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Semantic Memory and Language in Dementia of the Alzheimer Type

by

Monty K. Nelson ©

A thesis presented to the Faculty of Graduate Studies and Research in partial
fulfillment of the requirements for the degree of Doctor of Philosophy
in
Counselling Psychology

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Abstract

Dementia of the Alzheimer Type (DAT) is a degenerative, terminal illness that has a devastating effect not only on the individual, but also on their family and friends. Current research seems to indicate that neuropsychological tests of semantic memory through object naming can be helpful in identifying those who are entering the early stages of the disease, although it is unclear whether semantic memory disintegrates or if access routes are disrupted. Few studies provide comparisons between visual and tactile object identification skills in DAT patients. Little research exists comparing the performances of healthy adult controls to DAT patients, and even fewer studies investigate the utility of a nonverbal modality of response. In order to investigate these three areas, the performance of 18 patients with DAT was compared to the performance of 21 healthy adults aged 60 and over on several tasks. A set of household objects was presented one at a time for all participants to identify visually or by touch. Control and experimental participants tried to name these objects as quickly as possible, and the number of correct recognitions were compared. Results indicated that if patients were unable to state the name of the object they were attempting to identify they benefitted from having a selection of possible names to choose from, indicating that semantic information remains. Partipants also tended to respond verbally, even when given the choice of responding nonverbally. Finally, results indicated that the DAT patients performed significantly poorer overall on tactile and visual object identification compared to controls.

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CHAPTER ONE

Introduction

Understanding Alzheimer's disease and its cognitive, social, and economic effects is of utmost importance to our society. The "aging" of the population requires an awareness of diseases associated with aging in order to prepare our health care system for these conditions. Canadians born in 1995 can expect to live to the ages of 81.3 for women and 75.3 for men (an average increase of over 5 years compared to 1971). This extension of our lifespans is accompanied by a greater risk of incurring a dementia (Statistics Canada, 1997a). In Canada, approximately 8% of adults over age 65 are diagnosed with a Dementia of the Alzheimer Type, or DAT (Canadian Study of Health and Aging, 1994). The risk of incurring the disease appears to roughly double about every 5 years after the age of 65 (Bondi, Salmon, & Kaszniak, 1996).

By the year 2041, the proportion of the population that is 65 or older will nearly double to 23% from the current 12% (Statistics Canada, 1994; 1996). Unless an effective treatment is found, the numbers of Canadians suffering from DAT will also significantly increase. DAT produces not only severe memory problems and communication difficulties, it eventually leads to death for many Canadians. DAT caused more deaths than AIDS in 1994 (Statistics Canada, 1997b).

Over the years, clinicians and researchers have clarified the deficits that emerge in DAT, yet there are still many areas remaining to be explored. DAT is classically characterized by difficulties with memory for new events and information (episodic memory). Semantic memory, the ability to name common objects and to utilize stored facts and general information, is one of the cognitive domains affected by DAT.

Theorists have explored several possible sources of disruption in naming abilities, including stimulus variables and cognitive processes. Regarding the former, Davidoff & DeBleser (1994) have demonstrated that stimuli such as drawings and pictures of objects produce fewer correct names than presenting DAT subjects with the actual object.

Regarding the cognitive aspects, there are several models that attempt to explain the naming process. Levelt (1989) has proposed that the naming process occurs in serial or sequential stages. Early research focused on the possibility that DAT patients were not able to successfully accomplish the first stage of the process, that of correctly perceiving sensory information (e.g. Barker and Lawson, 1968). Other researchers (Bondi et al., 1996; Butters, 1987; Cherktow & Bub, 1990; Monsch et al., 1992) suggest that perceptual problems are not the primary cause of naming problems. Rather, they suggest that the content of semantic memory is actually destroyed by the disease. However, Bayles (1987), Bayles & Tomoeda (1996), Labarge, Balota, Storandt, and Smith (1992), as well as Nebes (1994) propose that semantic memory remains, but access to the lexical information associated with the object is disrupted. Still others suggest that DAT produces some access disruption as well as destruction of the semantic stores (Castaneda, Ostrosky-Solis, Perez, Bobes, & Rangel, 1997; Daum, Reisch, Sartori, & Birbaumer, 1996; Johnson, Bonilla, & Hermann, 1997).

Models that contrast with the serial stage approaches to errors in naming involve parallel or simultaneous activations of semantic materials and the phonologically matching labels (Goodglass, 1993; McCarthy & Warrington, 1990; Plaut & Shallice, 1994). These models suggest that access to semantic memory may be modality specific. McCarthy and Warrington (1990) propose that problems of naming may be a result of disconnections between modality specific semantic systems and verbal knowledge. Thus, the objects presented visually and haptically could produce different levels of success. These models may explain some of the naming difficulties that DAT patients have with naming tasks. However, they have received little empirical validation.

If some or all of the contents of semantic memory remain intact, then it is possible that varying the modality of presentation of stimulus materials may allow DAT patients to demonstrate their knowledge. According to parallel models, it would seem possible that certain modalities of input may be affected but not others. Barker and Lawson (1968), Harrold (1988), Kempler (1988), and Benton, Sivan, Hamsher, Varney, & Spreen (1994) give some support to this notion. In these studies, it was shown that patients could demonstrate some of their semantic knowledge through alternative modalities of expression, such as physical actions.

This dissertation presents the results of a study designed to compare the effect of two presentation modalities, visual and tactile (or haptic), on object recognition. A sample of healthy adult control participants and DAT patients were asked to name objects presented to them visually or by touch. It was expected that the performance of

DAT patients would be somewhat poorer overall than that of controls. Benton et al., (1994) reported that patients with “Brain Disease” performed poorer than controls on tactile recognition tasks. However, this study did not break down the rubric of “Brain Disease”, and did not compare visual and tactile recognition. With respect to comparing visual and tactile naming abilities, there have been no studies using DAT patients.

Furthermore, the issue of the semantic memory system is still unclear. There are two schools of thought. Bondi, Salmon, and Kaszniak (1996), Butters (1987), Cherktow and Bub (1990), Monsch, Bondi, Butters, Salmon, Katzman, & Thal (1992) suggest that the content of semantic memory is destroyed by the disease. Others (Bayles, 1987, 1996; LaBarge et al., 1992; Nebes, 1994) suggest that semantic memory remains, but that access routes to it or to the lexical information associated with the object are disrupted.

In light of these issues, several research questions emerge:

Research Question 1:

If unable to name an object during an object recognition task, can DAT patients choose the correct name of an object from a list of choices?

Null Hypothesis (H_{01}): Average DAT correct recognitions will not differ significantly from an expected chance value of 1 out of 4 (0.25%).

Research Question 2:

How do DAT patients perform in comparison to themselves and to controls in attempting tactile and visual identifications of objects?

H_o2: Average DAT tactile % correct = Average DAT visual % correct

H_o3: Average DAT tactile % correct = Average NC tactile % correct

H_o4: Average DAT visual % correct = Average NC visual % correct

Research Question 3:

When given the choice to respond verbally or nonverbally, how would DAT patients respond?

H_o5: Average number of DAT patient nonverbal responses = 0

Chapter Two of this document presents a review of the literature regarding the nature of DAT. The current controversies in the theories and research findings surrounding anomia in DAT are reviewed. Further rationale for the research hypotheses are presented. Chapter Three outlines the methodology, and in Chapter Four the results are reviewed. These results are discussed in Chapter Five.

CHAPTER TWO

Review of the Literature

Alzheimer's disease represents a major public health problem for that there is currently no known cure. In Canada, the population aged 65 and older numbered 3.2 million in 1991. This is the fastest growing portion of the population, and it is expected to more than double to 7.8 million by the year 2031 (Statistics Canada, 1994). In Canada, approximately 250,000 (8%) of these senior citizens have some form of dementia, and the largest portion of this group (161,000 or 5% of all seniors) have a Dementia of the Alzheimer's Type, or DAT. The proportion of seniors with DAT increases steadily in higher age groups, and it may be as high as 60% or more for those over age 90 (Launer et al., 1999). While the proportion of seniors in the population is expected to double, the proportion of DAT patients is expected to quadruple by 2031 (Canadian Study of Health and Aging, 1994).

Furthermore, it appears that the impact of this shift in demographics is being felt most in Canada's rural provinces and in one city. While provincial averages of senior populations currently stand at 12% across Canada, 14% of the residents in Saskatchewan and Manitoba are over the age of 65 (Statistics Canada, 1997a). However, in 1995, 18% of the residents in the city of Victoria were 65 or older (Statistics Canada, 1997b), and if current trends continue, the percentage will go even higher in the future.

As such, the need for health care professionals trained in issues surrounding aging is becoming more pronounced in our society and around the world. The specialists involved with dementia patients may include neurologists, psychiatrists, nurses, pharmacists, radiologists, pathologists, and even social workers, but it is psychologists who are often most important in diagnostic efforts and case management (Heston & White, 1991; Zarit & Zarit, 1998).

Differential Diagnosis of Dementia of the Alzheimer Type (DAT)

The criteria for diagnosis of DAT as listed in the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition* (DSM-IV; APA, 1994) include the presence of amnesia, as well as aphasia, apraxia, agnosia, or "executive functioning" difficulties (such as planning and organizational abilities). Furthermore, these deficits must be noticeable enough to cause significant impairment in the life of the individual, such as in their work or social functioning or being able to manage the activities of daily living. The history of the course of the individual's problems should indicate that the difficulties began gradually and progressively deteriorated in order to be considered an Alzheimer's illness. While memory problems are most often noticed, early difficulties can also involve language and naming problems and personality changes (Bolger, 1994; Lezak, 1995; Salmon & Bondi, 1997). Those affected with DAT may go from forgetfulness in the early stages of the illness to difficulties with essential activities of daily living, such as bathing, dressing, eating, and toileting (Tariot, 1994). In contrast, those who suffer a stroke or several strokes during their life generally evidence more sudden deteriorations in their performance, known as a "stepwise progression" (Lezak, 1995).

Other Dementias

DAT must be distinguished from many other conditions. DAT is the most common of several major subtypes of cortical and subcortical dementias (Benson & Ardila, 1996; Lezak, 1995; Maxmen and Ward, 1995; Zarit & Zarit, 1998), and it accounts for the majority of all diagnosed dementias. The second group of dementias are vascular dementias, that are caused by such factors as repeated strokes. This group accounts for slightly more than 10% of dementias. Third, substance-induced dementias account for slightly less than 10% of all dementias. Finally, dementias due to other general medical conditions account for up to 30% of all other dementias. This category includes dementias that are due to other systemic illnesses, such as Parkinson's disease, Pick's disease, HIV dementia, progressive supranuclear palsy, and Huntington's disease. It also can include conditions such as dementias induced by head injuries, vitamin deficiencies, or tumours (Maxmen & Ward, 1995).

Several other nondementia conditions may mimic the presentation of DAT. Current research as well as the DSM-IV state that particular caution must be used to distinguish dementias from delirium and depression (formerly referred to as pseudo-dementia). Although both of these conditions can present with memory problems and disorientation or confusion, depression and delirium generally emerge more suddenly than the symptoms of DAT (Cooper, 1993), and their course tends to be more variable. Further, Koss (1994) states that a rule of thumb is that depressed patients may appear more demented that they actually are, whereas the reverse is true for Alzheimer's patients. Depressed patients tend to complain about their difficulties, whereas DAT patients may try to hide them or minimize them, particularly in early to moderate stages of the illness (Kaszniak & Ditraglia-Christenson, 1994; Koss, 1994).

Language Disorders

Language disorders due to brain damage (aphasias) are also often confused with dementia. The diagnosis is made particularly challenging because the aphasias may occur in conjunction with a dementia or in association with more focal lesions and injuries, other degenerative conditions, or even developmental causes (Benson & Ardila, 1996; Damasio, 1992; Gaddes & Edgell, 1994). The categorization of aphasic difficulties is based upon the language functions (i.e., skills such as fluency, comprehension, repetition, and naming) that are impaired. For example, global aphasia generally impairs all language functions and usually occurs in large left-hemisphere strokes. By contrast, anomic aphasia, that is common in DAT and will be discussed in greater detail later, primarily affects word-finding and may be related to lesions in many areas, most notably the left angular or left posterior middle temporal gyrus (Weiner, 1996) or even extending to the inferior temporal gyrus (Goodglass, 1993). Broca's aphasia (also referred to as anterior or nonfluent aphasia) impairs verbal fluency, repetition, and some naming abilities. This condition often results from lesions of the posterior inferior portion of the dominant (usually left) frontal lobe, and is often associated with arm or facial weaknesses on the right side of the body (Code, 1989). In this condition, speech requires great effort, and the speaker omits word modifiers such as articles, prepositions, and conjunctions to form "agrammatic" speech (Ripich, 1994; Sasanuma, 1993). While usually able to comprehend speech and obey commands, these patients have difficulty with repetition, reading aloud, and even writing.

Naming difficulties that are often found with Broca's aphasics are often helped by prompting (Weiner, 1996). In contrast, Wernicke's aphasics (also referred to as posterior or fluent aphasics) have fluent paraphasic, neologistic speech with poor comprehension, repetition, and naming. This type of naming difficulty, however, is not usually aided by prompting (Damasio, 1992). Because of their inability to comprehend what others say, these "fluent aphasics" may become paranoid and confused (Gaddes & Edgell, 1994). Reading and writing are also impaired, and usually the Wernicke's aphasic is not aware of the peculiarity of his or her own speech. This condition can occur as a result of damage to the posterior superior portion of the first temporal gyrus of the dominant hemisphere (Weiner, 1996).

Other aphasia syndromes are transcortical motor (impaired fluency and naming), transcortical sensory (impaired comprehension and naming), conduction (impaired repetition and naming), and mixed transcortical aphasia, a combination of transcortical sensory and transcortical motor aphasias that renders a patient restricted to echolalic speech (Damasio, 1992).

In differentiating an aphasia from a dementia, it is essential to do a detailed history of the patient keeping in mind that the previously mentioned "progressive" versus "stepwise" progressions of the illness can be useful in detecting when an obvious brain insult, most often strokes or head trauma, might have occurred. There are usually neurological deficits such as hemiparesis (particularly in Broca's aphasics), unilateral hyperreflexia, and even visual field deficits that accompany these type of cerebral injuries. The aphasias may exist separately or in conjunction with DAT or in conjunction with many other conditions. Therefore, the differential diagnosis can be very difficult or nearly impossible to achieve while the patient is alive.

Postmortem Verification of DAT

The final diagnostic criterion listed in DSM-IV states that the diagnosis of DAT is truly a process of the exclusion of other possible causes of the symptoms. That is, competing factors such as cerebrovascular conditions, Pick's disease, Parkinson's or Huntington's disease, tumours, or other previously mentioned conditions must be considered and then ruled out as the cause of the patient's memory, language, sensory and motoric difficulties. To date, no single marker or set of markers for reliable positive identification of DAT in living patients has been developed, although cognitive and neuropsychological testing is becoming quite accurate (Zarit & Zarit, 1998; Lezak, 1995). Therefore, the confirmation of DAT requires specific postmortem neuropathologic findings. This postmortem confirmation entails the presence of neuritic plaques coating the cerebral blood vessels and neurofibrillary tangles within the neurons in parts of the cerebral cortex and hippocampus (Tariot, 1994). These plaques are spherical structures that contain a central beta-amyloid protein core and are surrounded by abnormal dendrites and axons. The purpose of this beta-amyloid protein is unknown, and while some view it as a protein crucial to the development of the central nervous system, others postulate that is a neurotoxin. Regardless of the purpose, most view the presence of the beta-amyloid protein plaques as a diagnostic sign of DAT (Gaspic, 1995). The tangles appear as bundles of filaments that are found in the cell bodies as well as in the dendrites and axons.

In addition to these plaques and tangles, the development of some cerebral atrophy and dilation of the ventricles is commonly seen in the brains of DAT patients in MRI or CT scans as well as during autopsy (Bigler, 1997). This type of finding is possibly due to a decreased blood supply, as seen in SPECT scans, and even decreased extraction of oxygen and glucose (Bigler, 1997; Maxmen & Ward, 1995). As cellular degeneration occurs and brain volume is lost, decreased amounts of cholinergic neurotransmitters have also been noted (Gaspic, 1995).

Etiology of DAT

The presence of plaques and tangles seem to be generally viewed as markers along the final common pathway of causes that produce DAT. However, many questions remain as to the precursors of this pathway. Speculations regarding the influences on the human body that might contribute to the later development of DAT vary widely. Certainly, one of the single most important risk factors for developing the disease is age (Bondi et al., 1996; Canadian Study of Health and Aging, 1994). Simply put, the older a person gets, the more likely he or she is to receive a diagnosis of DAT.

The incidence of the disease appears to double about every 5 years after the age of 65 (Lezak, 1995; Bondi et al., 1996).

Infectious processes analogous to the transmissible, progressive and degenerative central nervous system diseases of Kuru and Creutzfeldt-Jakob syndrome have been hypothesized to exist for DAT (Friedland, May, & Dahlberg, 1990), but evidence to support this has not been forthcoming. Other studies suggest that excessive inflammatory reactions due to repeated infections or autoimmune dysfunctions could lead to neuronal cell damage (McGeer, McGeer, Rogers, & Sibley, 1990). The occurrence of head injuries has also been identified as being associated with a greater risk of developing dementias such as Alzheimer's Disease (Bondi et al., 1996; Canadian Study of Health and Aging, 1994).

Exposures to environmental toxins have been suggested. One of these theories concerns the neurotoxic potential of aluminum in the environment (McLachlan, Kruck, Lukiw, & Krishnan, 1991; Tariot, 1994), but the evidence is inconclusive (Canadian Study of Health and Aging, 1994). That is, although deposits of aluminum are found in the brain cells of some DAT patients, it has been questioned as to whether the damaged brain cells collect, produce, or fail to absorb the aluminum and even whether the aluminum itself causes the damage (Lezak, 1995, p. 206; McLachlan et al., 1991). Furthermore, there is no consistent evidence to support that sources of aluminum are associated with cognitive impairment. For example, although a small association has been found between aluminum-containing antiperspirants and DAT (Graves et al.,1990), there was none found for products such as antacids. However, analyses of a

Canadian sample indicates an increased risk for DAT for those who were exposed to other environmental toxins, such as glues, pesticides and fertilizers (Canadian Study of Health and Aging, 1994).

The number of years of formal education has also been indicated as a risk factor for DAT (Canadian Study of Health and Aging, 1994; Katzman, 1993). Those who are uneducated are at a significantly higher risk for developing DAT than those with at least a grade school level of education (Bondi et al., 1996, p. 164). There are several theories regarding this association; it has been hypothesized that the connection is possibly due to increased brain reserve as a result of greater synaptic density (Katzman, 1993; Satz, 1993). However, it may also be that the amount of education that a person receives is related to his or her preclinical level of intelligence. Investigations of premorbid levels of intelligence and global cognitive functioning have been shown to be related to the incidence of Alzheimer's Disease (Small, Herlitz, Fratiglioni, Almkvist, & Backman, 1997). Schmand, Smit, Geerlings and Lindeboom (1997) studied estimates of premorbid levels of intelligence, years of attained education, and subsequent development of a dementia. They followed a sample of over 2000 Dutch men and women over the age of 65 for a period of 4 years and monitored the incidence of dementia. They found that low premorbid levels of intelligence were better predictors of incident dementia than levels of education. However, this study used a measure of expressive reading ability as a sole estimate of premorbid intelligence, and the diagnosis of a dementia was made by lay interviewers rather than trained health care professionals.

Amidst all of the above mentioned possibilities and risk factors, the strongest probable cause of DAT may lie in genetics. This suspicion emerges due to the fact that some families manifest high rates of DAT in an autosomal dominant pattern of transmission (i.e., familial Alzheimer's Disease). The pattern of prevalence seems to be much higher among first degree relatives of a person with DAT in these families than compared to the general population (Maxmen & Ward, 1995; Bondi et al., 1996). Specifically, mutations of chromosomes 4, 6, 12, 14, 19, 20 and 21 have been linked to a higher incidence of familial Alzheimer's Disease (Pericak-Vance et al., 1997; Tariot, 1994). Currently, most of the focus on genetic causes is centering on one variant of the substance known as Apolipoprotein that originates from the codes on chromosome 19. Three types of Apolipoprotein (also known as Apo E) have been identified: Apo E2, Apo E3, and Apo E4. About 15% of the population carry one or two copies of the E4 allele code. Unfortunately, people with one copy of the Apo E4 allele have two to three times the risk of developing DAT. Even worse, people who have both copies of the Apo E4 allele have nearly 10 times the risk (Zarit & Zarit, 1998) and are also likely to develop DAT quite early. Conversely, developing the E2 form of Apo actually decreases the risk of DAT (Pericak-Vance et al., 1997).

Although the precise nature and importance of internal or genetic factors and external or environmental factors are not completely understood, their roles appear to be variable and interactive. A single gene abnormality may be crucial in some cases to produce DAT, multiple abnormalities in other cases, and interactions between environmental risk factors and genetic predispositions in others may result in the development of DAT (Zarit & Zarit, 1998). Because no single, simple, identifiable cause for DAT exists and because it is more likely to develop as a result of complex interactions between multiple factors such as those described above, DAT as been described as a "convergence syndrome" (Blass, 1993). That is, multiple factors result in a final common pathway of symptoms.

Psychological Assessment in DAT

Cognitive assessments can play an important role in establishing or rejecting a probable DAT diagnosis. Of particular interest are some standard screening instruments as well as some specialized neuropsychological batteries. Certain memory and language disturbances that emerge in naming tasks can be a reliable and early marker of DAT (Bayles & Kaszniak, 1987). However, in cognitive neuropsychology, conflicting theories exist regarding the cause of these disturbances in language. An assortment of instruments and tasks have been designed and greatly refined over the years to improve these theories and the diagnosis of DAT.

General Assessment Instruments

Much of the research in neuropsychology has centered on attempts to identify cognitive markers of preclinical DAT. These attempts arise from the previously mentioned view that DAT may be the final pathway of a type of chronic disease, in that certain factors (such as genetics, trauma, or other factor) converge to predispose the brain to enter a type of active or malignant phase (Blass, 1993; Bondi et al., 1996).

This malignant phase is characterized by the intracellular events that lead to neuritic degeneration (i.e., neurofibrillary tangles, neuron and synapse loss) as well as the beginnings of cognitive difficulties. Over a period of time, the degenerations converge and gradually reach the level of clinically noticeable symptoms of the dementia syndrome (Katzman & Kawas, 1994). This model for understanding the framework and development of DAT suggests that the cognitive difficulties that are associated with DAT also appear gradually and might be identified before the level of neural degeneration reaches the level of clinically "diagnosable" symptoms of DAT.

Although the precise length of this preclinical phase of DAT is not known, and may vary considerably among affected individuals, there is a growing body of evidence that seems to show that subtle cognitive impairments, particularly with regard to naming abilities, can be detected several years prior to the clinical diagnosis of DAT (Bayles & Kaszniak, 1987; Bondi et al., 1996). The life expectancy of people who are diagnosed with DAT can vary significantly, ranging from approximately 2 to 15 years after symptoms emerge (Bracco et al., 1994), and it may be even significantly less for males (Heyman, Peterson, Fillenbaum, & Peiper, 1996). Therefore, early detection and preparation for the sequalae of the illness can be vital.

The standard short screening instrument for dementias is Folstein's (1975) Mini Mental State Examination (MMSE). Commonly used by a wide range of health care practitioners, including physicians, occupational therapists, nurses, and psychologists, the MMSE is a screening tool with various questions that are used to quickly assess the patient's time/place orientation, attention/calculation abilities, as well as some limited recall, language, and visuospatial skills. For each correct answer, a point is given with a maximum score of 30 points. A cut-off of 24 or lower suggests of cognitive impairment that could be due to dementia or delirium. Although the MMSE is extremely easy to administer and takes less than 10 minutes to gather valuable information about the basic functioning of the patient, it must be remembered that this instrument may easily be affected by the patient's education level or sensory impairments such as a visual field problem. Further, the MMSE is not able to accurately differentiate between the various types of dementias or their severity.

The MMSE has been altered by various clinicians and exists in several forms, but few have been standardized (Zarit & Zarit, 1998). Teng and Chui (1987) have developed the Modified Mini-Mental State (3MS) exam that is somewhat more sophisticated. The 3MS has a lower floor and higher ceiling, and it samples a wider range of cognitive abilities. Cognitive abilities sampled include orientation to time, place, and the person's own identity, as well as short- and longer-term memory, naming and verbal fluency, writing, drawing, and copying skills, and understanding commands. Based on a maximum score of 100, 78 or below represents a score indicating significant levels of impairment, often indicative of dementia. This test may be even more sensitive for detecting impairment than Folstein's original version (Canadian Study of Health and Aging Working Group, 1994), but one must keep in mind that it still has limitations. A person can receive a score much lower than the cut-off if he or she is nonverbal due to factors such as a stroke-related aphasia or if they have bilateral motoric impairments that prevent them from performing some of the manual tasks of the 3MS. As such, the primary utility of the 3MS remains as a brief screening instrument, and if impaired scores do emerge, further investigation must ensue. Some efforts are even being made to use the 3MS as a basis for nursing care plans (Barnes, 1998) in nursing homes. However, caution must be advised in using the results of the 3MS to assume that certain functions are intact or deficient. A neuropsychological assessment in order to obtain further information regarding the patient's memory and naming abilities is usually indicated if the scores on the 3MS reveal significant difficulties.

Neuropsychological Assessment of DAT

A near-essential feature in most hospitals that perform diagnostic work with patients suspected of having DAT is the neuropsychological evaluation (Lezak, 1995; Salmon, 1997). A neuropsychological assessment is often able to provide a unique and comprehensive perspective on the cognitive capabilities of people with brain damage and those with DAT. Larger, more detailed neuropsychological examinations may include the use of portions of the Halstead-Reitan test battery (Halstead, 1947; Reitan, 1984), the Boston Approach (Kaplan, Goodglass, & Weintraub, 1983), or others. In almost all cases, the Wechsler Adult Intelligence Scale-Revised (WAIS-R, Wechsler 1981) or Third Edition (WAIS-3,Wechsler, 1997) in whole or in part is often used as a core component of their investigations. However, differences often do not emerge on the WAIS-R or WAIS-3 that can assist in the differentiation between the primarily cortical dementias such as DAT and the primarily subcortical dementias that result from conditions such as Huntington's Disease (Butters, Goldstein, Allen, & Shemansky, 1998). As such, specialized batteries for dementias must be used that evaluate the illness. These more detailed and specialized batteries cover a wide range of tasks, including orientation, attention, memory, verbal fluency tasks (such as naming abilities), sensorimotor functioning, and executive functioning (Butters, Salmon, & Butters, 1994; Lezak, 1995).

Memory and DAT

Although many cognitive abilities are affected in dementia, the neuropsychological assessment of the specific deficits that are associated with memory dysfunction has proven to be the most useful in detecting a dementia (Butters, et al., 1994; Rosenstein, 1998; Salmon, 1997). To most people, DAT patients are classically thought of and characterized by their difficulties in the consolidation and storage of new occurrences, events, and information and a rapid rate of forgetting this "episodic memory" (Bondi et al., 1997; Welsh, Butters, Hughes, Mohs, & Heyman, 1991, 1992; Zarit & Zarit, 1998). Episodic memory deficits seem to occur as a result of defective encoding and storage of new information as well as a significant susceptibility to pro-active interference and accelerated rates of forgetting (Hodges & Patterson, 1995). Identifying the episodic memory deficits of mildly demented patients seems to be best achieved through a free-recall test of new material (such as a list of words) that was presented 10 to 20 minutes earlier in the assessment (Butters et al.,1988; Salmon, 1997; Welsh et al., 1991). This type of test is used for confirming the rapid rate of episodic decay that is characteristic of dementia patients (Welsh et al., 1991). However, these types of episodic memory tests may not always discriminate well between DAT and other dementias (Butters et al., 1994) and as such may lack some of the necessary specificity.

Semantic memory has been increasingly examined as a system that seems to deteriorate uniquely in DAT (Bayles & Kaszniak, 1987; Salmon, 1997). Semantic memory refers to the component of long-term memory that contains knowledge of objects, facts, concepts, as well as words and their meaning. In contrast to memory that is episodic, semantic memory is culturally shared rather than personal, and it is not necessarily associated with specific "episodes." In semantic memory conceptual knowledge is stored, such as types of food, cultural knowledge, basic rules of social interaction, and names of objects. Episodic and semantic memory are highly interdependent systems because information is transferred between them, and both types of knowledge are used in thinking (Nebes, 1989). Other tasks that are dependent on semantic memory include object naming (also called confrontation naming in neuropsychological testing), generation of definitions for spoken words, word-picture and picture-picture matching, and the generation of exemplars on category fluency tests (e.g. animals, vegetables, and so forth).

The underlying cognitive and theoretical conceptualizations of difficulties in tasks that depend on semantic memory has been a matter of controversy. Research has, therefore, sought to gain more information about the process of semantic memory access and utilization in hopes of providing increased diagnostic accuracy (Tierny et al., 1996). The majority of the research examining semantic memory is being pursued through tasks related to the generation of names, such as rapid verbal naming (verbal fluency tests) and confrontation naming of objects (Flicker, Ferris, Crook, & Bartus, 1987; LaBarge, Balota, Storandt, & Smith, 1992; Salmon, 1997). However, understanding problems in naming first requires a review of theories and conceptions of the normal process of naming.

Theories and Models of Naming

Anomia (disordered word finding ability) is a very common aspect of aphasia, if not the most common aspect (Benson and Ardila, 1996). Everyone complains from time to time that they are unable to find the "right word" for something, but this "normal" problem is greatly magnified to disabling levels by disruptions to the brain such as brain injuries or dementias. The use of the vast semantic memory "warehouse" of words, meanings, and associations that are available effortlessly to the average adult becomes a difficult chore for those with anomia when speaking in regular conversation or when asked to provide the name of an object.

Understanding what results in successful naming of an object is a complex process. Most approaches to describing models of naming involve qualities that depend on the nature of the object itself (stimulus variables) and processes that are thought to occur within the person (cognitive variables).

Stimulus Variables

Stimulus variables refer to the characteristics of the object or item that is to be named. Unfortunately, most research that has examined the effects of stimulus variables on naming have primarily looked at visual stimuli such as black and white hand-drawn pictures (Goodglass, 1993), and inferences have been made regarding how these would generalize to other modalities of sensory input (e.g., tactile or olfactory input). This research ignores the fact that pictures are rarely used in everyday discourse, and as such, naming tasks that use pictures of objects are artificial investigations (Goodglass, 1993; LaBarge et al., 1992). Nonetheless, one of the first categories of stimulus variables to be examined is the overall stimulus "quality." This category has been examined through procedures involving disruptions of the clarity of visual stimuli to be named. These disruptions have included drawing extra and irrelevant lines through pictures, presenting "out of focus" images, and even removing parts of the picture being presented. As would be expected, the poorer the quality of the stimulus, the more difficult it is to name objects (McCarthy & Warrington, 1990).

A second aspect of stimulus variables that has been examined is the size of the stimulus to be identified. Again, most of the work done in this area has examined manipulations of pictures. Results have shown a general link between typicality in size and success in object recognition, although this relationship is not always consistent (Johnson, Clark & Pavio; 1996).

A third aspect of the stimulus is the realism. Aspects of realism that have been examined include color, texture, viewpoint, and brightness. While this is a complicated area to study due to all of the potential aspects that may be subjectively associated with realism, generally, the more realistic the pictures, the more accurate the naming (Johnson et al., 1996). Furthermore, real objects are named more accurately than color pictures and black and white line drawings (Davidoff & De Bleser, 1994), especially for those people who are illiterate or semiliterate (Reis, Guerreiro, & Castro-Caldas, 1994). In addition, the "complexity" of the stimulus has been shown to possibly affect naming accuracy (Berman, Freidman, Hamberger, & Snodgrass, 1989), but even this may not be consistent (Biederman, 1987). However, as occurs with defining the concept of realism, research in this area is somewhat difficult to interpret due to the fact that researchers have defined complexity in so many different ways, ranging from participants' ratings of complexity, the number of pixels in a computer image, to the number of parts that an object has (Johnson et al., 1996).

In essence, it seems clear that interference with the clarity of stimuli can indeed result in poorer levels of naming. While the brain has remarkable capabilities to recognize and adapt to a wide variety of presentations of objects (McCarthy & Warrington, 1990), this adaptability has its limits. In addition, even when the presentation of the stimulus is clear, realistic (preferably the real object itself rather than a picture), and a typical portrayal, difficulties can still occur in one of the many cognitive components of naming.

Cognitive Models of Naming

Models to explain the cognitive processes involved in successful naming have evolved significantly over time, but they have retained many similarities. Based on the historical works of early European researchers such as Wernicke (1886) and Freund (1889), and even Freud (1935), many investigators have centered on a serial stage model of naming, such as that presented by Levelt (1989). Recently, competing theories, such as parallel or connectionist processing, have emerged (McClelland & Rumelhart, 1986; Plaut & Shallice, 1994). Many other models are being developed that seem to be integrating components of these two approaches, revolving around modified stage processes or even “dual process” approaches (e.g., Fernaeus & Almkvist, 1998; Johnson et al., 1997; Johnson, Clark, & Paivio, 1996).

Serial Stage Models

The serial stage models of successful naming generally posit that when a person is presented with the stimulus input of an object to be named the first component of the process is successfully recognizing the object. This object recognition stage involves the correct perception (Nebes, 1989) and identification of the object, although it may be a recognition that is ignorant of the range of uses and associations of the object (Gordon, 1997). Next, the object triggers a stage where the complete range of semantic associations and features of the object are retrieved from the semantic storage system (Johnson, Paivio, & Clark, 1996; Levelt, 1989; Nebes, 1989). Then the lexical information is accessed, including the specific name of the object. Levelt (1989) refers to the notion of a preword concept, called a "lemma," being activated just prior to the retrieval of the exact name for the object. The lemma does not have phonological properties; instead it is a configuration of semantic information that closely matches other concepts but will only identically "fit" one particular lexical representation. Finally, commands for articulation of a specific response are prepared and executed as phonetic output or motor realization (Johnson et. al., 1996; Levelt, 1989).

These stages are assumed to occur more or less in serial or sequential stages, although the number of stages can be described as few as three (Gordon, 1997) or as many as 6 or more (Levelt, 1989). Supporters of the serial stage model advocate that accessing the semantic store of information does not depend on modalities of sensory input, but rather that all modalities feed into the same semantic system. Geschwind (1969, cited in Goodglass, 1993) proposes that there is an actual anatomical centre corresponding to this central system, located in the left angular gyrus. Here, much convergence does indeed occur and stimuli from several areas relating to auditory, visual, and tactile information become associated, which allows us to link names with concepts. However, the angular gyrus is now seen as only one centre where a lesion may produce anomia (Goodglass, 1993; Goodglass & Wingfield, 1997). Cognitively, the "amodality" of the semantic system is subject to substantial debate (Gordon, 1997; Johnson et al., 1996; Goodglass, 1993; McCarthy & Warrington, 1990). Cherktow and Bub (1990) believe there is a centralized semantic store. They found a significant correlation between name comprehension (failures on a word to picture matching task where the target and distractors were from the same semantic category) and name production (confrontational naming) in a group of 10 carefully selected DAT patients. Their participants demonstrated a significant inability to answer questions concerning the pictures they were unable to identify. On the basis of this relatively consistent series of deficits relating to semantic memory, Cherktow and Bub conclude based on the consistency of difficulties across several access modalities, that the deficit in semantic memory was indeed a storage disorder.

However, De Bleser (1997), Shallice (1988) and others have criticized sequential stage models of naming difficulties due to the problems that these models have describing dissociations, in which semantic information about an object can be accessed through one modality but not another. These dissociations have been noted to occur where people were able to recognize an object and demonstrate that object through pantomime (De Bleser, 1997) but were unable to provide the name (otherwise called optic "aphasics"). Furthermore, Goodglass (1993) states that naming may not follow separate stages, and the types of errors that arise may not always show signs of being semantically or phonetically related to the target word.

Parallel Processing Models

Parallel processing models and the related theories referring to connectionist and "parallel distributed processing" (Goodglass, 1993; McClelland & Rumelhart, 1986; Plaut & Shallice, 1994; Shallice, 1988) take a different approach than models that describe discrete processing stages. In parallel processing, the presentation of a stimulus and demands to produce the name of that object produce a spreading activation throughout the neural network. It is hypothesized (Goodglass, 1993) that simultaneous activation of the semantic conceptual and lexical/phonological "tracks" in the neural network is either inhibited or reinforced according to strengths of associations between concepts, that are determined by prior learning and the individual's experiences. Plaut & Shallice (1994) state that the associative connections from a sensory-based stimulus to its conceptual representation in the brain are "updated" as a function of use and learning (p. 8). In essence, the searching activation of semantic conceptual and phonological tracks becomes refined, converges to interact and eventually pinpoints the correct semantic and lexical representation of the object (De Bleser, 1997). The production of output occurs without discrete and separable stages or ordinate rules. In essence, "probabilistic patterns" of neural activity develop each time a concept is reinforced through use and the strengthening of associations between related concepts. Consequently, errors in naming would result from inadequate selection processes among several interactions of related concepts, and semantically and conceptually related errors would be likely to result, as was found by Humphreys, Riddoch, and Quinlan (1988). Goodglass (1993) feels that the interaction track is a "highly vulnerable filtering apparatus" (p. 101), and while it normally rejects mismatches between the semantics and phonology of a concept, sometimes errors do make it to articulatory realization.

An approach to understand naming that is very similar to the parallel models, albeit described in slightly different terms, is offered by Johnson et al., (1996). These authors propose a 2-component or dual process model of processing. In their dual processing approach, thought is predicated on two independent but interconnected language and nonlanguage related subsystems (Johnson et al., 1996). The nonverbal aspect is comprised of image-like representations of objects, and the verbal subsystem is comprised of lexical or word-based representations. During the naming of an object, the stimulus is thought to link directly to the nonverbal system to provide increasing levels of activation until the recognition threshold for a nonverbal concept is surpassed, and the object is identified. This activation is spread to the associated lexical representations in the verbal system. Once sufficient activation occurs for a particular lexical representation, its threshold is surpassed and production of the name of the object begins (Johnson et al., 1996).

Broadly speaking, one of the key differences between the "serial" and "parallel" approaches is the conception that in the serial stage approach naming is generally thought to occur in distinct ordered stages and is mediated by a centralized semantic storage system (Levelt, 1989). This system, which contains the meanings and associations for objects, words, and other meaningful stimuli, is the general purpose knowledge base for attaching meaning to all sensory input stimuli. However, as mentioned above, this unitary conception of the semantic store is difficult to apply to cases of modality-specific anomias (McCarthy & Warrington, 1990). In the parallel or connectionist processing approach, it is held that there is a direct linkage between sensory perception of the object and a semantic store (Goodglass, 1993; Shallice, 1988). In essence, this "independent systems" account considers object recognition to be relatively self-contained and modality specific. Deficits or successes in naming are potentially able to be "dissociated" from other modality-based semantic systems (McCarthy & Warrington, 1990; Plaut & Shallice, 1994). Conversely, it would seem that the parallel models are also vulnerable to criticism as well. It is difficult to develop predictions in naming tasks based on this model, that usually requires detailed computer simulations and analysis. Furthermore, no attempts have been made to utilize this model in areas relating to DAT and naming difficulties.

Aging and Naming

Research generally seems to suggest that one's vocabulary usually remains strong throughout the last decades of life, but significant difficulties may still occur for normal elderly people during certain types of naming tasks. While an early study in this area by Borod, Goodglass, and Kaplan (1980) indicated that tests of confrontational naming ability showed declines with increasing age in the Boston Diagnostic Aphasic Examination, other research indicates that overall vocabulary seems to be relatively insensitive to normal aging effects (Bayles & Kaszniak, 1987; Nebes, 1989; Rosenstein, 1998; Salmon, 1997). In fact, many feel that an individual's language capabilities commonly increase during the lifespan, as evidenced by an increasing lexicon into the 60s and 70s (Bayles & Kaszniak, 1987; Salmon & Bondi, 1997). WAIS-R Vocabulary subtest scores remain stable or even increase with age (Benson & Ardila, 1996). LaBarge, Balota, Storandt, and Smith (1992) found few changes in the accuracy of object naming in 25 healthy elderly people on the Boston Naming Test. Nebes (1989) reports that many studies show that normal aging produces relatively slight changes in confrontational naming accuracy rates. Benson and Ardila (1996) state that language is relatively insensitive to age effects, and while some slight decrease in competency in confrontation naming may occur, educational levels are more significantly associated with these difficulties than age.

In contrast to the findings of these researchers, Nicholas et al., (1997) reported that statistical differences were detected when performances of four groups of men and women (ranging in ages from 30 to 79) were compared in confrontational naming abilities. In this study, they found that Boston Naming Test results were poorest in the oldest group. The authors report similar findings when they followed a group of 53 of these same men and women over a period of 7 years. Test scores declined significantly over time for people in all but the youngest age group. Furthermore, Nicholas et al, (1997) state that educational level was not a significant factor in word-finding abilities.

In summary, while much of the research over the years has supported the stability of vocabulary in normal aging, it seems that confrontational naming of line drawings (on tests such as the Boston Naming Test) may decrease over time. This leaves open the question as to whether naming difficulties are an inherent and normal part of aging or whether certain types of tasks with certain types of stimuli (e.g., confrontational naming of black and white drawings) are a poor method to measure verbal skills (Cox, Bayles, & Trosset, 1996). In the description of stimulus variables that can affect naming (discussed earlier in this chapter), it was shown that the more realistic the object, the better the chances of recognition (Davidoff & De Bleser, 1993;

Johnson et. al., 1996; McCarthy & Warrington, 1990), especially for those people who have literacy difficulties (Reis et al., 1994). Therefore, measuring confrontational naming skills using noncolored drawings such as those used in the Boston Naming Test is not the most appropriate means of evaluating naming abilities. While few models currently focus on the issue of perception as being primarily responsible for naming difficulties, it is certain that "less than perfect naming" can be induced by the use of "less than realistic" stimuli. As such, there is a need to evaluate object naming skills in normal elderly people and in those with dementias such as DAT, using real objects, in equivalent tasks across modalities. Perhaps then we can establish the true nature of naming abilities in elderly people.

Naming difficulties in Dementia of the Alzheimer Type

As stated earlier, severe anomia is a common occurrence in DAT. Whether measured through clinical observations, confrontation naming, or verbal fluency tasks (Bayles & Kaszniak, 1987; Benson & Ardila, 1996; Bondi et al, 1996; Lambon-Ralph, Patterson, and Hodges, 1997; Nebes, 1989; Paulman, Koss, & MacInnes, 1996; Rosenstein, 1998; Salmon, 1997), DAT patients consistently make more errors than controls (Lukatela, Malloy, Jenkins, & Cohen, 1998). Most of the current accounts of naming difficulties focus on the hypothesized sources and locations of problems within the serial or successive stage models of naming (Levelt, 1989). Three primary areas of difficulty have been investigated: the perceptual stage, the semantic access stage, and the lexical access stage. The probable source for the naming problems has developed through analysis of the types of errors that DAT patients make, their responses to assistance or cues, and the consistency patterns in deficits.

Early research suggested that many of the naming errors that DAT patients made were the result of problems in correctly perceiving the object. Barker and Lawson (1968) note that 100 patients with dementia showed a statistically significant improvement in confrontation naming when they were given the opportunity to handle the objects that were presented to them. They attributed their results to difficulties that dementia patients were having with perceiving the objects presented to them. While it is certain that elderly people can experience perception problems, naming problems continue to be more pervasive in DAT patients, even when possible sensory impairments have been investigated and screened out. Furthermore, errors made in naming are often semantically rather than perceptually related (Bayles & Kaszniak, 1987), and as such, it is generally felt that such perceptual errors are rarely the primary cause of naming problems in people with DAT (LaBarge et al., 1992; Lukatela et al., 1998).

Over the years, attention has gradually turned towards other aspects of the psycholinguistic stage models, such as the semantic memory storage system. At present, research is investigating whether semantic information remains intact during DAT or whether semantic memory is inaccessible (Bayles & Kaszniak, 1987; Cherktow & Bub, 1990; Hodges, Salmon, & Butters, 1992; Nebes, 1989). Investigations regarding this issue have generally utilized confrontational naming tasks or even verbal fluency tests.

In one of these studies, Butters et al. (1987) examined the verbal fluency of mildly demented DAT patients, Huntington's disease patients, and patients with alcoholic Korsakoff's syndrome using both letter and category tasks. In these tasks, participants had 60 seconds to verbally generate as many words as possible beginning with the letters F, A, or S, or exemplars from the semantic category “animals.” The results of this study showed that Huntington's disease and Korsakoff's syndrome patients demonstrated, respectively, severe and moderate deficits on both fluency tasks, presumably because of a general retrieval deficit. In contrast, DAT patients, who were matched with the other patient groups for overall severity of dementia, were impaired only on the category-fluency tasks. It was concluded that the difference was due to destruction of the semantic memory storage in DAT and that phonetic organizational strategies were not as vulnerable.

Monsch et al. (1992) investigated the efficacy of the category and letter fluency tasks for differentiating between DAT patients and normal elderly individuals. Consistent with the findings of Butters et al., (1987), these investigators found that the category fluency task was superior to the letter fluency task in differentiating between moderately demented DAT patients and normal elderly individuals and also between normal elderly individuals and patients in the earliest stages of DAT. Their results were also interpreted as being indicative of a loss of semantic knowledge or at least a breakdown in the organization of semantic memory. Other studies (Carew, Lamar, Cloud, Grossman, & Libon, 1997) have documented similar findings between patients with Vascular Dementia and DAT, and also conclude that the difference was a result of the destruction in semantic memory in DAT patients.

Contrary to the idea of a breakdown in the contents of semantic memory, other researchers (e.g., Bayles & Kaszniak, 1987; Bonilla & Johnson, 1995; Johnson, Bonilla, & Hermann, 1997; Nebes, 1989, 1994) suggest that the semantic knowledge base of the DAT patient still remains, but that problems with access to that information or even the lexical system result in difficulties with naming abilities. Evidence for the presence of impaired access as well as expression of semantic memory emerges from other researchers who found DAT patients were able to pantomime the use of given objects that they were not able to name (Barker & Lawson, 1968; Harrold, 1988; Kempler, 1988). These results can be taken to show that demented patients have information about the semantic attributes of objects, but may not be able to name them.

Nebes (1989) states that a naming deficit in dementia may even result from a combination of difficulties with accessing the lexical information regarding certain objects or even from some sort of identification problem rather than a deterioration of information in semantic stores. Nebes (1994) states that studies that use cues and verbal or visual "hints" (called priming) when a DAT patient cannot name an object or generate members of a semantic category reveal something about the nature of semantic memory. Nebes (1994) cites several studies that have shown that performance improves when priming occurs. He argues that this proves semantic memory contents remain, and that difficulties with language emerge due to problems in accessing this semantic memory store. LaBarge, Balota, Storandt, and Smith (1992) note that it is possible that semantic memory remains, but that access to a separate lexical store is impaired. According to the lexical access hypothesis, difficulties in object naming occur when the appropriate lexical information cannot be accessed or fails to be accessed properly, despite intact access to semantic information. For example, Harrold (1988) demonstrates that failures to retrieve the stimulus names can occur despite clear access to the semantic properties or qualities of the object (demonstrated through gestures or pantomime). Furthermore, "easing" lexical access through priming or providing the first syllable or phoneme of the target stimulus has been shown to produce better naming (Goodglass, 1993; Harrold, 1988).

The effectiveness of giving these phonetic or phonemic cues would seem to suggest that part of the breakdown in naming performances is due to the failures within the lexical system of cognition. LaBarge et al., (1992) presented a study in which 49 "very mild" and "mild" dementia patients were administered the Boston Naming Test. In their study, participants who were unable to provide the name of the pictured object were given a 4-item multiple choice from which they could pick the name of the object. Results showed that very mildly demented participants could usually choose the correct item (91% of the time) but that this percentage decreased significantly in the mildly demented group. Due to this deterioration, the authors conclude that the lexical retrieval is not the only difficulty dementia patients have naming objects. They conclude that early in the dementia process the loss of the verbal label for a particular object or concept may begin, followed by a progressive involvement of semantic structure deterioration as the dementia severity increases. This study's results, however, are difficult to interpret due to problems in several areas. To begin with, the diagnosis of very mild dementia and mild dementia was based only on an interview.

Little information was given regarding classification criteria used for diagnosis of dementia, and whether all types of possible dementias were included in the sample. Furthermore, the sample for the study was selected from another larger study, and no criteria were given for how these particular individuals were selected for the larger study or for the smaller naming investigation. As such, it is difficult to speculate about the actual deterioration in performances by the patients or whether there was another variable, such as sample bias, that could have produced some of the results.

Critics of these cues or "priming" techniques as a means to test the existence of semantic memory content have argued that certain types of priming may only trigger lexical relationships between words, rather than between words and their semantic category (Glosser & Friedman, 1991). As an example of this argument against the preservation of semantic memory, a priming word such as "cottage" would trigger "cheese" not because of any semantic relationship, but because of the high frequency of association between these words in the English language; and as such it reflects "lexical associates" rather than "semantic associates" (Glosser & Friedman, 1991). Nebes (1994) refutes this argument by Glosser and Friedman (1991) and shows that where a whole sentence or a single associated word was used as a prime for DAT patients to help them name a particular word, the whole sentence was significantly better at helping the participants produce the word. Nebes (1994) took this as strong evidence that semantic associations still exist in DAT patients, and that other factors such as purely "lexical" associations do not provide explanations for their performances.

Others report that further evidence of the breakdown in the content and structure of semantic memory can be found using different types of fluency tasks. These involve performances on a semantically based, category fluency task from the Dementia Rating Scale developed by Mattis (1976, 1988). In this fluency task, the participant must verbally generate items that can be found in a supermarket. The results of these studies reveal a disruption in the organization of DAT patients' semantic memory that is characterized by an initial loss of the most specific attributes of a semantic category but with relative preservation of more general superordinate knowledge (see Martin & Fedio, 1983; Troster, Salmon, McCullough, & Butters, 1989). In both of these studies, DAT patients generated significantly fewer specific items per superordinate category than did normal adults; they also generated a larger ratio of superordinate category names to total words produced. Thus, if the semantic representation of objects and categories are viewed as being organized in a hierarchical fashion with the most general aspects at the top and more specific features at the bottom, then DAT patients may demonstrate a progressive "bottom-up" deterioration of the hierarchical organization of semantic knowledge and memory. This “bottom up” finding has been reported by several researchers (Martin & Fedio, 1983; Troster et al.,1989; Warrington, 1975). In addition, these types of deficits have been reported as consistent across several tasks (Cherktow & Bub, 1990).

However, results from Cox, Bayles, and Trosset, (1996) and Bayles, Tomoeda, and Rein (1996) were inconclusive regarding the deterioration of semantic category knowledge versus the deterioration of specific attributional knowledge in DAT patients, and therefore these studies do not support a "bottom-up" process of deterioration. Cox et al., (1996) compared the performances of 37 DAT patients and 29 healthy normal adult controls on tasks such as category sorting of pictured objects, describing differences in attributes of pictured objects, as well as evaluating the participants' use of attributes and categories in descriptions of concepts. While DAT patients scored more poorly than controls on almost all tasks, they also scored worse on attribute descriptions compared to the category sorting task. Cox et al. point to the difficulties in methodology in their study and other studies whereby the attribute task was more difficult, and also compounded by episodic memory difficulties in the DAT patients. Further, Cox et al. point out that the rates of the spontaneous usage of attributes and overall categories to describe various concepts did not differ significantly in DAT patients in their study.

Furthermore, other recent studies (Nicholas, Obler, Au, & Albert, 1996) have concluded that mild and moderate DAT patients were no more likely to make semantically related naming errors than were controls. Nicholas et al. suggest that analysis of naming errors made by DAT patients during naming tasks may not be an accurate way to uncover the exact problem occurring in semantic memory. In addition, they note that the chances for misperceptions of stimuli by DAT patients did exist when line drawings (i.e., the Boston Naming Test) were used.

Other approaches to analyze naming errors using connectionist or parallel processing types of models rather than the serial stage models. However, few of these models have been used or tested on DAT patients. De Bleser (1997) points out the difficulties that serial stage naming theories have problems explaining modality-specific difficulties in naming, for example, McCarthy and Warrington's (1990) description of "optic aphasias" (p. 159).

The Need for the Current Study

As has been shown in the preceding section, arguments regarding the cause of naming problems in relation to the semantic system in DAT are far from over. The issues regarding whether semantic memory remains intact but is inaccessible or whether it is disrupted are still unclear. The process of deterioration and whether deterioration is more prominent in a particular modality are also unclear at this point. A study that compares naming performances in DAT patients across modalities (utilizing actual objects to minimize any perceptual interference), and also allows for prompts and priming of the names of the objects is needed for several reasons. First of all, a consistent level of impairment in naming across modalities, without any demonstrable benefit from cues, would support the presence of a unitary store of semantic information that is degraded by DAT. Conversely, naming impairment across modalities that is assisted by cueing would support the integrity of the semantic store but would demonstrate the disruption in accessing the lexical store. The third way that such a study would be of benefit is if a modality-specific deficit was uncovered. That is, if a severe deficit was detected with naming that was specific to a particular modality (in essence, a partial dissociation of functioning), then support would seemingly be lent to the connectionist approach and the stimulus-based semantic stores. To date, no such study has been conducted.

While it would be expected that the naming performance of DAT patients would be poorer than that of controls, as found in many other studies (Lukatela et al., 1998), the degree of difference in these particular tasks is unknown. Therefore, examining the nature of DAT performances across modalities, using actual objects, with the opportunities for cueing the correct response, could serve to greatly elucidate research regarding the semantic system. Furthermore, according to connectionist models, because we learn about more objects via visual input modalities (such as through mediums like books and television) than we do through tactile modalities, it should be slightly more difficult to identify objects by touch rather than by sight because their connections would be weaker (McCarthy & Warrington, 1990; Plaut & Shallice, 1994). To date, there has been no research to quantify the differences in tactile identification of objects between DAT patients and normal controls, nor has there been research comparing tactile object recognition to visual object recognition in these two groups.

The chance to select the name of the object from a list will also prove to be helpful in determining the presence of semantic memory in the presence of lexical access problems. Subsequently, better identification of objects may result, as found in the study by Labarge et al. (1992). However, the study by LaBarge et al. may not have been an accurate assessment of object naming abilities because they utilized drawings of objects rather that actual objects. Furthermore, they did not measure cross-modal differences in naming abilities. Hodges and Patterson (1995), Harrold (1988), Kempler (1988), and Barker and Lawson (1968) demonstrate that patients were able to benefit from haptic presentations of objects as well as being able to pantomime the uses of the object. This may indicate the viability of further exploration of nonverbal access routes to semantic information, and if combined with a nonverbal mechanism for articulatory transmission of that knowledge, one may be able to overstep a large portion of verbal production "interference" in semantic memory tasks.

The preceding groundwork of theoretical knowledge leads to the following research questions and predictive hypotheses:

Research Question 1

If unable to name an object during an object recognition task, can DAT patients choose the correct name of an object from a list of choices?

Null Hypothesis ($\mathbf{H_{o1}}$**):** Average DAT correct recognitions will not differ significantly from an expected chance value of 1 out of 4 (0.25%).

Research Question 2

How do DAT patients perform in comparison to themselves and to controls in attempting tactile and visual identifications of objects?

H_o2: Average DAT tactile % correct = Average DAT visual % correct

H_o3: Average DAT tactile % correct = Average NC tactile % correct

H_o4: Average DAT visual % correct = Average NC visual % correct

Research Question 3

When given the choice to respond verbally or nonverbally, how would DAT patients respond?

$H_{o}5$: Number of nonverbal responses = Number of verbal responses

CHAPTER THREE

Methods

Sample

There were a total of 39 participants in this study. In the experimental group (n=18) participants were selected from inpatients and outpatients attending a neuropsychological examination at the Northern Alberta Regional Geriatric (NARG) Program, Glenrose Rehabilitation Hospital in Edmonton, Alberta, from December 1997 to August 1998. Patients entering this program were usually referred by family members or physicians in order to investigate memory problems.

As part of their examination, patients are routinely administered a medical, nursing, and neuropsychological tests. The contents of this standard neuropsychological battery are listed in Table 1. Those patients who agreed to participate in this study were given the first portion of the standard neuropsychological exam component of the NARG program prior to their participation in the present study. Those who required further detailed neuropsychological testing were given part or all of section two of the battery.

Table 1 Core Battery of Neuropsychological Tests: Glenrose Rehabilitation Hospital NARG Program

Short Battery (Section One)

History Checklist
Information/Orientation
Digit Span Forwards/Backwards
California Verbal Learning Test I
Continuous Visual Memory Test I
Trails A Bi Bii B
WAIS-R (BD, PC)
California Verbal Learning Test II
Continuous Visual Memory Test II
WAIS-R (Voc, Ar, Sim)
Controlled Word Association (Animals)
Alternating Movements Test

Neuropsychological Battery-Section Two

Rey Complex Figure Drawing
Prospective Memory I
Directed Responding Test
Sequential Movements
Controlled Word Association Test
Prospective Memory II
Rey Figure Recall/Recognition
Visual Memory Span
Finger Tapping Test
Stories I
Judgment of Line Orientation
EPT test
Drawing Tasks (Geometric, figural,frontal)
Symbol Digit Modalities Test/Recall
Boston Naming Test
Writing to Dictation
Passage Reading
Repetition (Boston Aphasia Exam)
Token Test
Praxis

Additional Tasks (if necessary)

Finger Localization Test
Stories II
Wisconsin Card Sorting Test
WAIS-R (Com, Inf, OA, DS)
Digit Vigilance Test
Stroop Test, Form Discrimination

The diagnosis of probable DAT was made by a senior staff Neuropsychologist in conjunction with the medical team using DSM-4 criteria. As part of their examination, the DAT patients also received medical and laboratory tests to rule out other causes of dementia. Patients with a history of severe head injury, alcoholism, vascular diseases or accidents, and psychiatric illness were excluded from this study.

Those patients who were diagnosed with probable Alzheimer's disease were approached after their examination and asked if they would participate in the study. Verbal and written informed consents were obtained from each participant and a family member. Copies of the consent forms are listed in Appendix 3. None of the experimental procedures denied patients access to their regular care, nor was subsequent treatment or care contingent on their performance in this study. Of the 20 DAT patients who were approached, only 2 refused to participate. The mean age and education of the 4 men and 14 women who formed the experimental group are listed below. Although all of the DAT patients were retired, previous occupations were varied among this group: 6 had been farmers, 3 were former teachers, 4 were in managerial/office roles, and 5 reported that they were "housewives" and had primarily stayed at home to manage their families.

A group of 21 healthy adult volunteers (10 men and 11 women) also participated in this study. They were recruited through a volunteer pool of seniors living in the community in Edmonton, and accessed through the Department of Psychology at the University of Alberta. All participants were attending a study offered by the Department of Psychology, and were approached after they had completed their participation in that study . The experimental procedures were explained to them, and verbal and written consents were obtained prior to proceeding (see appendix 3 for sample consent forms). Of the 21 normal controls (NCs) asked to participate, none refused. The mean age and education of the NC group is also show below. Again, all of the control participants were retired, but occupations included 5 professionals (i.e.

engineers, university professors), 4 people who were in managerial/office administration, 5 former health care workers, 4 teachers, 1 trucker and 2 farmers. NCs were given only the experimental procedure and did not undergo neuropsychological or medical tests.

Table 2 Demographic Comparison of DAT Patients and Normals

	Study Group	**N**	**Mean**	**Std. Deviation**	**Significance**
Age	Alzheimer Disease	18	71.8 years	8.23	N.S.
	Healthy Adults	21	69.8 years	6.96	
Education	Alzheimer Disease	18	11.1 years	3.29	p.<.05
	Healthy Adults	21	14.6 years	3.35	

Pilot Trials and Development

In developing the materials for this study, two groups of common household objects were assembled, and pilot tests were run over a period of several months on other psychologists, psychometricians, friends and family members. All were administered the tactile and visual object identification tasks, and their comments were gathered. Objects that were deemed too awkward to palpate with one hand were excluded, as well as objects that were not correctly identified by any of the participants.

The finalized items, procedures, and scoring protocols for the actual study were based on the pilot trials.

Procedures

DAT patients and controls performed 2 object recognition tasks. In the visual recognition task, participants were shown various objects (one at a time) and asked to state each object's name. In the tactile recognition task, they placed their hand through a small opening in a cardboard screen. One at a time, a new set of objects was placed in their hand. Then, the participants were asked to name the object. All participants were given both recognition tasks, counterbalanced for order. Approximately half did the visual recognition task first, followed by the tactile recognition task. The other half performed the tactile recognition task first and then the visual task (see Table 3). Lists of the objects used are provided in the appendices.

If they were unable to provide the correct name after 15 seconds, they were then shown a list of 4 possible verbal labels. The names were shown and read to the participant, and they were told that they could indicate their choice by stating or pointing to the correct name of the object. Whether or not they chose the correct name, the next object was presented, and the process was repeated until all objects had been presented.

Table 3 Sample Procedures for Study Participants*

A. Object Presented Visually

→If correctly named by subject, next object is presented.→He or she tries to name it.

↓

If naming attempt unsuccessful, list of 4 choices is shown and read to the subject.

↓

Whether the item is correctly or incorrectly named, next object is shown.

↓

Continue until all 10 items have been shown.

↓

Repeat process with tactile identification of next set.

B. Object Presented Haptically

→Placed in subject's hand. If correctly named, next object is presented.

↓

If naming attempt unsuccessful, list of 4 choices is shown and read to the patient.

↓

Whether the item is correctly or incorrectly named, next object is placed in hand.

↓

Continue until all 10 items have been given.

↓

Repeat process with visual identification of next set.

---

*Procedures were administered in counterbalanced order, i.e., approximately half did the visual recognition task first; the other half did the tactile recognition task first.

Each study participant served as their own control between procedures, as well as being compared to the performance of the controls in certain cases (see next section). In essence, this study forms a quasi-experimental design, due to the fact that study participants could not be randomly assigned to the experimental or control groups.

Statistical Analysis

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS). Percentage of correct tactile and visual identifications were recorded, and comparisons were made between the control group and the experimental group, or within the experimental group.

The dependent variable in all tasks and for all hypothesis tests was the percentage of correct names produced by the subject. The design allowed for a within group t-test for research question one. This design also allowed for an examination of the differences in percentages of correct responses between the modalities of visual versus tactile identification. A within groups examination was conducted for the analysis of spontaneous versus cued responses. T-tests for related samples could be used, because each patient would effectively be compared to their own performance and thus form his or her own control. The examination of the differences of the control group's performance compared to the study group's performance form a "between groups" design, examining the type of task (visual or tactile recognition) by experimental group. This formed a two-way (Factorial) ANOVA, used in research question 2.

A Chi-square analysis was conducted for research question 3, comparing frequencies of response modalities. Alpha was set at the .05 level for all analyses.

CHAPTER 4

Results

Research Question 1

If unable to name an object during an object recognition task, can DAT patients choose the correct name of an object from a list of choices?

Null Hypothesis (H_{o1}): Average DAT correct recognitions will not differ significantly from an expected chance value of 1 out of 4 (0.25%).

To answer this question, the number of correct choices that the DAT patients made when provided with the cue list was recorded, and a correct percentage score was calculated. A single sample t-test compared the percentage of correct cued responses differed significantly from an expected value of 25%. This expected value was derived from the fact that each patient was allowed to choose from one of four different words. Random responding would be expected to produce an approximate average of 1 correct response out of 4 attempts, or 25%.

Table 4 Hypothesis One: Percentage of Correct Cued Responses in DAT patients

	N	Mean	Std. Dev.	Std. Error	Significance
Total % correct with cues **(VISUAL ITEMS)**	15	87.21	20.63	5.3258	p.<.001*
Total % correct with cues **(TACTILE ITEMS)**	18	88.93	19.29	4.5485	p.<.001

*Significance when compared to an expected chance value of 25% correct, or 1/4.

As shown above, on the items that were presented visually, 15 patients were unable to identify some of the items and needed to see the cue list. The mean percentage of correct choices from the cue list was 87%, and this was significantly different than an expected value of 25%. For items that were first presented for the patient to try to identify by touch, all 18 of the DAT patients needed to see the cue list for at least one item. The mean percentage of correct responses on these items was 88.9, and this value was significantly greater than an expected value of 0 (p.<.001). Therefore, the first null hypothesis was rejected.

Research Question 2

How do DAT patients perform in comparison to themselves and to controls in attempting tactile and visual identifications of objects?

H_o2: Average DAT tactile % correct = Average DAT visual % correct

H_o3: Average DAT tactile % correct = Average NC tactile % correct

H_o4: Average DAT visual % correct = Average NC visual % correct

To answer these questions, a 2X2 ANOVA with repeated measures design was conducted. This analysis compared group membership (experimental vs. control) with mode of presentation of objects.

Table 5 Hypothesis 2: 2X2 ANOVA with Repeated Measures on Tactile and Visual Identification Accuracy Rates between NC's and DAT patients

Within Subjects Effects*

Category	Df	Mean Square	F	Significance
Mode of Presentation	1	2910.79	18.117	<.001
Group x Mode	1	32.84	.204	.654

*Sphericity Assumed (Mauchly's W =1, Greenhouse-Geisser=1)

Between Subjects Effects

Category	Df	Mean Square	F	Significance
Intercept	1	484209.3	1568.726	<.001
Group	1	10596.967	34.332	<.001

Marginal Means

Study Group	Mean Percentage Recognition	Std. Error
DAT	67.3	2.92
NC	90.7	2.71
Tactile Presentations	72.9	2.18
Visual Presentations	85.2	2.712

Table 5 shows that there was a significant main effect for modality of presentation, as well as group membership, but no interaction effects on object identification rates. To further clarify and demonstrate the statistical differences between DAT patient's own performances, a t-test was run on tactile and visual identification rates.

Table 6 T-Test on DAT Patients' Tactile and Visual Identification Accuracy Rates

Category	Mean	N	Std. Dev.	T	Sig.
Tactile Identifications (% Correct)	60.56	18	17.9778	-2.336	.032
Visual Identifications (% Correct)	74.11	18	24.0731		

In table 6, it can be seen that DAT patients were able to identify 60% of the objects that were presented haptically, and 74% of objects visually ($p<.05$). This demonstrates that DAT patients were significantly worse at haptic than visual identification.

In conjunction with the 2 x 2 Anova, all three hypotheses were rejected in research question 2.

Research Question 3

During cued recall, when given a choice to respond verbally or nonverbally, that would DAT patients choose?

H_o5: DAT patient nonverbal responses = DAT patient verbal responses

In this component of the study, it was expected that DAT patients would either choose to respond to the cue list by stating the name of their choice (verbal choice), or by pointing (nonverbal choice). However, as the study progressed, it became clear that there were other avenues of responding occuring. In several instances, patients stated the name of their choice while pointing to it as well. In addition, in some cases patients indicated that they did not know and did not make a choice. Frequency of response occurrence was recorded. Table 8 demonstrates the breakdown of response categories, and the Chi-square analysis of the categorical data.

Table 7 Chi-square Analysis of Cued Recall Responses for DAT patients

Type of Response	Verbal	Nonverbal	Both	Neither
	68	13	28	3

$X^2 (3, N=4) = 87.5, \ p < .01$

As Table 8 indicates, the number of nonverbal responses were lower than the number of verbal responses, and the null hypothesis (Ho5) was rejected. It appears that the dominant tendency for DAT patients was to utilize a verbal means of response. Appendix 4 gives a complete breakdown of response types for all study participants.

Summary of Results

In the investigations of the research questions, all 5 null hypotheses were rejected. Results indicated that DAT patients were able to recognize correct names with cueing. Furthermore, DAT patients had more difficulties with identifying objects through touch than by sight, and performed worse on both of these tasks than the NC group. Finally, significant number of DAT patients chose to respond verbally when identifying the name of the object from the cue list. Implications and conclusions of these results are discussed in the next chapter.

Chapter 5

Discussion and Conclusions

The present study investigated the area of semantic memory in DAT patients and controls. An examination of their performance on visual and tactile confrontation naming of objects was conducted. Research questions centered on three areas: First, could DAT patients recognize the correct name of an object that they were unable to spontaneously identify? Second, how would DAT patients perform in attempting tactile identifications of objects in comparison to visual identification? As well, how would they perform on both visual and tactile identifications in comparison to normal controls? And finally, would significant numbers of DAT patients respond nonverbally?

Research Question One: Cueing and Naming

A significant number of DAT patients could choose the correct name of objects from a list when they did not previously produce the name of the object. This finding lends support to the hypothesis of an intact semantic memory held by others (e.g., Bayles & Kaszniak, 1987; Bonilla & Johnson, 1995; Johnson, Bonilla, & Hermann, 1997; Nebes, 1989, 1994).

Because they needed cueing in order to identify the name of the object in 41 visual trials and 71 tactile trials, this raises doubts about the accessibility of the lexical store for DAT patients. This supports the findings of researchers (Goodglass, 1993; Harrold, 1988; Labarge et al., 1992) who suggested that regardless of the model being used, there was a difficulty in accessing the word associated with the semantic concept.

From a serial stage model, it would seem that for the majority of responses emitted, DAT patients were able to access and utilize the semantic system. However, on 23% of the visual items and 39% of the tactile items they failed to produce the correct lexical response for the construct. From a connectionistic or parallel processing point of view (Goodglass, 1993), it may be that the conceptual or semantic track is activated, but that some disruption occurs in the lexical or phonological track.

The results of this particular analysis do not allow speculation on the nature of the semantic store, whether is a unitary and shared system or whether it has separate representations that are modality-specific. All we can state at this point is that with cues, regardless of modality, DAT patients were able to pick the correct word for an object about 88% of the time. Perhaps we can gain some greater insight regarding the nature of the semantic system in DAT patients from the other analyses.

Research Question 2: Tactile and Visual Identification Abilities in DAT Patients and Compared to Normal Controls

The present study also found that it was harder for DAT patients to name an object by touch (60% correct) than by sight (74% correct) (see Table 5). This finding lends strong support to the parallel processing model's notion of sensory-based semantic systems, and does not support the presence of a unitary semantic system as described in the serial-stage models of naming. In particular, these results would seem to indicate that tactile-based semantic information is particularly vulnerable to DAT.

Because tactile naming was more difficult, it appears that the lexical system that matches names to semantic information is more generally disrupted in that modality. This finding seems to indicate the disruption of a modality-based or modality-sensitive lexical system, as opposed to a modality-based semantic system.

Although tactile identification proved to be the most difficult task for the DAT patients, they were able to benefit substantially from cueing. DAT patients were able to spontaneously identify 60.5% of the tactile objects and 74.1% of the visual objects. With the 4-item multiple choice cues, DAT patients' performance improved to 88.9 % for tactile-presented items, which was a noticeable gain of 28.9% after cues. For visually presented items, their performance improved to 87.2 %, which is a gain of only 13% after cues. In essence, the identification rates improved to roughly the same level with cues.

What does this "differential effect" imply for our theories of naming? At a minimum, it appears that the modality of input does make a significant difference for DAT patients' naming abilities. However, it appears that the input information is not lost, or disrupted, but that the process of attaching a label to the tactile-presented information seems much more difficult. With cueing, the DAT patients were able to recognize approximately the same percentage of visual and tactile objects. This study lends support to a modality-specific naming impairment (McCarthy & Warrington, 1990). The findings indicate that the level of impairment is NOT at the access to the semantic memory, but at the level of access to and/or output of the lexical representation of the concept or object.

It also would seem from this study that tasks that measure confrontation naming in tactile modalities may be more sensitive to impairment than visual naming tasks.

An examination of Tables 6 and 7 reveals that the control group performed better at all of these tasks than the DAT patients and that the visual identification rates (96%) were also better than the tactile rates (85%) for controls. These findings are similar to many other investigations of naming abilities (Bayles & Kaszniak, 1987; Benson & Ardila, 1996; Bondi et al., 1996; Lukatela et al., 1998; Nebes, 1989; Paulman, Koss, & MacInnes, 1996; Ralph, Patterson, & Hodges, 1997; Rosenstein, 1998; Salmon, 1997). Globally, DAT patients had a more difficult time performing object recognitions than NCs, regardless of the modality of input or output. Even after cues, DAT patients' performance was not at the level of the naming ability of the NCs.

The difference in modalities supports Goodglass's (1993) hypothesis that the associations in the tactile modality may indeed be less "well connected" to each other within the semantic system, and require direct "activation" from the phonological system in order to "interact" (Goodglass, 1993).

However, one of the most important implications of this finding is the implication that there is a closer connection between visual stimulus input and naming abilities in both normal adults and DAT patients. If there were a single unitary semantic system, one would expect that naming abilities would be evenly dispersed across modalities. According to connectionist approaches (Goodglass, 1993;

McClelland & Rumelhart, 1986; Plaut & Shallice, 1994; Shallice, 1988), one develops stronger associations in the neural network as a function of learning and repeated use of those associations. As a result, visual identification seems easier for the network of semantic concepts and lexical "labels" to converge and for correct identification to occur.

Research Question 3: Mode of Responding

As reported in Chapter 4, under the cued recall condition, participants responded verbally more often than nonverbally. This result implies that it was easier and more natural for people to respond verbally.

Does the failure to name an object indicate that the semantic information was lost? In some cases, it would seem quite plausible that some of the participants may not have had previous exposure to the objects (such as pipe cleaner, faucet washer, and a computer disk). For example, one of the objects presented for visual or tactile recognition was a 3.5 inch floppy computer disk. An age cohort effect was observed when it became apparent, even after the cues were shown, that several of the older participants had never encountered a computer disk, thus it is impossible for the concept to be in semantic storage.

In addition, it seems very plausible to consider this possibility in light of the differences in years of formal education between the control and DAT groups. It could be argued that formal education allows for greater exposure to certain objects used in this study (i.e., the computer disk item) and therefore increases the chances of correct identifications. According to connectionist models (Plaut & Shallice, 1994), this would serve to "update" the network or reinforce the breadth and strength of the connections (Goodglass, 1993).

Relevance of This Study

This type of research becomes more and more helpful in developing an understanding of adult memory and learning processes, both in normal individuals and those affected with degenerative illnesses. As mentioned in Chapter 1, the rapidly rising proportions of older adults in our society means that there will also be more adults with DAT. Therefore, it becomes essential for science to investigate possible routes of delaying the onset of DAT. This study supports the hypothesis that when DAT occurs, semantic memory may be better than episodic memory at resisting the initial stages of the disease.

In terms of developing ways to delay the onset of the disease and to possibly even perform better cognitively when DAT does occur, continued pursuits of higher education may be the most viable option (Katzman, 1993; Satz, 1993). As this study and others have shown, the fewer years of education that a person has attained is associated with poorer cognitive performance in later years, as well as being associated with the development of DAT. While it is unclear as to whether this relationship is causational, the pursuit of higher and higher levels of education by successive generations of societies may mean that the actual incidence of DAT could begin to decline over time. This may be due to an increased or maximized cognitive reserve.

Continuing to develop ways to increase the capacity of this cognitive reserve by exposure to a wide variety of content in formal and informal methods may become important for the betterment of our society and the postponement of diseases such as DAT. This examination could include attempts to quantify and clarify the roles of hobbies, occupations, and other "mental activities" that may also explain why certain people get DAT and why others do not. In addition to this scrutiny, it may also be beneficial to determine the specific aspects or types of education that are associated with a decreased risk of developing DAT. Combined with what we know about the nature of episodic and semantic memory in DAT, we may be able to determine which components of education allow for a greater "strengthening" of those cognitive factors that are at greatest risk for the earliest deterioration (such as episodic memory). At a minimum, and until we understand the "active ingredient" of education and semantic memory, those adults who wish continue to lead a cognitively "normal" and healthy life into their senior years should be encouraged to pursue "life long" learning, and/or cognitive hobbies or pursuits to keep them active..

It appears that we are well on our way toward developing a population of life-long learners, which in turn might make us more resilient to diseases such as DAT. In 1981, 48% of Canadians had not completed high school. However, by 1996, this rate had declined to 35% (Statistics Canada, 1998). Furthermore, the number of Canadians graduating from university or other types of post-secondary institutions is increasing. In 1981, 29% of Canadians had completed post-secondary training, but this number had risen to 40% by 1996 (Statistics Canada, 1998). However, the effect of the increasing levels of education for Canadians in relationships to DAT may take years to become apparent. Furthermore, since the risk of developing a dementia such as Alzheimer's increases with age, longer average lifespans might counterbalance the positive effects of education. It is also conceivable that as society increases its average standard of education, we might see the average age of onset of DAT delayed, while the overall prevalence rates remain similar. Therefore it is necessary to understand what influences cognition and memory during "normal" aging processes and "abnormal" aging processes as part of our search for the determinants of a healthy life.

Clinical and Treatment Applications

The present study gives credence to the hypothesis that the fundamental "warehouse" of semantic knowledge can be accessed and used in early stage DAT patients, and that modality-specific semantic systems can facilitate naming. This study demonstrated that tactile identification was very sensitive to dementia, but patients responded very well to cueing. If these findings are upheld, clinical personnel, staff, and family members who deal with DAT patients should be educated about different types of memory. Families could be told that DAT patients have difficulties remembering time-related episodic information (i.e., what happened yesterday, or today), but that they might still be quite aware of the world around them, the objects that are in their lives, and the people who care for them. If family members were made aware of these distinctions in memory, they could be taught to use the existing semantic knowledge to facilitate living. Rather than having family members, or medical staff make "broad-based" assumptions about global deteriorations in DAT patients, it is important for them to be aware that DAT attacks cognitive skills unevenly. The disease has various effects on cognitive functioning, including memory and language.

Educational efforts for the families and staff who work with DAT patients should further serve to explain language deterioration and the nonverbal options for sending messages to and receiving messages from the DAT patient. For instance, deciding what to cook for a DAT patient could involve showing them 2 or 3 choices, asking that they prefer, and allowing the patient to point toward or state their most suitable choice. Potentially, some of the frustrations and confusion of both patients and families could be lessened amidst the course of a disease that can be so difficult to bear. It would seem quite beneficial to promote a broad range of expressive techniques for the DAT patients, while becoming creative when making demands on their retrieval skills.

Diagnostic Considerations

The literature review in Chapter 2 examined the various types of assessment instruments available for use with DAT patients, and revealed that characteristic features of DAT emerge during a psychological or neuropsychological assessment. Severe episodic memory deficits are present. Furthermore, difficulties in using semantic memory appear when DAT patients are asked to perform verbal fluency tasks that involve confrontation or category naming. The results from the present study might serve to refine the interpretation of the semantic memory difficulties. The present study suggests that these difficulties are influenced by modality, and a disruption of the lexical storage system. For example, semantic memory deficits detected through verbal fluency tasks or object recognition should be probed further, with closer scrutiny to the possible sensitivity of tactile object recognition and naming difficulties. As Cox, Bayles, and Trosset (1996), LaBarge et al. (1992), and Nebes (1989) indicate, the detection of semantic memory system difficulties may depend on how the DAT patient is tested.

Directions for Future Research

Results of the present study indicate that the instrument developed for this project (a cross-modality recognition test) is sensitive to naming difficulties in DAT.

A future evaluation to clarify the potential benefits of nonverbal responding in DAT could be undertaken. Such a study could occur in which one group would only be allowed nonverbal responses (i.e. through pushing a button, or selecting a name on a piece of paper and placing it next to the object). The other group would be allowed only verbal responses, and the response rates would be compared. This type of analysis would serve to provide even greater clarification of the role of the implementation of pre-verbal concepts into the "articulatory plan" aspect of the lexical/naming process.

Future research could examine the strategies that participants use in accessing semantic information. In the present study, participants were shown a list of names to help them to identify objects when they were unable to state the name of the object. In all cases, distractor names on the cue list were chosen according to three rules: one word was related semantically to the actual object name, one word was related phonetically, and one word was unrelated. To a certain extent, a process of elimination could have been used in selecting from the choices provided. That is, when participants were given choices on a list as to the possible names of the object, some of them took a step by step approach to elimination. If further research were to be done using the same methodology, it would be interesting to examine types of errors that the participants made.

In addition, further studies might reveal whether the present test can separate DAT from the other major causes of dementia. These include dementias related to vascular factors, dementias associated with Parkinson's disease, or other sources of cognitive impairment. The utility of such studies might prove to be important in detecting more significant differences between populations that are different from DAT. However, investigations of these other populations may prove to be somewhat difficult for the test instrument as it has been currently developed. For example, investigating the effects of Parkinson's disease on visual and tactile recognition with the current test may require some safety modifications due to the difficulties that occur with certain types of objects being identified haptically (such as tweezers or a ruler).

In the present study, when study participants were attempting to state the name of the objects, it is possible that a longer response time limit would have been helpful. However, it was noticed that the longer the participants took to provide the name, the greater the chance that they would not get the answer correct. Future studies that allow for greater than a 15 second identification period would be able to better clarify the difficulties with naming, and whether the participants would benefit from a longer response period. There is also risk in providing longer responses times. In many cases, the participants in this study were already becoming frustrated by their inability to identify the objects. Simply delaying the presentation of cues to assist them with their identification would seem to run the risk of having them refuse to continue the study.

An underlying premise of this study was that the usage of actual objects rather than pictures of objects was more appropriate for DAT patients. To evaluate this would require the concurrent use of a relatively equivalent pictured set of objects, compared between DAT patients and controls. In addition, DAT patients and controls could be given a pictured set of objects and actual objects over 2 time periods, and the results could be compared. This would allow for greater clarification of the theories espoused by researchers such as Lambon-Ralph, Patterson, and Hodges (1997), that indicate that the sensory information of the objects is important in object naming.

Perhaps a future version of this study should use a screening measure to clarify the degree to that the experimental and control groups were different. This would most likely include the Modified Mini-Mental State Exam (Teng & Chui, 1987), for example, or the Dementia Rating Scale (Mattis, 1988). In the present study, the differences in the DAT patients were assumed to be true simply due to the fact that one group had been experiencing difficulties and was diagnosed with DAT, and the other participants were living successfully and independently in the community without any diagnosis of cognitive impairments or DAT. However, to clarify the differences between the groups, it would have been helpful to utilize a standardized screening measure.

The consistent use of an "astereognosis" screen in both groups to rule out the possibility of loss of peripheral sensation difficulties, or tactile agnosia as confounding variables would have been helpful as well. While the instrument used in the present study could have been subject to interference from tactile agnosia, on a few occasions, finger recognition trials were run, and failed to reveal finger agnosia in some of the DAT patients. However, only through consistent screening can this element be completely ruled out as a possible intervening factor in the present study's results.

As some researchers have indicated, the discussion regarding the nature of semantic memory might not necessarily have to be directed toward the dichotomous discussion of whether or not semantic memory is spared during DAT. Rather, the discussion should include the notion that the semantic system and the lexical system might be variably affected during the course of the illness. It seems to be a logical possibility that perhaps (as demonstrated in this study) semantic memory is relatively spared early in the disease, but that processing becomes more effortful due to disruptions in the access to that information. It also seems plausible that semantic memory stores might be degraded or destroyed late in the disease. In essence, several processes, including disrupted access to lexical stores and degraded semantic system storage, could occur during the disease process. Johnson et al. (1997) discuss this notion when examining the results of their study on lexical decision tasks. These researchers found that DAT patients developed increasing difficulties when making evaluative judgments regarding semantic information, particularly when semantic distractors were added. They felt their results were consistent with a model of "graceful" breakdown of semantic memory, whereby semantic associations between concepts remain orderly but specific features of concepts are lost. In addition, they interpreted their results as indicating that information processing and retrieval difficulties were also occurring during their lexical decision task. Could the same processes occur in the disruption of the ability to generate a name of an object in DAT patients? Does the possibility exist for one modality of sensory input (such as tactile stimulation) to be more sensitive to disruption in the early stages of the disease and to signal eventual degradation in semantic material regardless of sensory modality? In the present study, it was determined that both the normal controls and DAT patients demonstrated greater difficulties with tactile object identification than visual object identification. Therefore, difficulties with tactile object recognition might be a slightly more sensitive measure of the disruption of access to the semantic system or even the lexical store. If this task were able to be performed with severe DAT patients, it would be interesting to monitor the gap between visual and tactile identification rates. It might be that both visual and tactile identification rates would decline, and eventually both rates would be very close to 0. Given the destructive nature of DAT, and the presence of the tangles, plaques, and amyloid protein deposits, it would certainly appear possible that lexical and semantic information are eventually lost in the course of the disease.

Conclusions

This study provides evidence that DAT patients are able to use cues to access semantic storage. Accessing stored information could enhance their quality of life. We must attempt to be as creative as possible in accessing the cognitive resources that remain. This has implications for communicating information to them and for allowing them to communicate with us. We may have to learn to allow for the exploration of other forms of communication, including verbal, visual, demonstrative, and emotional modalities. The present study serves to form a jumping-off point for future investigations.

The nature of DAT is vast, and its presentation from patient to patient varies widely. The nature of the semantic store component is also vast and just beginning to be understood. Detailed and thorough research is essential if we are to understand the communicative skills of DAT patients. It will require cooperation from many fields, including medicine, nursing, social work, psychology, and the families of the patients, and the patients themselves. Certainly, the journey has just begun. The link between clinical research and practice is essential, and with continued research we can hope to provide a better understanding of this painful and destructive disease.

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APPENDIX ONE:

Objects Used for Identification Tasks

Set A: Objects (acceptable responses)	**Set B:**
clothespin	thimble
quarter	film
candle	key
yarn (piece of wool)	tweezers
paperclip	straw
faucet washer (washer)	toothbrush
crochet hook	comb
computer disk	earring
spoon	pipe cleaner
ruler	rubber band

APPENDIX TWO:

Sample Examiner Protocols for Object Recognition Tests

VISUAL OBJECT RECOGNITION TEST Protocol

DATE:________ NAME:________________

D.O.B/AGE:__________

Yrs. of Education:___________ RH or LH

SAMPLE: -Show **BALL**(5 SEC)-*Say "Now quickly, tell me what that was"(15s)*

- *If no response, or incorrect*-Show Cue Chart and say "*WAS IT...*
GRASS, a ball, a BAT, or a DOLL?"

X √, & TIME		If wrong, prompt and record response:	Time Latency:	V OR P
___/___	1. clothespin			V/P
___/___	2. quarter			V/P
___/___	3. candle			V/P
___/___	4. yarn			V/P
___/___	5. paperclip			V/P
___/___	6. faucet washer (washer)			V/P
___/___	7. Crochet hook			V/P
___/___	8. computer disk (disk)			V/P
___/___	9. spoon			V/P
___/___	10. Ruler			V/P

%correct: ***%correct with cues:*** ***X TIME:*** ***#verbal:*** ***#pointed:***

TACTILE OBJECT RECOGNITION TEST Protocol

DATE:________ NAME:________________

D.O.B/AGE:__________

Yrs. of Education:___________ RH or LH

SAMPLE: -Place **PENCIL** in dominant hand (5 SECONDS)

-Say "Now quickly, tell me what that was". (15 seconds maximum)

- If no response, or incorrect

-Show Cue Chart and Read: (circle response)

Was it:

a stencil, a pencil, a crayon, or a shoe?

X √. & TIME		If wrong, prompt and record response:	Time Latency:	V OR P
______	1. thimble	______		V/P
______	2. film	______		V/P
______	3. key	______		V/P
______	4. tweezers	______		V/P
______	5. straw	______		V/P
______	6. toothbrush	______		V/P
______	7. comb	______		V/P
______	8. earring	______		V/P
______	9. pipe cleaner	______		V/P
______	10. rubber band	______		V/P

%correct: %correct with cues: X TIME #verbal: #pointed:

TACTILE OBJECT RECOGNITION TEST Protocol

DATE:_________ NAME:_________________

D.O.B/AGE:___________

Yrs. of Education:____________ RH or LH

SAMPLE: -Give **BALL**(5 SEC)-*Say "Now quickly, tell me what that was"(15s)*
*- If no response, or incorrect-*Show Cue Chart and say "*WAS IT...*
GRASS, a ball, a BAT, or a DOLL?"

X ✓, & TIME	If wrong, prompt and record response:	Time Latency:	V OR P
___/___1. clothespin	____________________		V/P
___/___2. quarter	____________________		V/P
___/___3. candle	____________________		V/P
___/___4. yarn	____________________		V/P
___/___5. paperclip	____________________		V/P
___/___6. faucet washer (washer)	____________________		V/P
___/___7. Crochet hook	____________________		V/P
___/___8. computer disk (disk)	____________________		V/P
___/___9. spoon	____________________		V/P
___/___10. Ruler	____________________		V/P

%correct: ***%correct with cues:*** ***X TIME:*** ***#verbal:*** ***#pointed:***

VISUAL OBJECT RECOGNITION TEST Protocol

DATE:_________ NAME:_________________

D.O.B/AGE:___________

Yrs. of Education:____________ RH or LH

SAMPLE: -Show **PENCIL** (15 SECONDS)

-Say "Now quickly, tell me what this object is". (15 seconds maximum)

- If no response, or incorrect

-Show Cue Chart and Read: (circle response)

Was it:

a stencil, a pencil, a crayon, or a shoe?

x ✓ . & TIME		If wrong, prompt and record response.:	Time Latency:	V OR P
__/__	1. thimble			V/P
__/__	2. film			V/P
__/__	3. key			V/P
__/__	4. tweezers			V/P
__/__	5. straw			V/P
__/__	6. toothbrush			V/P
__/__	7. comb			V/P
__/__	8. earring			V/P
__/__	9. pipe cleaner			V/P
__/__	10. rubber band			V/P

%correct: ***%correct with cues:*** ***x TIME:*** ***#verbal:*** ***#pointed:***

APPENDIX 3

Consent Forms

CONSENT FORM FOR RESEARCH STUDY

Title: **Semantic Memory in the Elderly**

Principal Investigators: **Monty Nelson, Ph.D. Student,**
Chartered Psychologist

Ivan Kiss, Ph.D., Neuropsychologist

Background: Sometimes elderly people find it hard to remember the names of things. We do not really know why this happens. We are trying to understand this problem better. We are doing research to compare people with and without memory problems. This could help us learn how to assist people with this problem.

Procedures: If you agree, a 15 minute task will be added to your assessment. You will be shown some objects, and you will touch some objects behind a screen You will be asked to name these objects, or to choose the name of an object from a list.

Risks/Benefits: This research will help us understand memory problems better. There are no direct benefits or risks to you.

Confidentiality: Your name and records will be kept private. Any reports of our findings will not give your name. All data will be stored in a safe place.

(OVER TO PAGE 2)

I voluntarily agree to participate. I agree to have Mr. M. Nelson access the information contained in my medical records. I may refuse to answer any questions. I am free to withdraw my consent and stop at any time. If I decide not to participate or I withdraw from the study, this will not affect present or future care for myself or my family.

I have read this form and this project has been discussed with me. All of my questions about this study have been answered to my satisfaction. I understand my involvement in this study. I have been given a copy of this consent form.

If I have any further questions, I can contact Dr. Ivan Kiss at 474-8830. If I have concerns about how this research is being done, I can contact the Office of Research Services at 471-2262 (ext. 2500).

Signature of Participant/Date **Signature of Witness/Date**

The person signing this form appears to understand what is involved in the study and voluntarily agrees to participate.

Investigator Date

Appendix 4

Cued Recognition Performances by Individual DAT patients and Controls

Performance on Visually Presented Items (DAT Patients)

DAT Patient	1	2	3	4	5	6	7	8	9	10
Number of Cues Needed	3	3	6	1	2	1	3	2	1	5
Verbal Responses	3	0	1	1	2	1	3	0	0	5
Nonverbal Responses	0	1	0	0	0	0	0	0	1	0
Both Verbal/Nonverbal	0	2	5	0	0	0	0	2	0	0
Number of Correct Choices	3	3	5	1	2	1	3	2	1	5
Percentage Correct	100	100	83.3	100	100	100	100	100	100	100

DAT Patient	11	12	13	14	15	16	17	18	n	Average	Standard Deviation
Number of Cues Needed	0	0	2	2	0	2	4	4	15	Total = 41 Mean=2.28	1.7083
Verbal Responses	0	0	1	2	0	2	3	1	12	total= 25	
Nonverbal Responses	0	0	1	0	0	0	0	0	3	total= 3	
Both Verbal/Nonverbal	0	0	0	0	0	0	1	3	5	total= 13	
Number of Correct Choices	0	0	1	1	0	1	4	3	15	Total= 36 2.00	1.6088
Percentage Correct	-	-	50	50	-	50	100	75		87.2	20.63

Performance on Haptically Presented Items (DAT Patients)

ID	1	2	3	4	5	6	7	8	9	10
Number of Cues Needed	3	3	8	5	4	2	6	3	1	1
Verbal Responses	3	2	1	5	3	2	0	3	1	1
Nonverbal Resps.	0	0	3	0	1	0	1	0	0	0
Both Verbal/Nonverbal	0	1	0	0	0	0	5	0	0	0
No Response	0	0	0	0	0	0	0	0	0	0
Number Correct	3	3	7	2	4	2	5	2	1	1
Percentage Correct	100	100	87.5	40	100	100	83.3	66.6	100	100

ID	11	12	13	14	15	16	17	18	n	**Average**	**Standard Deviation**
Number of Cues Needed	2	4	5	5	4	5	5	5	18	Total= 71 Mean=3.94	1.7978
Verbal Responses	2	4	3	5	2	3	2	2	17	Total = 44	
Nonverbal Resps.	0	0	0	0	2	0	2	1	6	Total = 10	
Both Verbal/Nonverbal	0	0	1	0	0	1	1	2	6	total = 11	
No Response	0	0	2	0	0	1	0	0	2	total = 3	
Number Correct	2	2	3	5	4	4	5	5		Total= 60 Mean=3.33	1.6450
Percentage Correct	100	100	60	100	100	80	100	100		88.9	19.3

Visually Presented Items (Control Subjects)

Control ID	1	2	3	4	5	6	7	8	9	10	11	12
Number of Cues Needed	0	0	0	0	1	0	0	0	0	0	1	0
Number of Correct Choices	0	0	0	0	1	0	0	0	0	0	1	0
Percentage Correct	-	-	-	-	100	-		-	-	-	100	-

Control ID	13	14	15	16	17	18	19	20	Average	Standard Deviation
Number of Cues Needed	1	0	2	1	0	1	1	0	.400	.5982
Number of Correct Choices	1	0	2	1	0	1	1	0	.400	.5982
Percentage Correct	100	-	100	100	-	100	100	-	100	0

Haptically Presented Items (Control Subjects)

Control ID	1	2	3	4	5	6	7	8	9	10	11
Number of Cues Needed	2	1	1	0	3	1	1	1	3	1	1
Number Correct	2	1	1	0	3	1	1	1	3	1	1
Percentage Correct	100	100	100	-	100	100	100	100	100	100	100

(part 2 of Normal Control data table)

Control ID	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**Average**	**Standard Deviation**
Number of Cues Needed	1	2	1	1	3	1	2	1	2	2	1.4762	.8136
Number Correct	1	1	1	1	3	1	2	1	2	2	1.4286	.8106
Percentage Correct	100	50	100	100	100	100	100	100	100	100	97.50	11.18