarities in performance of the groups. These data are represented in Table 7.

Table 7. Mean Scores and Standard Deviations for Errors on household and non-household items by SDAT and Normal groups (n = 30)

	Group	n	$\overline{x}$	v	SD
Household Item Errors (Max. correct = 30)	SDAT-Mild	9	13.11	107.43	10.36
	SDAT-Moderate	9	12.44	82.47	9.08
	Normal	12	2.67	8.06	2.84
Non-Household Item Errors (Max. correct = 30)	SDAT-Mild	9	3.22	28.40	5.01
	SDAT-Moderate	9	3.67	32.89	5.73
	Normal	12	0.33	0.56	0.75

Error analysis on individual groups revealed that normal subjects consistently performed with fewer errors overall than SDAT subjects when tested on household and non-household items. Normal subjects for household items had a mean error score of 2.67 as compared to mean error scores of 13.11 and 12.44 for the mild and moderate SDAT groups respectively. Normal subjects for non-household items performed with a mean error score of only 0.33, whereas the mild and moderate SDAT groups had mean error scores of 3.22 and 3.67 respectively. Both SDAT and normal subjects made significantly more errors when tested on household items than on non-household items. The error analysis revealed that both SDAT and normal groups had qualitatively similar patterns of performance. This finding supports the final hypothesis that the difference in performance of SDAT subjects and normals is quantitative and not qualitative in nature across tasks. Figure 6 shows the distribution of error scores on household and non-household items for SDAT and Normal subjects.

An examination of the mean error scores for the SDAT groups revealed that the mild SDAT group made fewer errors than the moderate SDAT group on household items but the reverse was true for non-household items. This same pattern was observed for the variance and standard deviation scores for the two groups. To explain these findings, it was necessary to conduct an individual subject analysis of error scores for household and non-household items for the two SDAT groups. It was generally found that subjects made more errors on household items than non-household items. Three mild SDAT subjects and three moderate SDAT subjects showed a reversal in this pattern of errors. The error scores for these subjects are presented in table 8.

Figure 6: Rank Ordered Error Scores for SDAT and Normal Groups

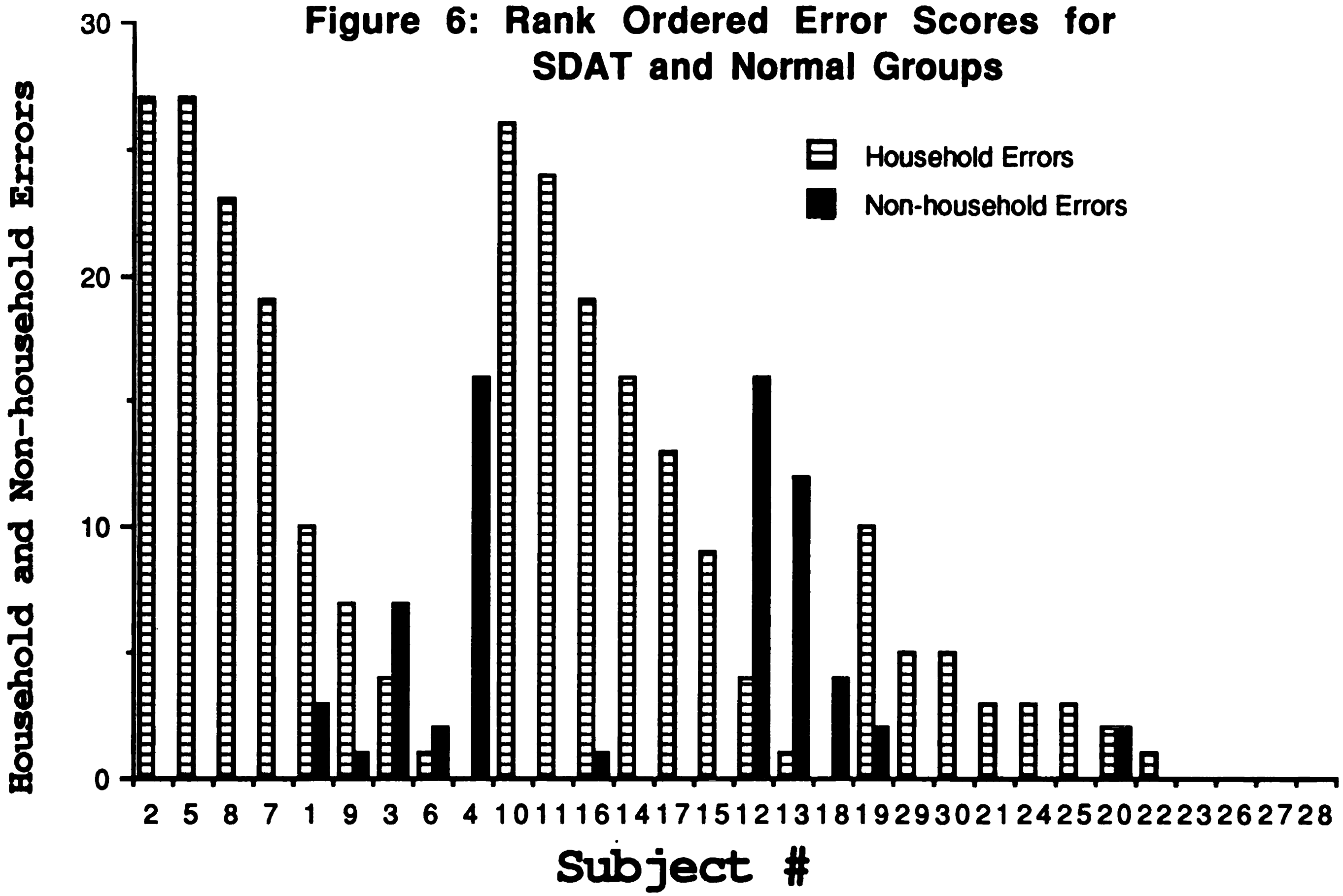


Table 8. Distribution of household and non-household errors on selected SDAT subject

Subjects #	Severity	Household Errors	Non-Household Errors
3	Mild	4	7
4	Mild	Ø	16
6	Mild	1	2
12	Moderate	4	16
13	Moderate	1	12
18	Moderate	Ø	4

Individual analysis of these data revealed that the differences in error scores between household and non-household items for subjects, 3, 6 and 18 were below 5. Subject #6 had only 1 household error and 2 non-household errors, and subject #18 had no household errors and 4 non-household errors. Subject #3 had 4 household errors and 7 non-household errors.

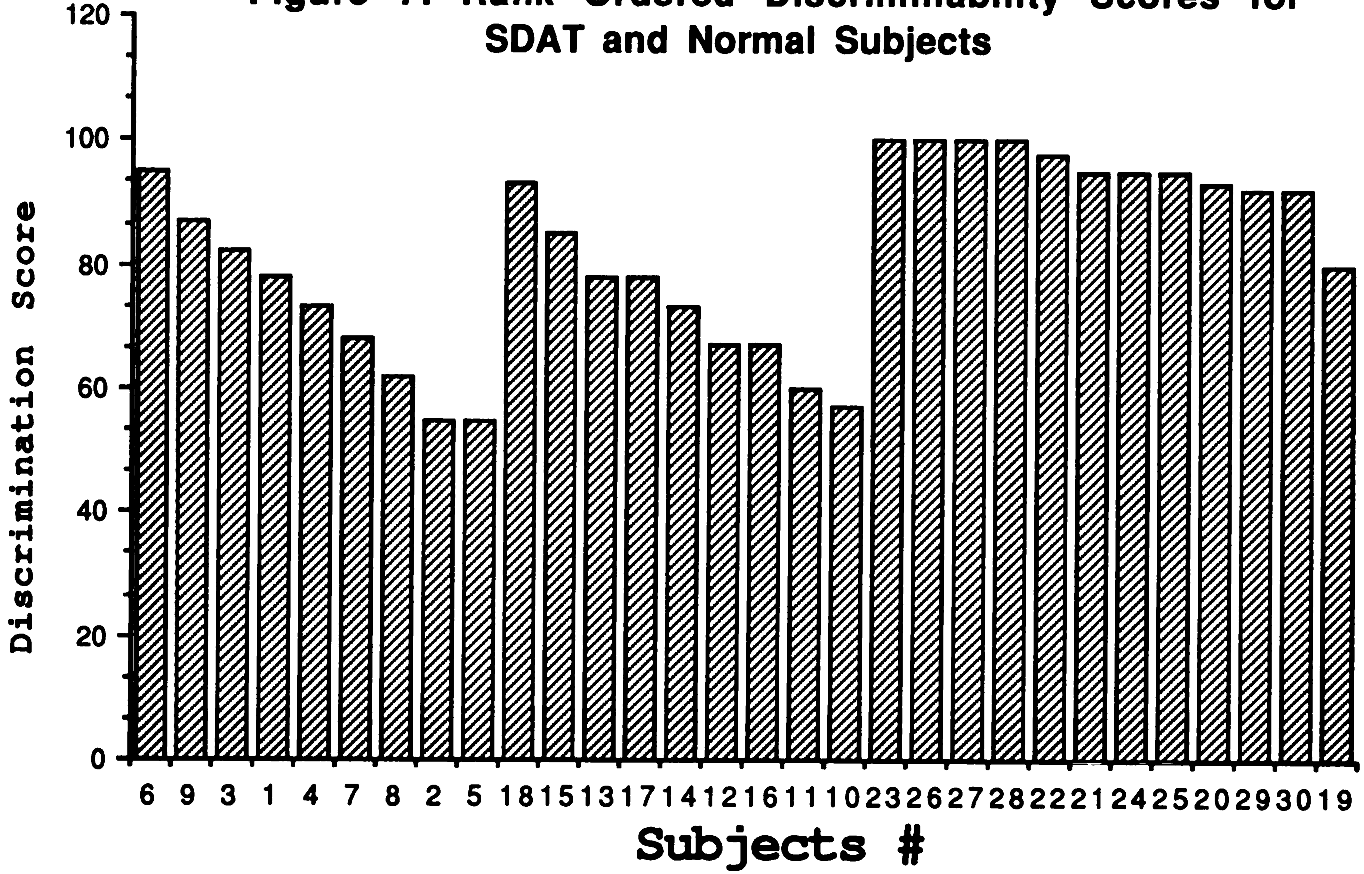
In the case of subjects 4, 12 and 13, the experimenter conducted an indepth review of past medical records to find possible explanations for the unusual findings. Subject #4 showed a high "Yes" response bias which might be explained by the fact that this subject grew up on a farm. Since a number of the non-household items were pictures of animals, it is conceivable that proactive interference, which occurs when previously learned information interferes with recall of more recent material, resulted in the large number of non-household item errors. A review of the past medical history of subject #13 revealed previous episodes of delusional ideation. Although this subject passed all screening criteria and did not seem to exhibit delusional behavior during the testing, it is possible that this subject's previous delusional tendencies may have contributed to the errors observed on non-household items. Subject #12 had the highest Dementia Behavior Scale (DBS) score of 39. This score is one point shy of the upper limit to exclude subjects with severe dementia. Based on this information, it may be that this subject is exhibiting a borderline moderate to severe dementia.

Because of the small sample size (n=30) of this study, a non-parametric discriminability index was computed to analyze the error responses for each subject. The discriminability index takes into account both correct responses and false positives and thereby provides a single measure of overall recognition performance. The formula [1-((False Positive + Misses)/60)] x 100 (Delis et al., 1987) was used to derive this index. The false positives were the non-household error scores and the misses were the household error scores. A low score on the index indicated an impairment in differentiating target items from distracter items, suggesting that the problems in encoding contributed to the subject's memory deficit (Delis et al., 1987). The discriminability scores for each subject are displayed graphically in Figure 7.

Analysis on memory scores of normal subjects showed that with the exception of subject #19, all subjects scored above the 90th percentile. That is, subjects had a score greater than 54 out of a possible 60. The memory score of subject #19 was similar to some mild and moderate SDAT patients. In fact, three mild and two moderate SDAT subjects had memory scores higher than this subject. A review of this subject's screening data did not reveal anything unusual. She reported good general health with no history of major illness, and she was not reported to be on any medications. There was no record of a progressive memory loss in the past 6 months, and she passed all screening tests. One explanation for this finding could be that this subject is showing very early signs of dementia that are not sensitive to the screening measures used in this investigation or that this subject merely did not adequately attend to the learning task and therefore did poorly on the recognition test.

It was generally found that both SDAT groups had scattered but similar recognition performance. The majority of subjects in both SDAT groups had discriminability scores between the 60th and 90th percentile. Only one mild SDAT and one moderate SDAT subject had a score greater than 90. Two mild SDAT subjects and one moderate SDAT subject had

Figure 7: Rank Ordered Discriminability Scores for SDAT and Normal Subjects



discriminablity scores of less than 60. It is possible that these subjects might have a different variant of the dementia syndrome.

An individual review of these subjects revealed some interesting findings. Subject #6 had one of the highest MMSE scores in the SDAT group. In addition, this subject reported being on 6 medications at the time of this investigation. Subject #18 had a low score on the MMSE and did not report being on any medications. The finding was that this subject reported being functionally independent. That is, she was independent in all Activities of Daily Living (ADL) including bathing, dressing, toileting, transfer, continence, walking and feeding; and most Instrumental Activities of Daily Living (IADL) including using the telephone, driving, shopping, housework, cooking and taking medications. The only thing the patient had given up was handling money. All other moderate SDAT subjects were dependent on all 7 IADL measures and dependent on an average of 2.75 ADL measures. Based on Reisberg et al.'s (1985) functional assessment stages (FAST) instrument which is derived from functional measures, this patient would fall at best in the mild dementia category.

DISCUSSION

Level of Encoding and Recognition Memory

There is evidence to suggest that it is possible to modify depth of encoding by using appropriate orienting tasks (Corkin, 1982; Martin et al., 1985). In the present study, a picture of an object was encoded in terms of its physical attributes using the question "Do you see an 'x' on the object?"; or it was encoded semantically using the question "Is this object small enough to carry?" There is a body of literature that shows that, normally, semantic encoding results in higher performance levels than physical encoding for both recall and recognition (Craik & Tulving, 1975; Fisher & Craik, 1977; Hyde, 1973; Hyde & Jenkins, 1973; Till & Jenkins, 1973). An extension to this processing framework included the concept of "elaboration" (Fisher and Craik, 1980). As indicated in the literature review, words rated on two dimensions resulted in better recall than words rated on a single dimension (Klein and Saltz, 1976). The present study also included this third level of processing which was facilitated by the statement "where in the house would you most likely find this object and place it there." It was expected that subjects could be oriented to concentrate on a certain aspect of the object (physical, semantic, semantic-elaboration) and that this orientation would strongly influence the manner in which the object was encoded.

The data in the present study showed that SDAT subjects did not benefit from processing material at the semantic level. It also showed that semantic elaboration did not facilitate better recognition in SDAT subjects. However, these results were consistent with previous dementia research in that SDAT subjects failed to use semantic orienting questions to enhance recognition memory. Corkin (1982) found that in a group of control subjects, recognition memory was enhanced most by semantic orienting and least by sensory orienting questions. The present study found a similar trend among the normal subjects. However, a ceiling effect for normal subjects made it difficult to make a true comparison of the three encoding tasks. Like Corkin's study, this investigation found no semantic advantage for the SDAT subjects, who performed in the same way with all three types of questions.

A more recent study by Martin et al. (1985) claimed that SDAT patients can benefit from semantic encoding to the same extent as do normal subjects. Their study differs from this investigation and the one by Corkin (1982) in that it was designed to investigate the possibility that SDAT patients suffer from a retrieval deficit. They manipulated depth of encoding to produce rhyme, semantic and semantic-praxic levels of processing. Subjects were required to recall the objects and then cued for those names that had not been recalled. There was also a no orientation or cuing condition in their study. In the final analysis, Martin et al. (1985) suggested that without cuing there was the same advantage of semantic versus phonemic encoding in SDAT and control subjects. These results were consistent with the findings in the present investigation.

Weingartner et al. (1981) used a processing explanation for the elaborative aspect of encoding and recognition memory, to suggest that SDAT patients were unable to organize events into a structure that would strengthen encoding and facilitate retrieval. This rationale for explaining the lack of benefit from semantic elaboration might also be appropriate for this study. In their study, Weingartner et al. measured free recall of lists of words that were either unrelated, drawn from two superordinate categories but arranged at random, or drawn from the same categories and arranged sequentially as intact clusters. SDAT patients showed no evidence of benefiting from the semantic relatedness. Similarly, this investigation showed that semantic elaboration (objects related to a house) did not facilitate better recognition memory. In fact, errors on related items were significantly higher than errors on unrelated items for most subjects.

Severity of Dementia and Recognition Memory

This investigation found that severity (normal, mild SDAT and moderate SDAT) as a variable significantly influenced recognition memory scores. However, when post hoc (Tuckey method) comparisons of means looked at individual differences, only comparisons between the normal group and the two SDAT groups were satatistically significant. The pair-wise comparison of means of the two SDAT groups was not statistically significant. The data indicate that this recognition memory test was able to distinguish normal subjects from mildly impaired SDAT subjects, but it was not able to distinguish mildly from moderately impaired SDAT subjects. Vitaliano et al.(1984) claimed that recall testing is a better measure than recognition memory for distinguishing controls from mildly impaired SDAT and that recognition memory along with attention are better for grading the severity of SDAT. However, the two studies presented different recognition memory tests. The recognition test used in this study involved pictures of objects, whereas the Vitaliano et al. (1984) study used recognition of words and designs in their testing.

It is possible that the small sample of subjects tested in each severity group (9 MIld SDAT and 9 Moderate

SDAT) was not sufficient to provide adequate discrimination of the SDAT groups.

Error Responses and Discriminability Index

Analysis of error scores on household and non-household items showed that SDAT subjects like normals made more errors on household items than on non-household items. These data suggest that SDAT and normal subjects have qualitatively similar patterns of performance although quantitatively the normal subjects perform better than SDAT subjects.

One plausible explanation for this finding would be that proactive interference caused the significantly higher error rates on household items in both SDAT and normal groups. That is, information from remote memory interfered with recognition of familiar objects presented on the test. However, the research suggests SDAT subjects do not exhibit proactive interference effects (Wilson et al., 1983). Furthermore, to support a proactive interference explanation, it would be necessary to include household items in the test presentation that did not appear earlier in the encoding task. If it is found that subjects make false positive errors on these items, we may then suggest a proactive interference effect as a viable explanation for the error patterns observed in both normal and SDAT subjects.

An alternative explanation for the error patterns observed is that SDAT subjects, like normals, are able to discriminate between "objects seen before" and "objects not seen before." However, they are unable to make the finer discrimination within the category of "objects seen before" which may require deeper semantic processing to begin with.

Data from the error analysis suggest that the SDAT subjects in this study encode information in a similar manner to normal subjects. It is possible, then, that the recognition memory deficits in SDAT subjects is just an exaggeration of normal performance. It has already been shown through rate-of-forgetting studies (Kopelman, 1985; Corkin et al., 1984; Becker et al., 1987) that SDAT subjects exhibit parallel patterns of forgetting. Clinically, these findings imply that the memory deficits in SDAT are a more advanced form of the deficits in normal adults.

The discriminability index which was computed for each subject and plotted to compare individual performances provides the single best estimate of overall recognition performance. The data suggest that SDAT subjects do encode information for future recognition but that this encoding is inefficient and does not facilitate normal levels of recognition.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Speech-language pathologists primarily deal with the comprehension and expression of thought. However, the primary basis for human thought is cognitive function. Cognition includes the process of attention, registration, memory, perception and higher functions such as judgment, reasoning and problem solving. Effective and efficient communication is dependent on an intact cognitive system.

There is considerable evidence in the literature that in Senile Dementia of the Alzheimer Type (SDAT) memory is disproportionately affected when compared to other cognitive disabilities. The ability to remember is essential for everyday living. Therefore, the purpose of this study was to analyze memory by looking at encoding in SDAT subjects using an information processing framework.

In this study eighteen SDAT subjects, medically diagnosed by a geriatric assessment team or through medical chart review, and twelve normal controls were matched for sex and age. Potential subjects were administered screening tests to reduce the influence of confounding variables such as depression and sensory deficits in all subjects, and cognitive deficits in normal subjects. Subjects that passed all screening criteria were included in the study. SDAT subjects were divided equally into two groups based on their Mini Mental Status Examination (MMSE) scores. SDAT subjects with a score of ≥20 were identified as mildly demented and subjects with a score <20 were identified as moderately demented. For normals this MMSE score was used to detect significant cognitive deficits.

Stimuli for the experiment consisted of 30 pictures of household objects presented during the learning phase. An additional 30 pictures of non-household objects were mixed in with the original 30 items and presented in the test phase. A pre-task screening was used to focus the subjects to the task presented.

Three subjects from the two SDAT groups (mild and moderately demented) and four subjects from the normal group were randomly assigned to participate in one of three learning tasks. The three tasks varied in their levels of encoding: RM1 - physical encoding was facilitated by the question "Do you see an 'x' on the object?", RM2 - semantic encoding was facilitated by the question " Is this object small enough to carry?" and RM3 - semantic-elaboration required a response to the question " Where in the house would you most likely find this object?". All subjects participated in the same Yes/No recognition task during the test phase of the investigation. The total number of correct responses on the recognition memory test and a breakdown of error responses in terms of household item errors and non-household item errors were recorded for each subject.

This research was designed to look at the effects of encoding and severity on recognition memory. Group analysis was performed by means of a two-way, 3 x 3 analysis of variance to determine the effects of the two independent variables (severity and encoding levels) on recognition memory. Post Hoc (Tukey Method) comparisons were made to look at the differences between the severity groups. Descriptive analysis was used to understand error patterns in SDAT and normal subjects. Finally, a non-parametric discriminability index which took into account both hits and false positives was computed for each subject in order to provide the best measure of overall recognition performance.

The results of ANOVA computations revealed that SDAT subjects do not benefit from semantic processing even with elaboration. These findings are consistent with Corkin (1982) who used a similar design to measure encoding deficits in SDAT. Martin et al. (1985) using a retrieval paradigm found that without cuing, SDAT subjects did not benefit from depth of encoding. Severity as a variable seemed to influence recognition memory performance. However, post hoc comparisons revealed that severity of

SDAT did not influence performance on recognition memory. The literature clearly supports the fact that normal subjects perform better than SDAT subjects (Kopelman, 1985; Corkin et al., 1984; and Becker et al., 1987). Descriptive analysis of error scores in terms of household and non-household items revealed similar error patterns between SDAT and normal subjects. Finally, discriminability scores suggest that problems in encoding did not contribute significantly to SDAT memory deficits.

Conclusions

Based on data from this investigation the following conclusions were made:

1. SDAT subjects in this study do not benefit from semantic processing to facilitate recognition memory.

2. Normal subjects perform better than SDAT subjects on all the learning tasks presented in this study.

3. Performance scores on recognition memory tasks in this study do not decrease the more advanced the disease.

4. The error pattern of SDAT subjects and normals in this study is quantitatively different but qualitatively similar in nature across tasks.

Recommendations

The results of this study provide implications for further investigations. The present data revealed no difference in performance using three levels of encoding. It was suggested that possibly the encoding techniques used were not distinct enough to show a difference in performance. Future research should consider more elaborate methods to facilitate the different levels of encoding.

It has been suggested that proactive interference might account for the errors made on household items. To test this hypothesis, a modification could be made from the present study to include household items that were not presented during the learning phase but only during the test phase.

Since subjects were not instructed on the nature of the test that was to follow the learning phase, it was possible that subjects did not encode the right stimulus attributes to facilitate recognition memory. Future studies might consider more explicit instructions at the start of the learning phase so as to cue the subject to attend more selectively.

In this study subjects were not required or encouraged to name the objects; therefore, it was difficult to speculate the influence of anomia on the results. A slight modification to the present study would be to have subjects name the objects right before they respond to each question during the learning phase. Analysis would involve anomic errors and recognition memory. An added dimension would be to look at the influence of articulatory rehearsal on recognition memory. Analysis here would involve correct naming behavior and recognition memory.

The qualitative similarity in error patterns for SDAT and normal subjects has significant clinical implications for understanding learning patterns of persons with Alzheimer's disease. The findings in the present study suggest that memory processing in mild and moderate SDAT subjects is similar to that of normal subjects. Therefore, the currently prescribed treatment for memory disorders might be beneficial in preserving, if not improving, memory skills during the early stages of SDAT. Future research should explore this finding with a methodology geared specifically to analyze error patterns in the two groups.

Finally, it has been suggested that the classification of SDAT subjects into severity groups, based on cognitive testing and scores on the dementia behavior scale, do not efficiently categorize subjects into the different subtypes of dementia. Future research should consider single subject design studies to explore the different variants of the dementia syndrome.

APPENDICES

APPENDIX A

DIAGNOSTIC CRITERIA FOR DEMENTIA

A. Deterioration of intellect of sufficient magnitude to interfere with social or occupational functioning

B. Impairment of memory

C. At least one of the following:

   (1) impairment of abstract thinking

   (2) impairment of judgement

   (3) impairment of other higher cortical functions as evidenced by presence of: (a) aphasia, (b) apraxia, (c) agnosia, (d) constructional difficulty

   (4) personality change

D. Unclouded state of consciousness (does not meet the criteria for delirium or intoxication; however, these conditions may be superimposed)

E. One of the following:

   (1) a specific organic factor judged to be etiologically related to the disturbance through evidence from the history, physical examination, and laboratory tests

   (2) in the absence of such evidence, an organic factor can be presumed if: (a) conditions other than organic mental disorders have been excluded, and (b) cognitive impairment is apparent in many areas

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DSM-III, 1980 (modified)

APPENDIX B

INTERVIEW CHECK LIST

Subject Code:-__________________ Date:-_____________________

1. Sex: Male / Female 2. Age:____________years

3. Educational Level:
   a) grammar school_______
   b) high school__________ diploma ______ No ______Yes
   c) college________________ highest degree___________
   d) other vocational training__________________________

4. Pre-retirement occupation:-____________________________

5. Health:
   a) hypertension or heart problems ______ No _____ Yes
   b) chronic lung problems ______ No _____ Yes
   c) diabetes or thyroid problems ______ No _____ Yes
   d) Parkinson's disease ______ No _____ Yes
   e) kidney problems ______ No _____ Yes

6. Hospitalized for above conditions (past year)__ No __Yes

7. Medications taken at present time including dosage:_____

____

8. History:
   a) Psychosis _________ No ________ Yes
   b) Depression _________ No ________ Yes
   c) Alchoholism _________ No ________ Yes
   d) Head injury _________ No ________ Yes
   - Loss of consciousnes _________ No ________ Yes

9. Progressive memory loss (past 6 months) ____No ____Yes

10. Sensory deficits:a)Vision:__No__Yes b)Hearing:__No__Yes
    Other Sensory Deficits:__No__Yes. Specify______________

____

APPE

11.

Subj

12.

APPENDIX B (cont'd)

11. General Health:__excellent__good__average__fair__poor

Subjects diagnosed with SDAT check the following tests.

12. Tests completed:

a) Physical Examination	________	No	________	Yes
b) Neurological Examination	________	No	________	Yes
c) Laboratory Blood Tests	________	No	________	Yes
d) EEG (brain wave)	________	No	________	Yes
e) CT scan	________	No	________	Yes

APPENDIX C

"MINI-MENTAL STATE" EXAMINATION

Subject Code:-__________________ Date:-__________________
Score:-__________________

Now I would like to ask you some questions to check your concentration and your memory. Most of them will be easy.

	Right	Error	Can't Do	Other Refusal
ORIENTATION (Maximum score 10)				
What is the.......				
year?	1	2	6	7
season?	1	2	6	7
date?	1	2	6	7
day?	1	2	6	7
month?	1	2	6	7
Where are we right now?				
country?	1	2	6	7
state?	1	2	6	7
city?	1	2	6	7
street?	1	2	6	7
next street?	1	2	6	7

REGISTRATION (Maximum score 3)

I am going to name three objects. After I have said them, I want you to repeat them. Remember what they are because I am going to ask you to name them again in a few minutes.

Score first try, Repeat objects until all are learned.

Please repeat the	Apple:	1	2	6	7
three items for me.	Table:	1	2	6	7
"Apple""Table""Penny".	Penny:	1	2	6	7

Count trials and record. Trials:________________

APPENDIX C (cont'd)

ATTENTION AND CALCULATION (Maximum score 5)

Can you subtract 7 from 100, and then subtract 7 from the answer you get and keep subtracting 7 until I tell you to stop?	Record: (93) (86) (79) (72) (65)
	Number of errors: 0 1 2 3 4 5
	Can't do....................6
	Other refusal 7

Count 1 error when difference between numbers is not 7.

OR

Now I am going to spell a word forwards and I want you to spell it backwards. The word is WORLD, W-O-R-L-D. Spell "world" backwards.	Print letter: __ __ __ __ __
	Number of errors: 0 1 2 3 4 5
	Can't do 6
	Other refusal 7

Repeat if necessary, but not after spelling starts.

RECALL (Maximum score 3)

		Right	Error	Can't Do	Other Refusal
Now what were the three objects I asked you to remember?	Apple:	1	2	6	7
	Table:	1	2	6	7
	Penny:	1	2	6	7

LANGUAGE (Maximum score 9)

Show wristwatch. What is this called	Watch:	1	2	6	7
Show pencil. What is this called	Pencil:	1	2	6	7
I'd like you to repeat a phrase after me: "No ifs, ands, or buts" Allow only one trial.		1	2	6	7
Read the words on this page and then do what it says. Hand "close your eyes" sheet. Code 1 if respondent closes eyes.		1	2	6	7

APPENDIX C (cont'd)

		Right	Error	Can't Do	Other Refusal
Read full statement and then hand over the paper. I'm going to give you a piece of paper. When I do, take the paper in your right hand, fold the paper in half with both hands, and put the paper down on your lap	Right hand:	1	2	6	7
	Folds:	1	2	6	7
	In lap:	1	2	6	7
Write any complete sentence on that piece of paper for me. Sentence should have a subject and a verb, and make sense. Spelling and grammar errors are okay.		1	2	6	7
Here is a drawing. Please copy the drawing on the same paper.		1	2	6	7

Correct if the two five-sided figures intersect so that their juncture forms a four-sided figure and if all angles in the five-sided figures are preserved.

Folstein et al., (1975)

APPENDIX D

DEMENTIA BEHAVIOR SCALE

Subject Code:____________________ Date:_____________________

Score:____________________________

LANGUAGE - CONVERSATION
0 Conversational
1 Repeats self, searches for synonyms, reticent conversation
2 Circumlocution, white lies, mild vocabulary limitation, easily led in conversation, automatisms
3 Loses thread of thought, noticeable vocabulary loss
4 Less aware of mistakes, poor syntax and sequence, perserveration, neologisms
5 Parrots words, incoherent, uncomprehending, severe vocabulary limitation
6 Mute, unresponsive

SOCIAL INTERACTION
0 Assists, takes initiative
1 Active participant, follower
2 Bland participant, no longer empathic, loss of tact
3 Observer only, misidentifies close relatives, at time belligerent-defensive-suspicious
4 Out of step, poor recognition of persons, mistakes own reflection, at times menacing
5 Wanders, frequent catastrophic reaction (defiant, suspicious, combative)
6 Blank

ATTENTION - AWARENESS
0 Bright, responsive
1 Requires guidance, can't recall date
2 Shortened attention, can't recall day, easily distracted
3 Wandering attention, easily tires, very few pleasures
4 Distracted by illusiions, picks at imaginary lint, misidentifies objects
5 Can be engaged sporadically and briefly
6 Oblivious

APPENDIX D (cont'd)

SPATIAL ORIENTATION

Ø Oriented
1 Oriented to immediate locus only (can't get home)
2 Hesitant, loses things
3 disoriented to place, hides things, pack rat
4 Body disorientation, can't seat self on chair, bodily illusions, oblivious to posture
5 Hallucinating
6 Totally lost

MOTOR COORDINATION

Ø Fully coordinated
1 Underactive, responsive to commands
2 Poorly coordinated, slowly moving, stumbling
3 Occasionally requires manipulation, occasionally requires assistance
4 Involuntary movements interfere, immobile, neglect of one side, requires manipulation and assistance
5 Spastic, chin on chest, wheelchair for safety, maximum physical assistance
6 Unable to ambulate, limbs contracted

BOWEL AND BLADDER

Ø Self care
1 Asks to go, needs cues to locate loilet
2 Remindable, poor hygiene occasionally, forgets to flush
3 Regular supervision, requires assistance occationally wet
4 Occasional fecal incontinence
5 Unpredictable, control by enema, occasional diapers
6 Fully incontinent, full-time diapers, full-time catheter

EATING AND NUTRITION

Ø Self-care, weight steady, can cook
1 Needs prompting to eat, history - weight loss, burns pots
2 Needs food cut up, wanders from table, can't cook
3 Improper use of utensils, uses fingers,slight weight gain
4 Voraciously interested in sweets, steals food, marked weight gain, marked weight loss
5 Must be fed, eats nonfood
6 Tube fed, dysphagic

APPENDIX D (cont'd)

DRESS AND GROOMING

Ø	Appropriate self-care, well groomed
1	Won't change, poorly groomed
2	Dirty, ill-kempt, inappropriate dress, food on face
3	Misuse of clothing, misidentification of clothes, wears other's clothes, needs clothes set out
4	Dresses with instructions and help, oblivious to grooming
5	Requires full assistance
6	Must be dressed, hospital gown

Haycox (1984)

APPENDIX E

GERIATRIC DEPRESSION SCALE (SHORT FORM)

Subject Code:-______________
Date:-______________________
Score:-_____________________

Instructions: Choose the best answer for how you felt over the past week.

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1. Are you basically satisfied with your life?..... yes/no
2. Have you dropped many of your activities and interests?.................................... yes/no
3. Do you feel that your life is empty?............ yes/no
4. Do you often get bored?......................... yes/no
5. Are you in good spirits most of the time?....... yes/no
6. Are you afraid that something bad is going to happen to you?............................... yes/no
7. Do you feel happy most of the time?............. yes/no
8. Do you often feel helpless?..................... yes/no
9. Do you prefer to stay at home, rather than going out and doing new things?................. yes/no
10. Do you feel you have more problem with memory than most?............................... yes/no
11. Do you think it is wonderful to be alive now?.. yes/no
12. Do you feel pretty worthless the way you are now?...................................... yes/no
13. Do you feel full of energy?..................... yes/no
14. Do you feel that your situation is hopeless?.... yes/no
15. Do you think that most people are better off than you are?............................... yes/no

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Sheikh and Yesavage (1986)

APPENDIX F

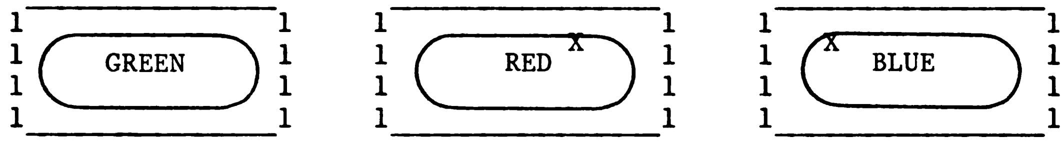
SCREENING TEST

To test vision and ability to comprehend directions. It also serves as a practice exercise before actual testing.

Color Recognition Memory Task

Initial learning task

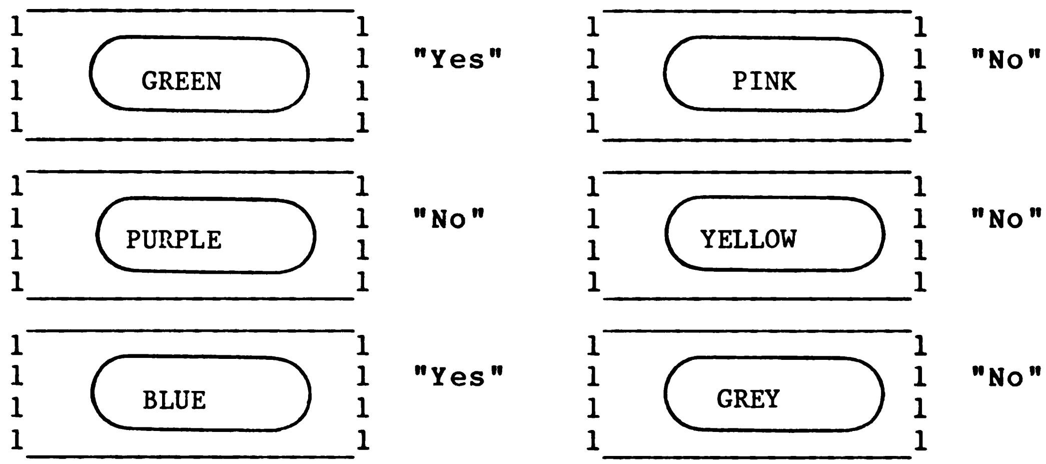
Instructions: Point to the "Yes" response card if you see an "x" on the colored shape, and point to the "No" response card if you do not.



"No" "Yes" "Yes"

Memory recognition test

Instructions: You will be shown a series of colored shapes. Point to the "Yes" response card if you have seen this color before and point to the "No" response card if you have not.

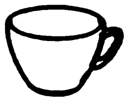


APPENDIX G

PICTURE RECOGNITION TASK

Picture Recognition Learning Phase

Instructions for RM1 - "Do you see an 'x' on the object?"

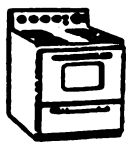


"NO"

Instructions for RM2 - "Can you carry this object easily?"

"YES"

Instructions for RM3 - "Where in the house would you most likely find this object and place it there."



bedroom	bathroom	
kitchen	living room	Garage

Picture Recognition Test Phase

Instructions for all groups (RM1, RM2 & RM3) - "Have you seen this picture before?" or rephrased "Do you think you saw this object or do you think you did not see this object?"

"YES"

APPENDIX H

PICTURE RECOGNITION LEARNING FORM

Learning Phase Score Form for RM1

	RM1: focus- physical		
ITEM	"YES"	"NO"	NO RESP.
1. stove			
2. telephone			
3. washing machine			
4. bed			
5. fireplace			
6. toaster			
7. faucet			
8. screw driver			
9. toothpaste			
10. couch			
11. refrigerator			
12. dress			
13. car			
14. toothbrush			
15. broom			
16. television			
17. shirt			
18. saw			
19. pants			
20. fork			
21. toilet			
22. tie			
23. rocking chair			
24. shoe			
25. comb			
26. cup			
27. piano			
28. bicycle			
29. soap			
30. hammer			

APPENDIX H (cont'd)

Learning Phase Score Form for RM2

ITEM	RM2: focus- semantic		
	"YES"	"NO"	NO RESP.
1. stove			
2. telephone			
3. washing machine			
4. bed			
5. fireplace			
6. toaster			
7. faucet			
8. screw driver			
9. toothpaste			
10. couch			
11. refrigerator			
12. dress			
13. car			
14. toothbrush			
15. broom			
16. television			
17. shirt			
18. saw			
19. pants			
20. fork			
21. toilet			
22. tie			
23. rocking chair			
24. shoe			
25. comb			
26. cup			
27. piano			
28. bicycle			
29. soap			
30. hammer			

APPENDIX H (cont'd)

Learning Phase Score Form for RM3

Item	RM3: focus- semantic elaboration					
	Bed room	Bath room	Kitchen	Living room	Garage	No res.
1. stove						
2. telephone						
3. washing machine						
4. bed						
5. fireplace						
6. toaster						
7. faucet						
8. screw driver						
9. toothpaste						
10. couch						
11. refrigerator						
12. dress						
13. car						
14. toothbrush						
15. broom						
16. television						
17. shirt						
18. saw						
19. pants						
20. fork						
21. toilet						
22. tie						
23. rocking chair						
24. shoe						
25. comb						
26. cup						
27. piano						
28. bicycle						
29. soap						
30. hammer						

APPENDIX I

PICTURE RECOGNITION TEST FORM

Test Phase Score Form

ITEM	"YES"	"NO"	NO RESP.	DON'T NO
1. faucet				
2. broom				
3. airplane				
4. couch				
5. comb				
6. turtle				
7. bus				
8. bed				
9. rabbit				
10. washing machine				
11. toothbrush				
12. kite				
13. fireplace				
14. cow				
15. stove				
16. feather				
17. screw driver				
18. ship				
19. shirt				
20. bird				
21. truck				
22. toilet				
23. parachute				
24. camel				
25. cup				
26. monkey				
27. rocking chair				
28. helicopter				
29. saw				
30. star				

APPENDIX I (cont'd)

Test Phase Score Form

ITEM	"YES"	"NO"	NO RESP.	DON'T NO
31. car				
32. balloon				
33. piano				
34. bear				
35. hammer				
36. dress				
37. lion				
38. train				
39. pants				
40. swan				
41. deer				
42. bicycle				
43. church				
44. refrigerator				
45. peacock				
46. telephone				
47. moon				
48. soap				
49. mountain				
50. fork				
51. skunk				
52. toothpaste				
53. hen				
54. toaster				
55. tie				
56. snake				
57. heart				
58. television				
59. pig				
60. shoe				

APPENDIX J

INFORMED CONSENT FORM

It is important that the following explanation of the proposed research be read and understood before agreeing to participate in this study. It describes the purpose, procedure benefits, risks, costs and confidentiality of the study.

Purpose of the study

I,______________________________(subject's name), freely consent to participate in a research project, the purpose of which is to learn how different groups of older adults remember information, given different questions to help focus on a specific aspect of the stimuli during initial learning.

Procedures

I will be asked to participate in a short interview for the purpose of obtaining general background information. I will also take a short examination focused on orientation, memory and language skills. This information will be used to select and match subjects with similar characteristics and mental capacity for the study. If I am asked to continue as a subject in this study, I will then be asked to answer questions about how I felt

APPENDIX J (cont'd)

over the past week and how I function in my activities of daily living. The researcher will then show me a series of pictures and ask me to respond to a question by pointing to a "yes" or "no" response card. At the end of this series, a second series of pictures will be shown to me and I will be asked to respond in a similar manner. The estimated time of my participation in the study is about one hour.

Risks, Benefits, Confidentiality & Costs

The only risk factor in this study is that of fatigue. To counter this effect I will be given frequent rest periods during the study. I will not be involved in any activity that presents either psychological and/or physical danger. I understand that there are no guarantees of individual benefit from the results, but I will not incur any costs as a participant in this study. The information obtained during the study will be confidential and anonymity will be guaranteed by removing all names and identifying materials from records that are kept.

Right to Withdraw & Availability of Information

My participation in this study is voluntary. I understand that I may refuse to participate, and I am also free to withdraw from the study at any time. These actions

APPENDIX J (cont'd)

will not prejudice my future treatment in any way. If I have any questions concerning this study, I may seek answers to these questions from the researcher, Mangala Sadasivan (Phone: 355-2740 or 353-8541)

Witnessing and Signatures

I have read and understood the above explanations and give consent to my voluntary participation in this study.

Signature of Subject / Legal Representative ______ Date

Signature of Investigator ______ Date

Signature of Witness ______ Date

LIST OF REFERENCES

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