THE SYNTACTIC COMPREHENSION DEFICIT OBSERVED IN ALZHEIMER’S PATIENTS USING AN OBJECT MANIPULATION TASK

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In the present study, the syntactic deficit of Alzheimer’s patients was investigated, using an object manipulation task. Four case studies were presented, using data from test batteries devised by Caplan (pers. comm.) and the author. Subjects responded by acting out stimulus sentences presented in aural and written modes, using a set of small figurines. Responses were evaluated following criteria described by Caplan (1986, pers. comm.). Data from the four subjects were compared with each other, and with data obtained from a similar battery administered to aphasic patients. An impairment in the ability to interpret certain syntactic structures was found for all subjects, indicating that Alzheimer’s patients do suffer from a syntactic comprehension deficit in the early stages of the disease. Several syntactic structures which caused errors in the responses of the Alzheimer’s subjects, also caused errors for the aphasic patients, suggesting that the parsing model underlying the design of the stimuli, described by Caplan (in press) is a valid description of normal language function. Results of the present investigation are examined in relation to a model of syntactic comprehension suggested by Caplan (in press). Contradictions to hypotheses proposed are noted. The limitations and diagnostic use of the object manipulation test, are discussed.
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CHAPTER 1

INTRODUCTION

Alzheimer's Disease (A.D.) is described as a state of progressive cortical atrophy in which higher intellectual functions such as language, memory and visuospatial skills are progressively impaired over a period of several years. Early literature about language impairment resulting from this dementing disease includes descriptions of patients with senile dementia. That is, it does not deal exclusively with A.D. Diagnostically, A.D. is defined as a deficit in three or more areas of intellectual functioning including language, memory, visuospatial skills, emotion or personality, and cognition (Cummings and Benson, 1983).

Thus far, data on syntactic comprehension in A.D. is conflicting and sparse (Kempler, 1984; Schwartz, 1979). Kempler and Schwartz, using four and two-array picture stimulus sets, respectively, in picture pointing tasks, reported conflicting results for a task of syntactic comprehension. Caplan’s (1986) object manipulation task is a rigorous test of syntactic abilities. This task provides data about a patient’s comprehension and thus offers a means of testing possible syntactic deficits that have so far proved elusive in studies which have examined only language production (Kempler, 1984).
Early studies of A.D. described symptoms as occurring only in its late stages. The symptoms described included primarily word-finding deficits and empty, circumlocutory speech (Obler & Albert, 1981). Language tests were thought to be of little diagnostic use in the early stages of the disease, since reported deficits of memory and visuospatial tasks were and are so apparent. Recent studies indicate that it is possible for language deficits to occur in the very early stages of the disease, before the appearance of memory and visuospatial deficits (Wechsler, 1977), e.g. it has been observed that word-finding and comprehension are mildly impaired (Kempler, 1986), that there is an increased use of stereotypic conversation, and word list generation may be difficult for a patient (Bayles & Boone, 1982). It is still commonly reported that syntax, phonology, and interactional pragmatics are preserved (Obler & Albert, 1981). Many studies have focused on the semantic deficit associated with A.D., thus:

"Semantic functions were found to be more vulnerable than phonologic and syntactic to the effects of progressive cortical atrophy." (Bayles & Boone, 1982, p.211)

In the moderate stages of the disease, Kempler (1984) reports that speech may be "empty", with severe anomia. As the disease progresses, the comprehension deficit gradually becomes more pronounced, and some uncorrected semantically related naming errors may occur (Obler & Albert, 1981; Schwartz et al., 1979). Repetition of sentences, and whole stories has been noted. Some patients have been observed to use grammatically simpler sentences, whilst becoming less talkative (Bayles, 1982) whereas others continue to use complex structures, accompanied by a press of speech (Obler & Albert, 1981). In
Obler's review (1981) of Irigary (1973) some general behaviors noted while testing demented patients' of varying severity are described as follows: refusal to respond or indicating not knowing answers to questions, echolalia, perseveration, inability to redirect attention, a loss of specificity (an increased use of indefinite terms), reliance on syntactic form (fluent use of long complex syntactic structures to encode empty speech), breakdown of pragmatic appropriateness (such as commenting on the task rather than trying to perform it), giving more than one response, or questioning the information they give, absence of appropriate linguistic interaction (for example, the use of second person pronouns, questions, and commands do not occur), logorrhea, muteness in the later stages; in general, difficulties initiating, maintaining and stopping speech are noted. As the disease progressively worsens, a severe impairment in all language modalities is noted, and the patient's productions are limited to echolalic and pallalalic utterances (Cummings & Benson, 1983), neologisms and paragrammatisms occur, and discourse is disorganized and stereotypic (Obler & Albert, 1986). In the final stages, pragmatic skills are severely impaired such that speech is not interpreted in relation to its context, and humour and sarcasm become uninterpretable for the A.D. patient (Bayles, 1982).

As cited in a review of the dissolution of language in A.D. and senile dementia (Pulkys and Gilbert, 1986) few investigators have attempted to describe a neuroanatomical basis for language function that would be adequately upheld based on the pattern of language dissolution that occurs in A.D. and other language disorders. Schwartz et al. (1979) suggested that there is more specialization in the left hemisphere for productive language processes, thus speech-motor control, and syntactic and phonological processes are seen as functions located largely in one hemisphere, whereas the lexicon is viewed as having a more bilateral distribution. In their view, this might explain the relative preservation of syntactic and phonological processes in the presence of a lexical-semantic impairment.
Caplan (1987) reported a lack of evidence to support such neuroanatomical theories based on a series of studies in aphasiology. He and his colleagues looked at the performance of a variety of aphasic types on a battery of syntactic comprehension tests. Results indicated that site of lesion was not a useful predictor of how patients would perform.

Obler & Albert (1986) pointed out that the following variables could affect results while conducting investigations of language across the lifespan: institutionalized versus noninstitutionalized, sex differences, native and non-native speakers of a language, and differences resulting from differing levels of education. In "Sentence Comprehension Abilities Throughout the Adult Life Span" by Feier & Gerstman (1980), age differences were noted on an object manipulation task involving the comprehension of relative clauses; subjects between 60 and 70 years old made more errors than subjects in younger age groups. It was found that after 70 years of age, errors were more frequent and qualitatively different than those noted in younger subjects. There was a low, yet significant correlation between vocabulary scores (based on the Vocabulary subtest of the WAIS) and comprehension of relativized sentences suggesting that these two skills involve different processes. Based on a correlation between digit span and auditory comprehension, the authors suggested that immediate memory plays a role in the processing of sentences, and that individual words are held in short-term memory over an entire clause, and only then are they interpreted. Although sentence comprehension requires the interpretation of both meaning and syntax (whereas digit span presumably does not), they proposed that processes involved in both are similar and may influence performance on either. Although omission of words might signify a lack of linguistic understanding, it was also possible that omissions reflected a lapse in attention or memory. In the authors' opinion, the slowness of processing (commonly noted in the elderly) reduced the subjects' chances of correctly interpreting relative clauses.
Appell, Kertesz and Fisman (1982) administered the Western Aphasia Battery to 25 A.D. patients and found that most had a syndrome similar to either Transcortical or Wernicke's type aphasia. The authors concluded that semantic and cognitive operations were impaired, in the presence of intact phonological and syntactic abilities. It should be noted that their assessment of syntactic comprehension did not involve systematic testing of various syntactic structures. Although an assessment of fluency may take into account sentence length, sentence structure, and the use of grammatical modifiers and conjunctions, this type of production data is insufficient evidence from which to conclude that syntax remains substantially intact. The authors found, as did Kempler (1986) that contrary to the naming deficit commonly reported in this population, their subjects were able to name objects with no apparent difficulty. The authors suggest that it is performance on more abstract naming tasks, such as a word fluency task, which is impaired. Their subjects also performed poorly on naming abstract items, although the exact stimuli used were not given. The A.D. group experienced difficulty in carrying out sequential commands (attributed to a memory deficit), although it is possible that this difficulty could be evidence of a comprehension deficit involving more than problems in lexical retrieval. Unfortunately, the sentences used did not separate the ability to process syntax from the ability to use lexical and pragmatic knowledge to interpret the sentences.

Kempler (1984) describes the dissolution of language resulting from A.D. as occurring in three stages (early, middle and late). Word-finding difficulties in spontaneous speech are an early appearing symptom. Comprehension is impaired. Impairment in comprehension has commonly been attributed to deficits of memory or attention, or described as a lexical or semantic deficit (Kempler et al., 1986; Schwartz et al., 1979; Martin & Fedio, 1983; Obler, 1981; Appell et al., 1982; Townsend et al., 1979). The overwhelming conclusion which appears in the literature is that syntax is relatively preserved (Appell et al., 1982; Bayles,
1982; Schwartz et al., 1979; Bayles and Boone, 1982; and Whitaker, 1976). Until recently there have been relatively little data concerning syntactic comprehension, and much of the reported research is either on single word comprehension (Martin & Fedio, 1983; Schwartz et al., 1979; Rochford, 1971) or involves a production task such as sentence correction or paraphrasing (Appell et al., 1982; Bayles & Boone, 1982; Irigary, 1973; Whitaker, 1976). The few studies which have examined syntactic comprehension often employed a picture choice task (Schwartz et al., 1979; Kempler, 1984; Kempler, 1983) the results of which may be complicated due to the quality of the foils used. Studies such as Kempler's (1983, 1984) have examined a small range of syntactic types.

Some investigations in the past have focused on the use of language tests as a diagnostic tool for A.D. Bayles & Boone (1982) attempted to describe demented patients' performance on a variety of language tasks. Patients' performance was then compared with their scores on a series of psychological tests. The comparative usefulness of these tests in diagnosis was then evaluated. Their subjects included 35 diagnosed senile dementias, and a control group of 28 normal elderly. The language tests used included: 1) Story-Retelling- subjects were told a story and then had to retell it; 2) Sentence Correction- subjects judged whether or not a sentence was correct; if it was not, a correction was performed. Test sentences contained either phonological errors, as in "He is a fisherman."; syntactic errors, as in "Write down it."; or semantic errors, as in "I'm not as tall as I am.". 3) Sentence Disambiguation- subjects were required to correctly paraphrase the different meanings of a sentence. Three types of ambiguous sentences were used: a) lexically ambiguous sentences, in which a word or group of words had more than one meaning, as in "We saw the pitcher."; b) surface structure ambiguities, in which subjects were to hold the exact ordering of lexical elements in memory, as in "He told me to go without hesitation."; c) sentences with deep structure ambiguity in which different logical relations could hold
between the words, and interpretation depended on the analysis of actor and action, as in "Visiting relatives can be a nuisance.". 4) **Verbal Expression**- in this task, often cited as difficult for A.D. patients, subjects were required to hold an object and then asked to describe it (a "fluency" test). 5) **Naming Tasks**- subjects were expected to name twelve photographs of common nouns.

Results of this study were given in correlation coefficients and weightings. Individual and average group scores were not given. The authors listed the different tasks in order of their usefulness in differentiating demented subjects from normals. They then used these weightings to reclassify normals and demented subjects. The authors calculated inter-test correlations between psychological and language tests, and found them to be highly positively correlated; they also found that different language tasks were highly correlated with each other, indicating that a smaller battery might still have been useful. The authors concluded that some language tests have more discriminant value than the Block Design or Similarities subtests of the WAIS, or the Nonsense Syllable Learning Test for differentiating dementia from normals. They found that:

"the test of the ability to correct semantically anomalous sentences contributed most to the differentiation of senile dementia patients from controls, and the Similarities Subtest of the WAIS (Weschler Adult Intelligence Scale) contributed least."(p.214)

The authors state that their data support the view that semantic knowledge is more impaired than either syntactic or phonological knowledge. The authors interpret their results within a model of the language deficit characterizing A.D.:

"The processing of phonology and syntax by lower order mechanisms may be possible because these rules are finite, learned early in life, and well-rehearsed by the time of the senium."(p.216)

As suggested earlier in this review, problems exist in using only this type of data to
refute the existence of what may be a moderate-severe syntactic deficit. It is unfortunate that this study does not show ways to differentiate A.D. or demented patients from other kinds of language impaired populations. It would have been useful to determine which combination of a select few of the weighted tests could have been used to make up a smaller, useful battery. The Mental Status Questionnaire was the only psychological test that proved to be as useful as language tests in differentiating between demented and normal subjects.

In general, this study showed some high correlations between language and psychological tests, and between different language tasks. Since correlations are not predictive, it cannot be concluded that patients will perform similarly on these different tests; that is, one task may still be more diagnostically useful than another, despite a high correlation between the two.

At the UBC Alzheimer’s Clinic, as well as the Geriatric Outpatient Clinic at UCLA (Kempler, 1984), Alzheimer’s patients were routinely given (among other tests) the Mini Mental Status Exam (MMS) (Folstein, Folstein, and McHugh, 1975). This is an eleven question examination which takes 5-10 minutes to administer and was designed as a screening test for demented patients. The test has two parts: the first part requires vocal responses, and covers orientation, memory and attention (maximum score 21); the second part investigates the ability to name, follow verbal and written commands, write a sentence spontaneously, and copy a complex polygon (maximum score 9). The total maximum score is 30, and the test is not timed. Folstein et al.(1975) found that three groups of patients can be differentiated based on their performance on the MMS. The average score for demented patients was 9.7; depressed patients with cognitive impairments scored 19.0; and patients with uncomplicated affective disorders (depression) scored an
average of 25.1. The mean score for normals was 27.6. It was found that the MMS scores correlated significantly with scores on the WAIS.

At the UBC A.D. Clinic patients are assessed by a multi-disciplinary team as being: i) healthy, ii) questionable, iii) mild, iv) moderate, v) severely impaired. For example, according to the clinic, a severe deficit in all areas of functioning would not be seen until the later stages of the disease. Performance at this level would be described as follows: "Severe memory loss, unable to recall relevant aspects of current life, and very sketchy recall of past life; impairment of social functioning marked, not independent functioning outside of home; no functioning in the home, no hobby involvement maintained; needs constant supervision and assistance in feeding, dressing, and hygiene; unable to even attempt to solve problems regardless of level of complexity, much trial and error behavior; frequent changes or sustained alterations in affect impairing patient's contact with reality; oriented to person or not at all; severe impairment of receptive and/or expressive language, production of unintelligible speech."

In addition to the categorization of specific skills, patients are assigned a score from 1.0 to 8.0 indicating differentiation of the onset and progression of the disease. The system operates as follows: 1) neither patient nor relative is aware of any deficits or changes in behaviour; 2) variable/fluctuating symptoms reported by patient or relative seemingly unrelated to level of functioning; 3) gradual onset, presence of sustained progressive deterioration; 4) abrupt onset, presence of sustained deterioration and stepwise progression; 5) abrupt onset, presence of sustained deterioration and unremitting progression; 6) abrupt onset, stable course; 7) abrupt onset, self-limited; 8) gradual onset, stable.

In Schwartz, Marin, and Saffran's often cited case study (1979), an adult female
subject was diagnosed as having a progressive dementing disease. When first seen she had an IQ of 95, good visuospatial skills, scored low-normal on the Standard Progressive Matrices test, had a digit span of five forward and three backward, normal motor sequences, no apraxia, adequate handwriting, and poor memory (both verbal and nonverbal). Language was severely impaired, especially for lexical information. On the PPVT (Peabody Picture Vocabulary Test) she scored at chronological age 6;0. She demonstrated profound anomia, circomlocutions, and a low ability at naming confrontation for real objects. Semantic paraphasias were rare, and phonemic paraphasias were absent.

Over the 30 months of testing (twice monthly for one hour sessions) the authors noted a dramatic decrease in cognitive functioning. The patient’s vocabulary scores on the PPVT dropped significantly, and her anomia progressively increased.

A confrontation naming task was administered in order to explore the subject’s willingness to accept related, but inappropriate substitute words for pictures with which she was presented. She was shown 70 photos, one at a time, and then asked to point to the correct written word from a choice of five (the target, two unrelated foils, a word phonologically similar, and a semantically related foil). The 70 words were tested twice. Results indicated 46/51 errors were made on the semantic distractor (out of a total of 140 total presentations). The test and retest showed a similar distribution. Most often, if a particular picture was named correctly in the first test it was named incorrectly in the second test. The subject was correct on only four pairs of words in both trials. The authors suggest that for this subject, terms no longer specify unique referents, but instead identify a population of related referents. The more specific semantic features used to define a referent show gradual deterioration. The test was performed three more times over a course of several months, during which time the subjects’ performance progressively
worsened (39% errors in the first test increasing to 65% in the second). Interestingly, the pattern of errors changed during this time. Thus at 15 months her original performance of 90% semantic errors had decreased to 61% because she began to choose an occasional unrelated foil.

The subject was given the task of matching pictures with animal names. Since, in the first test, a systematic overextension of some pairs of words was noted, this test was conducted to determine whether she had a conceptual problem with animals such as "cat" and "dog", or if she was failing due to a semantic confusion. They compared her performance under two conditions: applying verbal names versus nonverbal ones.

In condition A (verbal), "verbal-match-to-sample" the subject chose between two typed names which were placed below a series of photographs presented one at a time. The series was administered twice. Results indicated that there was considerable variability over the two test trials. In this condition, the patient called a "cat", "dog" 5/7 times.

In condition B (nonverbal), "nonverbal-match-to-sample" the subject was asked to match each photo with one of two smaller which were placed beneath it. Failure on this task was interpreted as evidence for a conceptual deficit. The subject was correct on all "cat" photos, but called "dogs", "cats" unless given a "bird" as the alternative. Thus it appeared that the subject had an impaired concept of the animals "cat" and "dog". Note that these results are contrary to the verbal naming condition in which she often misnamed "cats" as "dogs". On the basis of these results the authors suggested that the subject's concepts of cat and dog had melded, such that the prototype of both "cats" and "dogs" was "cat" (explains the photo matching). In addition, the subject possessed a label "dog" that she applied to this concept which (explains why she overextended "dog" for all dogs plus
most of the "cat" photos).

In the second part of their experiment, "Dissociations in Language Functions", the authors compared the subject to three aphasics who showed impaired syntax and good referential vocabularies (Broca's type syndrome). In sentence production these subjects were to complete a short paragraph presented aurally that constrained the syntactic form of the responses possible. The aphasic's responses were incomplete, and thus uninterpretable. In 1967, Irigary had concluded that demented subjects were unable to generate novel sentences, although he used paragraph completion as his experimental task, which supposedly places more demands on memory. In the Schwartz et al. study, the subject was to transform the sentence given into a question, by carrying out aux-inversion, negation, pluralization, or by changing the structure into a past tense form. Schwartz et al.'s subject was able to produce these novel sentences. Her 6/100 errors were attributed to her producing irrelevant sentences, rather than ungrammatical ones. Thus it appears that Irigary's conclusions did not apply to all demented patients.

In a two-choice, picture pointing syntactic comprehension, task the subject could choose the target or a foil of the same action, but with Agent and Actor reversed for active and passive types. Her performance was compared to that of aphasics on active and passive sentences. Although the aphasics did not perform as well on passives, the A.D. subject did equally as well on both structures. Errors were attributed to lexical, rather than syntactic confusions; for example, she made errors on sentences containing the lexical pairs "cat-dog", "car-truck", and "horse-cow". Subsequently she was asked to point to each lexeme and could not. It was suggested that for objects she could not name, the subject was analyzing the stimulus sentences using syntactic cues to assign the correct semantic roles specified in the surface structure. She also did well on spatial prepositions and
comparative adjectives, indicating full comprehension of the relational terms in the sentences.

The subject was able to read aloud, indicating preservation of a phonological code. On a multiple choice task using homophones as stimuli, she was to match a spoken word with one of three phonetic spellings. The subject did well whereas the aphasics, who are known to have disordered grapheme-phoneme correspondence rules, could not perform the task.

With test words that did not conform to regular spelling patterns, the authors paired 57 high frequency words (26 pairs) with similar spellings but different pronunciations (for example, "home-come"). The objectives of this task were to: a) recognize the stimuli as words, and b) know how each word should be pronounced. The subject did well, confirming the implication of an intact phonological encoding system.

The authors therefore concluded that their subject's anomia was a problem occurring at the pre-phonological level of retrieval. Her poor word retrieval was considered to result from an inability to conceptualize the referent, rather than an inability to read it.

In the third part of their experiment, "The Effect of Context in the Disambiguation of Spoken Homophones", Schwartz et al.(1979) hypothesized that due to her disordered semantic abilities, the subject's choice of homophone would not be affected by semantic contextual cues. This was compared with her ability to use cues provided by the syntactic context. She was presented with thirty pairs of homophones (60 words) embedded in three different contexts: 1) semantic triads such as "priest,pope,/n n/", 2) limited syntactic contexts as in "a /noz/-he /noz/", and 3) full sentence contexts such as "she /blu/ out the
candles—she wore a /blu/ skirt". Since the task required written responses, and the aphasics could not write, they were unable to perform the task. Results indicated that she successfully chose four times as many homophones in the full sentence condition compared with the semantic triad condition. Errors were either homophone substitutions or mispellings. Performance using a limited syntactic cue was equally as successful as using a full sentence cue. Thus the semantic information available from the full sentence cue was not necessarily the only information used in the selection of the correct homophone; she was able to select homophones by using syntactic cues. Normals who made errors did so in all of the conditions; errors were attributed to poor spelling ability.

The subject was characterized as unable to interpret information from semantic context. It was suggested that she performed a syntactic analysis in order to arrive at a decision about the syntactic category for each word, to satisfy the constraints of syntactic context. The dissociation of language functions reported by Schwartz et al. is a characteristic commonly associated with language breakdown resulting from dementia. The authors speculate that lexical processes have a more bilateral hemispheric distribution; thus ability to interpret lexical information deteriorates in a qualitatively different way from the ability to process syntactic and phonological information, given that both latter functions are more lateralized to one hemisphere. It is also possible that these functions may differ in their neurological organization: referential operations may require the interaction of a larger area in the brain indicating a more diffuse system, whereas syntactic processes might be more localized and "tightly wired".

In Kempler, Van Lanckner, and Read's study "Comprehension of Sentence Structure and Meaning by Alzheimer Patients" (1986) the authors assessed the abilities of A.D. subjects' to use both grammatical structure and meaning. Subjects were given a four-choice picture
pointing task, using ten trials each of three different types of auditory stimuli: 1) single words (concrete nouns); 2) novel sentences (in which the authors suggest meaning must be derived by using encoded semantic and syntactic information) which included structures containing negation, prepositions, topicalization, as well as interpretation of the simple active positions of subject and object; 3) familiar phrases ("meaning scenarios" or idioms which the authors suggest are not interpretable from knowledge of the words or the syntax of the sentence). An example of a familiar phrase used is "The truth, the whole truth, and nothing but the truth.". The novel phrases were created to match the familiar ones in length and complexity, for example "The clown, the small clown, is not in front of the girl.". Foils included two unrelated structures, and for novel phrases, a syntactic foil (reversed subject and object, incorrect locatives, etc.). For familiar phrases, the related foil was semantic (a variation of the meaning of the phrase or a word within it). Stimuli were repeated if necessary, and testing was completed in one session.

Subjects included 29 probable A.D. patients, grouped into mild (9), moderate (11), and severe (9) categories by the Mini Mental Status Exam. Thirty left-brain damaged (LBD) subjects were also tested, in addition to a control group of 43 normal elderly subjects.

Results indicated that the A.D. group performed well with concrete nouns (average score for the group was 95% correct; only the severe subgroup scored below 95% correct) in contrast to a majority of studies which have suggested that word recognition, among other lexical deficits, is an early language impairment to occur (on confrontation naming and word fluency tasks). The group average for novel sentences was 73% correct (severes averaged 55%), and 47% on familiar phrases (severes getting approximately 30%). Without exception, none of the A.D. subjects performed better on the familiar phrases versus the novel. This pattern of performance was in contrast to the average scores of the 30 LBD
subjects (left brain damaged) who did better on familiar phrases. Individual data on the LBD subjects were not given.

The discrepancy found between the A.D. subjects' almost normal ability to comprehend single words compared with an impaired ability to comprehend familiar phrases suggested that familiar phrases are not stored in the same manner as other words, or combinations of words. It is curious that the subjects in this study performed well on single words, whereas other studies have suggested that this task should be difficult for a subject with A.D. (i.e. Schwartz et al., 1979; Appell et al., 1982). It is possible that their good performance was related to the very small number of trials. The difference between the behaviors of the averaged A.D. group and the averaged aphasic group may be useful diagnostically. It would be interesting to determine whether similar discrepancies arise between A.D. and aphasic subjects on other tests such as the batteries used by Caplan (1986) to test syntactic comprehension abilities. It would be useful to know if Kempler's system of grouping A.D. subjects using the Mini Mental Status Exam (Folstein, Folstein & McHugh, 1975) correlates with the system used by the UBC Alzheimer's Clinic, as well as the variety of other systems used to classify the severity of impairment. It is hoped that groupings like these will correspond with how closely subjects in each subgroup cluster in their performance. If subjects in these severity groupings display a large range of language abilities, it would not be surprising to see differentiation between their test performances, such that subgroups of language performance might not fall into the three rather broad groups of mild, moderate, and severe. Thus it would be of interest and value to determine how closely overall severity of the disease corresponds to severity of language impairment.

Martin and Fedio (1983) also agreed that A.D. leads to a specific disruption of semantic
knowledge. They tested 14 mildly impaired subjects who were suspected of having A.D. The authors used two tests requiring word-finding ability: 1) the Boston Naming test in which subjects were required to give names for pictures, and 2) a fluency test in which subjects were given 60 seconds to name as many different items found in a supermarket as they could. The authors also gave two tasks which required subjects to rely on their knowledge of word meaning: 1) a broad category judgement task, in which subjects were asked to rate the pleasantness of written words, and 2) a symbol referent test, in which subjects had to point to one of a choice of four pictures, when given a written stimulus. None of these tests examined syntactic comprehension, and although results indicated a semantic deficit for individual lexemes, this finding did not rule out the existence of an additional syntactic deficit.

Since dementias predominately affect older people, it is important to have an accurate description of language of the normal population at this age. Obler & Albert (1986) discuss the gradual, normal changes which occur as a person ages. As noted in the literature on dementia, the majority of psychological studies deal with naming and defining abilities, and the learning of these lexical items. In their study, 160 elderly subjects were given the Boston Naming test; an error analysis indicated that the percentage of semantic substitutions did not change systematically with age. Circumlocutions describing the item, and comments on the task or item did increase with age. Naming scores for verbs and nouns decreased with age for 70-year-olds. Different mean scores were obtained depending on the relative health of the subject population. The authors noted an increasingly elaborate discourse style in older subjects, although contrary to their expectations, old and young subjects relied equally successfully on aural context in tests of auditory comprehension.
Kempler (1984) examined a range of language abilities of eight subjects diagnosed as having A.D. or Primary Degenerative Dementia. Based on the Mini Mental Status Examination, two of the subjects were categorized as severe, four as moderate, and two as mild. To test syntactic comprehension, subjects were shown four line drawings and instructed to point to the picture corresponding to an auditorily presented sentence. Ten different sentence structures were tested, twice each. The syntactic types were: active voice, passive voice, subject relatives (using the complementizer "who" rather than "that"), clefting (cleft object), complex negation, object relatives (using "who"), subject relatives ending in N-V (using "who"), relatives with double function (using "who"), double embedding, and object-object relatives. Foils were created to depict the same actors and actions in different relationships to each other. As Kempler has stated, a drawback to this test is that it requires attention, memory and task orientation. His results indicated that comprehension of syntactic constructions, as well as individual words, was impaired. Kempler described the comprehension deficit as being milder than the production deficit; however, he noted that lexical retrieval as seen in naming tasks is not the sole problem in A.D. Interestingly, he found that whereas syntactic production was intact, syntactic comprehension was severely impaired. Data about which of the syntactic types proved difficult were not provided. Kempler found that syntactic abilities were relatively unimpaired in both spontaneous and elicited speech. Very few morphosyntactic errors were made spontaneously; subjects used a normal range of syntactic constructions with normal frequency, and in writing were able to use syntactic cues far more effectively than semantic cues. These results are similar to those found in case studies by Whitaker (1976) and Schwartz et al.(1979) who also found syntactic abilities relatively unimpaired. However, no recent studies have examined more than a small range of grammatical constructions over a limited number of trials, nor have these studies examined the possible linguistic explanations for the pattern of errors observed.
Recently there have been a series of psycholinguistic studies, conducted to examine syntactic comprehension in aphasic populations. Syntactic comprehension has been (and is being) studied in order to correlate deficits affecting specific syntactic structures, specific processing procedures, and the "computational space" (Caplan, 1987) used in syntactic comprehension. It is hoped that an empirically supported theory for the neural basis of the syntactic function of language will develop out of this activity. As Grodzinsky (1986) noted, the analysis of abnormal language must do two things: It must provide a model of the impaired processing components and must also characterize the structural(syntactic) deficit; one of the foregoing may result from the other, but this relationship is as yet unclear. It is essential that language impairment be characterized with respect to a theory of normal language (Kean, 1980; Caplan, 1986; Lapointe, 1983). Caplan (1987) discussed syntactic comprehension disorders in terms of a "work space" required by the parser, but did not attempt to describe the degree of reduction of a parsing work space quantitatively. Instead he used the term non-formally. His notion of a syntactic Work Space, is almost completely undefined, although he proposed that it is distinct from other cognitive constructs such as Working Memory. Further investigation of the constraints on the heuristics used while compensating for impairments in syntactic comprehension will hopefully help describe the functions of the Work Space.

The goal of case studies of syntactic comprehension disorders is to provide a description of the specific deficits in linguistic terms. Generalizations are made about how the specific structures are interpreted, and the possible strategies being used to interpret them. The account of an observed impairment requires a theory of normal language processing, of possible deficits, of adaptations to deficits, and how a parser (the mechanism by which a sentence is interpreted) assigns syntactic structure to a sentence. The parser
must preserve linguistic components, and produce syntactic trees (hierarchical groupings for the components of sentences). In a normal system, specific linguistic constraints are enforced in order that a sentence may be interpreted correctly on repeated trials. A linguistic description of the stimuli to be processed is necessary in order to decide whether a deficit is due to a linguistic impairment or an impairment in some other cognitive sphere. Caplan (1987) described a general theory of possible aphasic deficits which recognises three types of impairments: 1) linguistic representations may be affected; a subject who is consistently unable to comprehend a particular syntactic structure may have an impairment affecting the linguistic representation itself; 2) a processing deficit; a subject who shows variable difficulty on a particular structure may be unable to carry out a particular parsing operation; the disturbance does not affect the linguistic structures themselves; 3) a limitation in the "capacity" or Work Space which is required in the parsing task. This type of deficit results in a subject being unable to process specific linguistic items in complex structure, although she can process them in a simple sentence. In such cases, Caplan is interested in determining what the particular sources of complexity are, and which, if any, of the processes are more likely to break down when the workspace is filled beyond its capacity. His results illustrate how one domain of human cognitive psychology breaks down, and may represent a model of the general nature of the breakdown that occurs in other functional spheres. His results have implications for models of neural correlates of normal syntactic representations and how they are processed.

Based on extensive data collected from numerous studies over the past ten years, Caplan (1987) has documented several specific syntactic features which contribute to the complexity of processing a sentence. Thus complexity may be due to:

1. The demands of building hierarchical structure, specifically complex NPs.
2. The demands of holding an NP in the syntactic structure without a thematic role.
3. Transmission of a thematic role from an empty NP to its antecedent.
4. Searching for an antecedent.
5. Searching for an antecedent over a sentence boundary.
6. The need to hold propositions in memory and assign thematic roles to real-world referents (creating post-syntactic complexity).

It appears that several heuristics were used by his subjects in order to parse sentences (Caplan, 1986); they can be given, as follows:
1. In N-V-N or N-N-V sequences, assign either the immediately pre-verbal noun or the first noun in the sentence the role of Agent and assign the remaining noun the role of Theme.
2. In sentences with a verb requiring three arguments, assign the first noun the role of Agent, the second noun the role of Theme, and the third noun the role of Goal.
3. In a sentence with two verbs each of which has two arguments, use Rule 1 iteratively around each verb.
4. Assign the noun in the phrase "by-N" the thematic role of Agent.

Caplan goes on to propose that, when the parser is abnormal, subjects obligatorily employ heuristics to satisfy the semantic properties of the sentence. These heuristics are obligatory and highly constrained, yet not completely invariant. Caplan found that he could not predict which heuristic a particular subject would select to interpret a particular sentence type. Nonetheless, some features of the sentence were thought to account for changes in the use of a heuristic by any one particular subject, for example, Caplan suggested the following: 1) the order of the nouns and verbs in a sentence; 2) the presence of a referentially dependent element; 3) the presence of a relative pronoun; 4) the presence of passive morphology (the by-phrase); 5) the presence of a word with a specific
semantic content (friend) in a sentence with proper nouns. Caplan has suggested in this article that there are two factors resulting in the inconsistent use of these heuristics as a function of the presence of these surface features. First, the parser itself can at times use these features to interpret parts of a sentence, thus eliminating the use of a heuristic at all. Second, some of these features are themselves the basis for interpretive heuristics (such as the by-phrase), which could alternate with word-order to determine its interpretation.

Thus, there are two factors in the variation seen in responses which require explanation. As Caplan has maintained, the parsing process intermittently fails. He found no evidence upon which to base an explanation of this variation. In addition, the particular heuristic to be used is partially constrained by the surface features of the sentence. Caplan (1986) noted that, although his study did not specifically compare a detailed measure of short-term memory with a measure of sentence comprehension, the nature of a syntactic comprehension impairment is not predictable from digit or word recall. Neither the qualitative nature of impairments, nor the heuristics employed in the presence of these impairments are predictable from recall experiments. This finding is in contrast to Albert (1976) who stated that there is a correlation between sentence comprehension and short-term memory span. Although Caplan found correlations between digit and word recall span and overall level of accuracy on the sentence comprehension batteries used in the case studies, this correlation was not invariant. Specific deficits in syntactic processing can occur independently of reduced digit span. Short digit span may reflect a reduced short-term memory capacity not directly related to the capacity needed for syntactic parsing and storage.

Syntactic representation is the means by which a linear string of words is related to
meaning. Lexical items are inserted into a deep structure which has a syntactic structure. In Government-Binding theory (Chomsky, 1965) transformations act upon the deep structure to produce a surface structure. At a level of processing called Logical Form, this S-structure is converted into a semantic (meaningful) representation. To be an acceptable sentence, lexical items must be syntactically acceptable before they can be semantically interpreted. Syntactic and semantic levels are distinct. Theta roles (so named to distinguish them from "thematic roles" which refers to the assignment that occurs at the semantic level) are assigned to a sentence such as "John ate the apple." so that John is the Agent of the verb and the apple is the Theme of the verb. At the syntactic level, the predicate (in this case "eat"), assigns its associated thematic roles to particular grammatical positions in the sentence. This assignment is independent of the semantics of the sentence. Only at the level of Logical Form are the semantic values of the thematic roles interpreted. In Government-Binding theory, theta roles are assigned to particular grammatical positions. Thus a verb such as "eat" will assign the theta role Agent to the subject NP and the theta role of Theme to the direct object NP. In particular sentences, such as relative clauses or passives, transformations are acted out on the deep structure so that one or more of the NP's may not be in the proper structural position to receive the correct assignment of Agent and Theme. Thus it is thought that the NP arguments are inserted into grammatical position at the deep structure level and therefore receive the correct theta roles. When these NP's are later moved to new structural positions by transformations, they leave behind an empty NP called a "trace" which links them to their old position. In this way, thematic roles for all NP’s in the sentence are interpretable since they can be linked back to the roles they were originally assigned in deep structure.

Processing models that describe how syntactic features are assigned to a sentence so that they may ultimately serve as input to the logical form where meaning is assigned are
called "parsers". The parser assigns syntactic structure to incoming strings of words, and assigns theta roles to the sentence so that it is ready for semantic interpretation. The assignment of empty categories, and the coindexing of NPs, is done at the syntactic level so that this information can be preserved and used at the semantic level of processing. Caplan used a model of parsing based on Berwick and Weinberg (1985). This parser assigns structure one phrase at a time. The parser is specific in exactly what it accepts as a phrase or constituent. When a string of words has been broken down into a hierarchy, then the parser can assign theta roles in accordance with a set of rules. Using evidence from aphasic language, Caplan supported his model of how the parser assigns theta roles, coindexes NPs, and assigns empty categories. After theta roles are assigned, the phrase is interpreted for its propositional content (a semantic interpretation where a meaning is assigned to the sentence). In Government-Binding theory this is called the level of Logical Form. There are models of sentence interpretation which do not require the use of a parser. In the model Caplan follows, this type of processing (relying on lexical and pragmatic information to process a string) is probably performed simultaneously with the functioning of the parser, and may contribute to the assignment of meaning for at least some simple or routine sentences. Heuristics, which play an important interpretive role in parserless models, may help in a parsing model to trigger parsing rules, and assign preferred syntactic structures in ambiguous cases. Caplan’s support of this model of normal functioning is compatible with the data he has collected over a series of studies on aphasic language. It would be of interest to see if the language deterioration resulting from Alzheimer’s Disease is in any way similar to that which occurs in aphasias resulting from other etiologies.

According to Caplan (1987) both processing and storage (memory) take up space in the "working memory" capacity used in sentence comprehension. If processing is impaired,
there will be less room for short-term storage, or vice versa. There is a strong relationship between the amount of storage available and the efficiency of parsing language. Caplan has summarized the psycholinguistic literature in this area by concluding that parsing processes occur quickly, and that the parser makes decisions even at ambiguous points in the sentence. The parser has a limited capacity that is affected by both storage and processing functions. Object relatives take up more capacity than subject relatives, and there is no evidence that constructing empty NPs is any more demanding on the parser’s capacity than constructing any other type of NP.

Caplan found very little evidence to support a neurolinguistic theory (termed the Connectionist theory (eg. Geschwind & Benson, 1975) in which specific syndromes of aphasia occur as a result of the location of the lesion site. He found that the most important determinant of performance on a test battery was the amount of Work Space available for syntactic comprehension. Although different subgroups of subjects were found, all of the subgroups had lesions confined to different portions of the perisylvian cortex. It appears that the localization of the Work Space is variable, and is not correlated with sex, age, or educational level. Caplan’s survey showed that the degree of impairment in syntactic comprehension is independent of lesion location within the perisylvian cortex. Thus the theory of "equipotentiality" is also ruled out, since in that theory it is thought that undamaged areas of the brain have the capability of taking over the functions of damaged areas. Such a theory would predict that, if a lesion was very localized, functions usually carried out in the lesioned area would be assumed by another area and a severe impairment would not result. Caplan’s data suggest that the amount of cortex responsible for syntactic comprehension is highly variable across the population.

In one particular study "Syntactic Determinants of Sentence Comprehension in Aphasia"
(1986), Caplan devised a test to be used as a preliminary battery for screening and exploration of all aphasic groups. Results of his experiment indicated that sentence type does not affect all subjects in the same manner. The results of a principal component analysis using different loadings on the vectors confirmed that although his sentence comprehension test clustered aphasics mainly according to overall severity, the type of sentence structure also contributed to the determination of some of the clusters. Thus, some groups of aphasics could interpret certain structures, others could not. Performance on different structures varied due to constraints on the way in which syntactic comprehension breaks down in aphasia; it is assumed that these constraints are the result of normal parsing (interpretive) processes. Caplan used his results as evidence for a particular syntactic analysis of these structures. When the sentence word order deviated from canonical form (NVN) (as in passives and sentences with two pre-verbal NPs, with the exception of cleft sentences), subjects had an equally difficult time parsing the sentence.

It is common for confusions to arise in interpretation of results of psycholinguistic studies involving tasks which could be described as tapping memory versus those involving linguistic processes. For example, Lorsbach and Simpson (1984) looked at the effects of age on short-term memory. Their stimuli were designed to test the recognition of probe words appearing on a computer screen. The authors measured the speed and accuracy of visual, phonemic, and semantic recognition of a probe word embedded in a string of ten words. Performance between two groups ranging from 18 to 29 years, and 58 to 79 years of age, was compared. Three different probe types were used: 1) sometimes the probe word was identical to a word in the list, 2) sometimes it was a homonym (having the same pronunciation), or 3) the probe could be a synonym. The list of words was given at a varying presentation rate (350, 700, and 1000 msec) and the serial positions of the ten words was varied over trials. The instructional cue presented to each subject on the
computer screen was: 1) I indicating identical, 2) H for homonym, or 3) M meaning the same. The subject was instructed to respond to the instructional cue with a "yes" or "no" by pressing a switch. Each trial consisted of: 1) the sequential presentation of a warning signal, 2) 10 unrelated words, 3) an instructional cue, and 4) a probe word. Results indicated that older adults require more time to respond to synonym probes than homonyms or identical words; the older group was also slower at scanning the semantic contents of short-term memory for a word with the same meaning. Not surprisingly, older subjects are slower at recognizing information that has been presented recently. There was no age difference on recognition accuracy, rate of presentation, or serial position. Older adults are slower at retrieving semantic information from early list positions when presented at a slower rate. This study confirmed that age does not affect the ability to hold physical, phonemic, and semantic information in short-term memory, but that retrieval time of semantic information is affected by age. It is of interest to note that, whereas the linguistic variable of semantic content is seen to be affected by age, this paper gives no linguistic description of this effect. The authors explained that the effects of retrieving semantic information from "secondary memory", although reliable, accounted for only a small portion of the variance. They suggested that there may be an increase in processing demands as the task becomes more complex, thus causing increased retrieval time. The paper contains no discussion about how the task becomes more complex; it is suggested that the "complexity" has a linguistic basis.

Kopelman (1986) compared A.D. subjects, amnesics, depressed and healthy controls in the immediate recall of semantically anomalous sentences. The author argued that, due to a severe short-term memory impairment, A.D. subjects are dependent on semantic clues in the recall process. He therefore predicted that they would do poorly on sentences which were semantically ambiguous. Much research has suggested that A.D. subjects have a
severe impairment in semantic knowledge; if true, the presence of semantic clues would not be a potential aid in recall. Kopelman argued that if A.D. patients have a selective short-term memory deficit, particularly for the primary memory component of serial-position digit recall, then short-term memory would be dependent upon semantic cues in verbal recall. He maintained that A.D. subjects should have even more difficulty, since they have deficits in both short-term memory and semantic processing. Kopelman’s stimuli consisted of eight sentences, two of which were normal and six of which were anomalous. Four of the anomalous sentences had normal syntax but were semantically ambiguous, one was semantically reversible, and one was syntactically ambiguous. Errors were classified as: omissions, intrusions, order/perseverative errors, phonemic confusions, semantic confusions, and semantic corrections. The sentences presented were as follows:

1. The team of workers built the bridge.
2. The man posted the letter.
3. Colourless green ideas sleep furiously.
4. The man that the book read was interesting.
5. Wasn’t the fat ceiling robbed by the tired pen?
6. The sky that the dream thought jumped cheaply.
7. Wasn’t the rich uncle advised by the nice manager?
8. Not in tree to the ran lake with.

(Kopelman, p.160)

Results showed that the A.D. subjects were proportionately more impaired on the anomalous sentences. (This is not surprising, since it is known that A.D. subjects have difficulties processing semantic information.) All four groups were able to recall sentences one and two (the normal sentences) correctly. All had difficulty with the random word string (sentence eight). An error analysis indicated that A.D. subjects made more omission errors than the depressed, Korsakoff or control groups. Both the Korsakoff and Alzheimer’s groups made twice more intrusion errors than the other two groups. There was no difference between the Korsakoff and A.D. groups in the number of semantic or phonemic confusions made. In summary, the author suggested that semantically anomalous
sentences may be used in differentiating dementia from other types of memory impairments. Kopelman states that, although the performance differences between the A.D. and Korsakoff subjects could be explained as either due to a linguistic or short-term memory impairment, the A.D. subjects he tested were not clinically dysphasic (a judgement based solely on a picture naming task administered by the author). Poor performance is therefore explained as a memory deficit, "although the contribution of a subtle linguistic impairment (e.g., in making use of syntactic cues) cannot be completely excluded". Kopelman used errors such as "The sky that jumped...something... I've lost it." and "Wasn't the fat... it's gone." as evidence of this short-term memory deficit. He did not discuss a model of linguistic processing which would explain why a linguistic variable, such as a semantic cue has such a dramatic affect on "memory". It could be argued that semantically anomalous sentences create a difficult parsing task for the patient in the presence of a severe linguistic deficit, one that is not evidenced in a picture naming task. Thus increased task complexity manifests itself as a breakdown in short-term memory. A sentence that is not processed linguistically will not be assigned a propositional interpretation, and will thus be much harder to recall. The implications of studies such as these are equally as explicable in linguistic terms, and should be included in a model of the language dissolution that results from A.D.

In summary, from the evidence reported it appears that persons suffering from A.D. do not have a global impairment which crosses all language functions. The data suggest that lexical and semantic knowledge are relatively impaired, in comparison with phonologic and syntactic abilities. At present, non-verbal tasks are being used as indicators of A.D., since they are thought to be diagnostically more sensitive in the early stages of the disease. Brief, informal language assessments are performed, based on the subject's ability to answer a series of questions such as "How many children do you have?" and "Where do you
live?", as well as a brief picture naming task of common items such as a clock, and an envelope. The linguistic sensitivity of a battery of tests based on Caplan (1986) is of interest.
CHAPTER 3

STATEMENT OF PROBLEM

The purpose of this investigation was to gather data on four A.D. subjects, using an object-manipulation test of syntactic comprehension devised by Caplan (1986). Individual batteries were devised to elicit data which might further characterize the extent of each subject's syntactic comprehension deficit. Patients selected as subjects were all in the early stages of the disease, and classified in the mild range of overall impairment. Results were interpreted using syntactic analyses based on methods devised by Caplan (1987). The language deficit resulting from A.D. was further characterized using this comprehension data. The sensitivity of this type of test as a possible early diagnostic tool for A.D. was discussed. The results of a similar test administered to four aphasic patients were compared to the A.D. group, and qualitative differences in their performance reported. Finally, the language impairment noted by the use of this test was compared with clinical descriptions previously given on each A.D. subject based on informal testing.
CHAPTER 4

METHOD

This study consisted of four case studies of persons diagnosed as being in the early-mid stages of Alzheimer’s Disease. The initial test batteries used were similar to those used in a study at present being conducted by Caplan (pers. comm.), in addition to a completed study by Caplan (1986), both on aphasic subjects. Control group data on a normal population completed by Caplan (1986) was applicable to the test stimuli and procedure used in this study. It was anticipated that similarities between this study and those of Caplan, would allow for some comparison of syntactic comprehension deficits of aphasics and patients with Alzheimer’s Disease. Following administration of test batteries, data were analyzed and a specific probe battery was designed for each subject which was used to test hypotheses based on the first data set.

Subjects were presented with a series of sentences in aural/written form, and asked to interpret the sentences by moving toy figurines. The task was to indicate who did what to whom. This type of task allowed the subject to make a range of errors that would not be possible in a picture-pointing task, thus avoiding the difficulty of designing appropriate foils. The batteries given to all four subjects, tested two areas of syntactic comprehension: Test 1, a 36-item test, entitled OBJECT MANIPULATION BATTERY (OMB); Test 2, a 48-item test of the subject’s ability to coreference NPs, entitled ANAPHORA BATTERY.
4.1 Subjects

Subjects were four females, aged 66, 70, 74, and 82 years at the time of testing. Subjects were contacted through the UBC Alzheimer's Clinic at the UBC Health Sciences Center. All had been diagnosed as A.D. within the last year except for subject 04, who had been initially diagnosed three and a half years prior to this study. All subjects had been reevaluated at the clinic within 6 months prior to the beginning of test sessions.

Diagnostic criteria used at the UBC Alzheimer's clinic are based on a system similar to that described by Kempler (1984) in use at The Geriatric Outpatient Clinic at UCLA. Evaluations in medical, neuropsychological, and psychological status were made. All patients were given the Mini Mental Status Exam (MMS) (Folstein, Folstein, and McHugh; 1975), an eleven question, 5-10 minute exam designed particularly for demented patients. The clinic summarized the results of the initial assessment on a form called the Functional Rating Scale. On this form a patient is assessed in the areas of: i) memory, ii) social/occupational, iii) home and hobbies, iv) personal care, v) language, vi) problem solving/reasoning, vii) affect, and viii) orientation. An impairment of memory, in addition to impairments in three or more other cognitive areas must be evidenced before a positive diagnosis is made. A patient is scored on a 15 point scale (1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, etc.) where a score that begins with the number "1" is considered healthy, "2" is questionable, "3" is mild, "4" is moderate, and a score of "5" or more denote a severe impairment.

In this study, subject's 01 and 03 scored in the questionable range (a score of 2) on the Functional Rating Scale. Subject had undergone extensive medical and psychological testing prior to being selected for this study.
language abilities. Subject 02 was assessed as having a moderate language impairment (a score of 4), and subject 04 was described as having healthy language abilities (scoring 1). As described on the clinic's assessment sheet, a score of 1 in language skills indicates "No disturbance of language reported by patient or relative." A score of 2 is "Subjective complaint of, or relative reports, language deficit, usually limited to word finding or naming." Scores in the 3 range denote "Patient or relative report variable language disturbance, (e.g. slurring of words, naming deficits); occasional language impairment noted on examination." A score of 4 would be applied when "Patient or relative report language disturbance, and language disturbance is evident on examination." Finally, scores in the five range indicate "Severe impairment of receptive and/or expressive language; production of unintelligible speech." (pers. comm.)

Other disorders which may complicate the diagnosis made by the clinic, such as depression were noted on the evaluation. For example subject 02 was reevaluated after initial assessment, because of a suspected lack of success resulting from depression rather than dementia. Based on this rating scale the four subjects selected for this study were described as having a mild overall impairment, obtaining mean scores of 2.9, 3.2, 3.1, and 2.9 respectively. Each initial assessment included an estimate of the duration of the disease prior to the assessment. If this estimate is included for subjects 01 through to 04 respectively, they are seen to have shown effects of the disease for 7, 4, 9, and 5 years prior to testing. Subjects' educational backgrounds ranged from grade eight to grade twelve; one subject possesses a teaching certificate. All are native speakers of English.
4.2 Testing Procedure

Subjects were tested over a period of two-three sessions, determined by the amount of time required by each individual. Sessions were usually one or one and a half hours in length, and included one to four breaks of ten minutes each. Testing was completed within a three week period. For subjects 02 and 04, sessions were discontinued at their request, or if they appeared to be performing poorly due to a lack of attention or motivation. Testing consisted of the completion of a pre-screening test, followed by the OMB (Object Manipulation Battery) and ANAPHORA battery, which are similar to those used by Caplan (1986). Data from these batteries were analyzed, and hypotheses developed to account for strategies used which resulted in the errors. A probe battery was then designed and administered to each subject.

4.3 Screening Procedure

Test sessions began with a discussion of what was to be done and why. The detail of this conversation varied depending on the level of each subject’s understanding. A subject was told that she was to perform a language test which would show how much she was understanding. She was instructed to use the animals or dolls placed before her to act out the sentences heard, taking care to show "who does what to whom". Prior to the administration of either the OMB or the ANAPHORA battery, each subject was required to carry out a screening test which was used to rule out severe memory, attention, or lexical deficits which could complicate results on this test of syntactic skills. In this pretest, each subject was required to identify one from an array, when given its name; in addition, she was required to use her short term memory in a serial ordering task. In the OMB pretest, for example, each subject was asked to point to (identification task) in any order
two items in a five item array ("point to the goat and the monkey") out of five animals laid out in front of the subject. The OMB pretest included the following object identification tasks: 1) one item in a five item array; 2) three items in a five item array. To test serial order (point to the items in the order mentioned) each subject was required to point to: 1) two items in a two item array; 2) three items in a three item array. Criterion for success was three consecutive correct responses (out of eleven items per type); criterion for failure was three consecutive incorrect responses or five incorrect responses (out of eleven). In the pretest for the Anaphora battery, each subject was asked to point to all the dolls named in random order twice ("Point to the __"). All four subjects passed this screening test.

For both the OMB and ANAPHORA batteries, a varying amount of time was spent practicing, in accordance with the method proposed by Caplan (pers. comm.). Subjects were told that it was not so important to show the details of the action (i.e. push, kick, or hug) so much as to make clear who was doing what to whom. Unfortunately, some subjects experienced difficulty remembering the task and had to be cued during each test session. Cues included "Show me who does what to whom", "Show me the whole sentence" or "So who did the kicking?". Some of the subjects, although successful on the pretest, had increased naming problems when the task became more complex, and would ask for confirmation "Is this the goat?". Subjects were given assistance when they asked for it. Practise times ranged from only a few minutes (for subject 03) to twenty minutes (for subject 02). Subjects generally practiced at least one example of each sentence type on the battery.
4.4 Object Manipulation Battery

The OMB battery was administered first to all four subjects. In this battery, a pool of six small (3 inches high) animals was used in an act-out task. The number of animals used was limited in an effort to decrease demands made on lexical/naming abilities. Subjects were seated at a table across from or at right angles to the examiner. The examiner read off the list of 36 sentences, pausing between each to score subjects' responses. Three animals to be used in the act-out were selected from the pool and laid out on the table in a set linear pattern to control for positioning effects.

4.4.1 Test Stimuli

The six different syntactic types and examples of stimuli used in the OMB battery were as follows:

1. DATIVE ACTIVE (DA): "The rabbit passed the cow to the goat."
2. CONJOINED (C): "The turtle patted the monkey and the elephant."
3. DATIVE PASSIVE (DP): "The elephant was given to the monkey by the turtle."
4. OBJECT-SUBJECT RELATIVE (O-S): "The goat hit the rabbit that grabbed the cow."
5. PASSIVE CONJOINED (PC): "The rabbit was hit by the monkey and the turtle."
6. SUBJECT-OBJECT RELATIVE (S-O): "The monkey that the rabbit grabbed shook the goat."
4.5 Anaphora Battery

In all cases the ANAPHORA Battery was given after the OMB. Four dolls labelled grandfather, boy, father, and friend were laid out in front of subjects. A label was placed at the foot of each of the six inch high plastic dolls. Of the 48 stimulus sentences, there were eight different syntactic structures represented. Most of the sentences required an ability to co-index NPs. Co-indexing (often referred to as coreferencing) is a syntactic term which explains how a subject can correctly assign thematic roles even when the surface structure context does not satisfy the rules of coreference (Radford, 1981).

4.5.1 Test Stimuli

The eight different syntactic types, and examples of stimuli used in the ANAPHORA battery were as follows:

1. PREPOSITIONAL PHRASE/REFLEXIVE: "The child of the father covered him."
2. PREPOSITIONAL PHRASE/REFLEXIVE: "A friend of the father kicked himself."
3. RELATIVE (THAT) CLAUSE/PRONOUN: "The father believed that the old man pinched him."
4. RELATIVE (THAT) CLAUSE/REFLEXIVE: "The father said that the old man tickled himself."
5. RELATIVE (THAT) CLAUSE/NOUN: "The father knew that the old man tickled the boy."
6. INFINITIVIAL/PREPOSITIONAL PHRASE: "The boy learned from the old man to dance."
7. INFINITIVIAL/TO PHRASE (SEEM TO, APPEARS TO, SWORE TO): "The old man seems to the father to be bending over."
8. SIMPLE INFINITIVIAL: "The boy convinced the old man to eat."
Following the presentation of these two test batteries, analyses were conducted. Hypotheses made regarding strategies used included:

1. Noncanonical word order will increase the complexity of a structure. That is, the parser will have more difficulty with PASSIVE, SUBJECT-OBJECT, and OBJECT-SUBJECT relatives than with other structures included in the test stimuli.

2. Assignment of thematic roles to three noun phrases (three place verb sentences) will be more difficult than to two. That is, DATIVES and DATIVE PASSIVES will generate more subject errors than active sentences and passive sentences.

3. Two verb or three place sentences which also have a noncanonical word order will be the most difficult stimuli. That is, SUBJECT-OBJECT relatives and DATIVE PASSIVES will generate more subject errors than will other stimuli.

4. A percentage of errors will be due to short-term auditory memory deficits. Subjects will make fewer errors if: 1) stimuli are presented in writing, and 2) subjects are given as much time as necessary to respond.

5. Subjects will perform better on the ANAPHORA battery than the OMB. That is, they will demonstrate a relatively less impaired ability to comprehend anaphors.
CHAPTER 5

CASE STUDIES

5.1 Case 01

5.1.1 History

This 82 year old woman was initially assessed at the Alzheimer's Clinic in July of 1986, and a diagnosis of A.D. was made on July 15/86. The disease was estimated to have had its onset 72 months prior to the assessment date; it was described as of "gradual onset", with sustained progressive deterioration. Subject 01 (S01) was described as having a questionable (Level 2) impairment of personal care, language, problem solving/reasoning, and orientation. She had a mild impairment (Level 3) of memory and affect, and was moderately impaired (Level 4) socially/occupationally, and in home and hobbies. No other medical factors were noted. A CAT scan taken at the initial assessment indicated diffuse cortical atrophy associated with small areas of white matter change in the posterior parietal area. S01, widowed since 1975, had a grade 9 education and was a housewife for the majority of her married life. Her living conditions changed between test sessions. When first contacted was living alone in the family home. Since that time she moved to a residential home for the elderly. Nurses at this home described S01 as having adjusted well to her new environment.
5.1.2 Testing and Results

S01 was cooperative during testing. She had fairly good attentional skills, and could keep on task for sessions of up to one and a quarter hours if given 5-10 minute breaks approximately each half hour. She quickly went through the original OMB and ANAPHORA batteries, taking 45 minutes and 20 minutes respectively (not including practice time). For general errors it was noted that S01 was confused when choosing the correct animal or doll out of the set, which may have contributed to some of her errors. Occasionally, she omitted acting out part of a sentence, although she would say it aloud. She appeared to forget that she was expected to act out all parts of the sentence, and if given a cue such as "What about the goat?", she would then include the omitted animal in her performance. Her performances of the sentences were relatively easy to interpret.

On the initial test date, S01 completed both the OMB and ANAPHORA batteries, scoring 17/36 and 30/48 respectively. The test procedure for S01 differed from the test procedure for the other three subjects. For S01, in the OMB test all six animals were set out in front of her; she was then expected to choose from the complete set. Ss02-04 had only to choose from three animals, all of which played a role in the sentence. For S01, one of the animals was a hippo rather than the monkey, which was used for the other three subjects. In the ANAPHORA battery, no written labels were provided, whereas for Ss02-04, the dolls were labelled. This may have hindered S01's performance, since two of the dolls looked very similar except for their clothing. It was noted that occasionally S01 did not notice the "father" doll, and thus she would choose the white haired "grandfather" doll as the next likely choice. Obvious lexical errors were always cued for the subject by saying, for example, "Is that the father?".
An analysis of S01’s errors revealed that she performed better on some constructions than others. S01’s scores on the different syntactic types in the two batteries are given in the following tables:

**TABLE V.i. S01 OMB: Aural Stimuli**

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DATIVE ACTIVE</td>
<td>4/6</td>
</tr>
<tr>
<td>2. CONJOINED</td>
<td>4/6</td>
</tr>
<tr>
<td>3. DATIVE PASSIVE</td>
<td>3/6</td>
</tr>
<tr>
<td>4. OBJECT-SUBJECT RELATIVE</td>
<td>1/6</td>
</tr>
<tr>
<td>5. PASSIVE CONJOINED</td>
<td>4/6</td>
</tr>
<tr>
<td>6. SUBJECT-OBJECT RELATIVE</td>
<td>1/6</td>
</tr>
</tbody>
</table>

**TABLE V.ii. S01 ANAPHORA: Aural Stimuli**

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PREPOSITIONAL PHRASE INSIDE: PRONOUN</td>
<td>7/7</td>
</tr>
<tr>
<td>2. REFLEXIVE</td>
<td>6/6</td>
</tr>
<tr>
<td>3. THAT CLAUSE: PRONOUN</td>
<td>3/5</td>
</tr>
<tr>
<td>4. REFLEXIVE</td>
<td>6/6</td>
</tr>
<tr>
<td>5. NOUN</td>
<td>3/6</td>
</tr>
<tr>
<td>6. INFINITIVE: PREPOSITIONAL PHRASE</td>
<td>2/2</td>
</tr>
<tr>
<td>7. TO PHRASE</td>
<td>6/8</td>
</tr>
<tr>
<td>8. SIMPLE</td>
<td>5/8</td>
</tr>
</tbody>
</table>

In general, most errors, when occurring on the same type, were qualitatively different each time. For example on the CONJOINED structures: in sentence 9, S01 chose an unmentioned (incorrect) Patient in the second half of the sentence, whereas in sentence 22 she chose an unmentioned (incorrect) Patient for the first part of the sentence. Some patterns did arise, which were used to design the probe stimuli. For example, in all three of the DATIVE PASSIVE stimuli which were incorrect, not once was the "by-phrase"\(^1\)

\(^1\)"by-phrase" refers to that portion of the passive syntactic structure which begins with "by", and ends acts as the Agent.
correctly interpreted. This was demonstrated in different ways, such as omission of an Agent for the sentence (self becomes Agent, as in sentence 10) in which she touched the first noun mentioned and omitted the rest of the sentence (as in sentence 24), or she selected an incorrect, unmentioned animal for an Agent (as in sentence 36).

Interpretations of OBJECT-SUBJECT relatives suggested that S01 used an "Agent carry-over" strategy, whereby the Agent in the first phrase became the Agent in the second phrase (re. sentence 16) or vice versa (re. sentence 20). S01 was often able to interpret the first noun-verb combination, but when reaching the complementizer "that", could not make closure between the Agent before the complementizer and the rest of the sentence following the complementizer.

While interpreting SUBJECT-OBJECT structures, a common error made by S01 was to "act out" the first NP with the final verb, but omit a "chunk" from the middle of the sentence (as in sentences 11, 17, and 19). Across all types, a common error was to choose an Agent or Patient that was not mentioned in the sentence, indicating an inability to remember all three animals in a difficult context (as in sentences 30, 9, 22, and 12).

Results obtained from S01 led to the following conclusions, based on the hypotheses as described in the Methodology:
1. S01 made fewer errors on DATIVE ACTIVE, CONJOINED, and PASSIVE CONJOINED structures; this supports Hypothesis 1.
2. The most difficult structures for S01 were OBJECT-SUBJECT, and SUBJECT-OBJECT relatives (such as "The goat hit the rabbit that grabbed the cow." and "The elephant that the cow patted kissed the rabbit."); this supports Hypothesis 1.
3. S01 performed as poorly on O-S relatives as she did on S-S relatives. She made fewer errors on DATIVE PASSIVES than on S-O and O-S relatives; this leads to the rejection of Hypothesis 3.

4. Comparisons between S01’s reading and auditory comprehension scores gave no support to Hypothesis 4. S01 did better on some portions of the reading task, but worse on others, when compared with her original scores on the auditorily presented stimuli; results from S01 lead to the rejection of Hypothesis 4.

5. S01 made fewer errors on the ANAPHORA battery than on the OMB battery; this supports Hypothesis 5.

It was felt that the presence of six animals in the OMB pool made the test significantly more difficult for S01, causing problems attributable to lexical confusions rather than to syntactic errors. To test this notion, all of the probes involved selection of animals from a pool limited to only three animals, the hippo being replaced with a monkey. Each error made on the OMB battery (nineteen in all) was repeated to allow for any improvement under the new conditions. Results indicated an improvement: Out of the nineteen original errors, she made only four errors (scoring 15/19 correct on OMB 1A). Errors that remained under these new conditions were made on the DASTIVE PASSIVE and SUBJECT-OBJECT constructions, making the performance of this A.D. subject similar to aphasics who also performed at the lowest level on these two sentence types (Caplan, 1986).

The initial batteries and the probes administered to S01 are given below. The goal of each particular probe is provided. Each probe was devised to test a hypothesis about S01’s comprehension strategy which resulted in particular error patterns found in the the original OMB and ANAPHORA batteries:
1. OMB aural (presented verbally). The original OMB test of 36 items, covering six different syntactic structures.

2. ANAPHORA aural. The original ANAPHORA test of 48 items, covering eight different syntactic structures.

3. OMB 1A ("A" stands for "aural", i.e. presented to the subject aurally). This probe consisted of 24 items, which included the repetition of the nineteen errors made on the original OMB battery, to test the hypothesis that S01 would do better when the animal pool was limited to three animals, and the confusion of hippo and elephant was omitted. Also included in this probe were five PASSIVES (devised from one DATIVE PASSIVE and four PASSIVE CONJOINED sentences), to test the hypothesis that S01 made errors on the DP and PC sentences because of an inability to process the PASSIVE structure and, if given a simple PASSIVE, would not be able to correctly interpret the sentence. Note that S01's ability to interpret simple CONJOINED structures was impaired (4/6 correct) on the original OMB.

On OMB 1A, S01 was presented with six simple PASSIVE sentences, to see if on the DATIVE PASSIVE sentences (on which she had originally scored 3/6 correct) it was the DATIVE, or the PASSIVE, or a combination of the two that created difficulty for her. Results showed that S01 achieved 6/6 correct, indicating that it was the DATIVE which was difficult for her to process. On the OMB 1A probe, S01 scored 16/19 on the repetition of errors made on the original battery. Thus, it appeared that S01's performance on any particular syntactic type was not consistent over test sessions.

4. OMB 1R ("R" stands for "read", i.e. the stimuli were presented on written cue cards). This probe consisted of seventeen items which included the repetition of all six OBJECT-SUBJECT and six SUBJECT-OBJECT sentences presented on the original test, to test the hypothesis that the pool of six animals caused a decrease in S01's performance, and also to
test the hypothesis that demand on memory increased the complexity of the task, and thus were a factor in the poor performance noted on these stimuli in the original test (by comparing these twelve auditory comprehension items to twelve reading comprehension items which posed less memory demand). If S01 was syntactically impaired and memory was not confounding the difficulty of the task, it was anticipated that she would perform equally as poorly on both R and A tests. Five simple PASSIVES (identical to the ones administered in OMB 1A) were also included in this probe. These were used to test the hypothesis that reading comprehension scores would not be any higher than aural comprehension, if S01 had adequate memory, but an inadequate linguistic system to process the stimuli.

OMB 1R was used to investigate S01's reading comprehension of O-S and S-O relatives. She scored 6/6 and 4/6 correct respectively. Thus, her scores improved considerably from the original test (both scores improved from 1/6). This could be partially due to the fact that the pool of animals was reduced, and also that S01 had time to reread the sentence, thus reducing memory constraints. She read the six sentences of revised DATIVE PASSIVES (where the by-phrase and the locative phrase were in a reversed position). On these, S01 scored 4/6 correct, a decrease from the aural score of 6/6. It is possible that on the reading task, S01 was confronted with constructions that she could not assign a heuristic to, and thus became frustrated, whereas in the aural condition, items which could not be processed in the normal manner were quickly assigned an incorrect interpretation.

5. OMB 2A. This probe consisted of six items, including three revised O-S and three revised S-O stimuli. The revisions were made in order to shorten the sentences into "that phrases" involving two animals, which were then used to test the hypothesis that S01 was impaired on the S-O and O-S types due to a syntactic disorder, and that her performance
on the stimuli would also be impaired. This probe was also used to test the hypothesis that S01 was using a "first NP as Agent" strategy to process stimuli.

OMB 2A was devised to investigate S01's performance on partial "that phrases" taken out of the SUBJECT-OBJECT and OBJECT-SUBJECT sentences. On phrases such as "the rabbit that grabbed the cow" and "the elephant that the cow patted", S01 scored 6/6 correct, indicating that she was not using a "first noun as Agent" strategy (if she had been using such a strategy, she would have scored poorly on the S-O portions, where Agent comes second). Why she could not get these portions correct, when embedded in a full sentence, is not clear, although it is apparent that the presence of the third animal made a more complex construction than did the sentences' component parts. The presence of the complementizer did not make these portions more difficult for her, but it is possible that she was not processing them at all.

6. OMB 4A. This probe consisted of twelve items, including six revised DP's which had been used to test the hypothesis that S01 had misinterpreted the "by-phrase" at the end of the sentence as a locative ("by" having the meaning of "near" or "nearby"). The "by-phrase" could not be misinterpreted this way in the new items. Six revised CONJOINED sentences which had two different verbs in them, unlike the C sentences on the original battery which had only one verb, were also included in this probe. These were devised to test the hypothesis that S01 was capable of holding three nouns and two verbs in memory, but that her performance on O-S and S-O sentences was due to a syntactic deficit.

To determine whether on DATIVE PASSIVES, it had been the dative or the conjoined construction caused the difficulty with this task, OMB 4A was devised. This probe was

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2 "that phrase" refers to a fragment of a S-O or O-S structure, i.e. "the monkey that the cow kicked".
used to examine a variety of conjoined constructions, as well as different datives. The
new set of datives ruled out a misinterpretation of the "by-phrase" at the end of the sentence, by exchanging the position of this phrase with the dative. Thus "The elephant was given to the monkey by the turtle" was presented as "The elephant was given by the turtle to the monkey". SOI 6/6 correct on these new DATIVE PASSIVES, indicating that she could process the passive construction, and the dative correctly. It is possible that SOI misinterpreted the "by-phrase" in these original sentences as a locative, rather than a passive construction.

The new conjoined sentences were devised to determine whether the presence of two verbs had increased the difficulty of the SUBJECT-OBJECT and OBJECT-SUBJECT sentences (the CONJOINED and PASSIVE CONJOINED sentences on the original battery had only one verb). SOI scored 5/6 correct, indicating that her memory for sentences with two verbs was relatively good. It is possible that her poor performance on S-O and O-S sentences was due to an inability to process this type of syntactic construction.

7. OMB 4R. This probe consisted of nine items, six of which were identical to the revised DP's administered in OMB 4A. These six were used to test the hypothesis that aural scores were lower due to increased memory load which caused a breakdown in comprehension. Also included in this battery were three revised CONJOINED items similar to the ones devised in OMB 4A.

8. ANAPH 1A. This probe was composed of ten items, consisting of a direct repetition of the ten items on which SOI erred on in the original ANAPHORA battery. This was given to test the hypothesis that lexical difficulties lowered performance scores, and that labelling the dolls would increase the SOI's performance on these items.
SOI originally had no labels to refer to on the ANAPHORA battery. On the original battery she scored 38/48 correct (10 errors were made). Out of the ten sentences she originally erred on, in probe ANAPH 1A, she made only three errors (scoring 7/10 correct). All her original errors on "that" clauses containing a noun were correctly processed once labels were provided. It is possible that some of this improvement could be the result of variability in performance; if these ten sentences were administered again, her performance would again show variation.

9. ANAPH 1R. This probe consisted of ten items identical to ANAPH 1A, except that they were presented on written cue cards. This probe was devised to test the hypothesis that if memory constraints confounded scores, SOI would do better on the reading task, than she would on the aural task.

SOI was presented with a reading test of the sentences which had given error scores in the initial ANAPHORA battery. She scored 10/10, i.e. she performed correctly on all items on which she had previously made errors. This indicated that the presence of memory cues aided subject performance. In view of the scores obtained with this probe, it appeared that SOI was able to perform correctly on all the ANAPHORA constructions through either aural or read stimuli; she had residual syntactic skills which enabled her to correctly comprehend the constructions tested. Her inability to correctly process the sentences aurally might be attributed to: 1) memory, 2) attention, or 3) variability in performance, characteristic of the language impairment (family and friends also note variability in performance in other areas such as affect and memory on a daily basis).

3 "that" clause refers to a complete sentence containing an embedded clause cued by a "that" complementizer.
In summary, S01’s most severe impairments on the constructions tested aurally were as follows:

OMB: There appeared to be a severe impairment in the ability to interpret sentences containing a "that" clause, particularly when S01 was expected to assign thematic roles to three NP’s (S-O and O-S relatives).

ANAPHORA: There appeared to be a severe deficit in the ability to interpret sentences which contained: 1) simple infinitives or infinitives with an additional "to phrase", and 2) "that" clauses containing pronouns or simple nouns.

S01 made no errors on the following aural stimuli:

OMB: not applicable since there were errors present on all sentence types in the OMB battery.

ANAPHORA: There appeared to be no impairment in the ability to interpret sentences which contained: 1) prepositional phrases with a pronoun or reflexive, 2) "that" clauses containing a reflexive, and 3) infinitives containing a prepositional phrase. Although many of the ANAPHORA sentences contained three NP’s, S01 was required to act out only the last action in the sentence. Thus, all sentences containing "that" clauses were easier in the ANAPHORA battery than the OMB battery (S01 made more errors when three NP’s were involved in the sentence). If S01 had been required to act out the first action (impossible due to the nature of the verb, i.e. "seems", "thought") it is hypothesized that she would have made more errors than these scores indicated.
S01’s reading scores indicated variable results. On some constructions she made fewer errors when required to read the stimuli, i.e. on: 1) O-S and S-O relatives, 2) "that" clauses containing either a pronoun or a noun, 3) simple infinitives, and 4) sentences containing both an infinitive and "to phrase". On some constructions her reading scores were lower than her aural scores, i.e. on revised dative passives which were reordered to require the correct interpretation of the passive "by-phrase". There were several constructions on which S01 performed equally as well in both reading and aural comprehension, i.e. on: 1) conjoined sentences containing two verbs, and 2) simple passives.
5.2 Case 02

5.2.1 History

This 74 year old woman was initially assessed at the UBC Alzheimer's clinic on November 12-13, 1986. At that time, she was suspected of being depressed, which could have affected her test results. A psychiatric evaluation on December 11, 1986, confirmed this diagnosis. On January 26, 1987, the subject was reevaluated at the clinic and was diagnosed as having Alzheimer's Disease. It was estimated that the onset of the disease was 36 months prior to initial assessment; it was described as of gradual onset, with sustained progressive deterioration noted. Subject 02 (S02) was described as having a questionable impairment (Level 2) of problem solving/reasoning, and orientation. She was mildly impaired (Level 3) in the areas of memory, personal care, and affect. Social/occupational, home and hobbies, and language showed moderate impairment (Level 4). Other important medical factors included: 1) diabetes, for which she had been taking medication (Diabeta) since 1983; 2) a family history of depression; 3) the use of antidepressant medication at the time of testing. She was described on the psychiatric report as having major depressive episodes, which at the time of testing were in remission. CAT scan information was not available. S02 had a grade 12 education, as well as a teacher's certificate. Her profession was as a teacher for special needs children. At the time of testing, S02 was living with her sister in an apartment. Her sister described the subject as having few activities, and requiring several naps throughout the day to relieve drowsiness. The sister also reported that whereas S02 used to read considerably, this activity had lessened considerably in the past five years. S02 reported that she read the Bible and the newspaper every day, but did not do any writing.
5.2.2 Testing and Results

S02 was cooperative during testing. On the initial test date, she had been given a sleeping pill several hours prior to the session, to relieve her anxiety. S02 was slow and drowsy during this session. She worked on the OMB battery for five minutes, and then stopped for a ten minute break. Testing was postponed until the next day following a further five minutes of testing. During subsequent sessions, the subject was more attentive, although she still required rest breaks at twenty-minute intervals. Her responses were more easily interpreted than on the first session. S02 was distracted, and continued to have difficulties maintaining eye contact throughout all test sessions.

On the initial test date, S02 completed only seventeen items on the OMB battery, scoring 11/17 correct. On the following day, she completed the OMB battery and the ANAPHORA battery, scoring 27/36 and 35/48 correct respectively. The test procedure for S02 resembled as closely as possible the procedure described for S01, except in two ways: 1) only three animals at a time were placed in front of the subject, and 2) in the ANAPHORA battery, the dolls were labelled, to reduce the likelihood of lexical confusions between dolls, for example, the friend versus the father.

An analysis of S02’s errors revealed that she performed better on some constructions than others. S02’s scores on the different syntactic types in the two batteries, are given in the following tables:
TABLE V.iii. S02 OMB: Aural Stimuli

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DATIVE ACTIVE</td>
<td>5/6</td>
</tr>
<tr>
<td>2. CONJOINED</td>
<td>6/6</td>
</tr>
<tr>
<td>3. DATIVE PASSIVE</td>
<td>5/6</td>
</tr>
<tr>
<td>4. OBJECT-SUBJECT RELATIVE</td>
<td>3/6</td>
</tr>
<tr>
<td>5. PASSIVE CONJOINED</td>
<td>5/6</td>
</tr>
<tr>
<td>6. SUBJECT-OBJECT RELATIVE</td>
<td>3/6</td>
</tr>
</tbody>
</table>

TABLE V.iv. S02 ANAPHORA: Aural Stimuli

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PREPOSITIONAL PHRASE INSIDE: PRONOUN</td>
<td>5/7</td>
</tr>
<tr>
<td>2. REFLEXIVE</td>
<td>5/6</td>
</tr>
<tr>
<td>3. THAT CLAUSE:</td>
<td></td>
</tr>
<tr>
<td>PRONOUN</td>
<td>2/5</td>
</tr>
<tr>
<td>REFLEXIVE</td>
<td>5/6</td>
</tr>
<tr>
<td>NOUN</td>
<td>4/6</td>
</tr>
<tr>
<td>6. INFINITIVE:</td>
<td></td>
</tr>
<tr>
<td>PREPOSITIONAL PHRASE</td>
<td>1/2</td>
</tr>
<tr>
<td>TO PHRASE</td>
<td>6/8</td>
</tr>
<tr>
<td>8. SIMPLE</td>
<td>7/8</td>
</tr>
</tbody>
</table>

In general, most errors, when occurring on the same type were qualitatively different each time. For example, on SUBJECT-OBJECT RELATIVES: in sentence 11, S02 replaced the Patient in the first part of the sentence with the last noun mentioned, whereas in sentence 2, she made the same error as in sentence 11, and omitted the last part of the sentence completely. This last portion of the sentence was not omitted (in all other trials, it was acted out correctly) in any other S-O trials.

Another example of very different errors occurring on the same sentence type occurred on THAT CLAUSES containing a PRONOUN. On one trial (sentence 2), S02 reversed the Patient and Agent roles, whereas on sentence 10, she omitted the correct Agent and made the verb reflexive, resulting in an interpretation in which the Patient acts upon himself.
Frequently, she made only one error on a given sentence type, thus it was difficult to make a hypothesis about what strategy might have been used to parse the sentence. The probe stimuli were designed to investigate different hypotheses about the heuristics used by S02 when her responses had resulted in incorrect interpretations of structures. In view of S02's history of depression, as well as her distracted behavior during the sessions, it was suspected that her impaired attentional abilities confounded the test results. It was hypothesised that poor ability to focus attention affected S02's memory skills, thus generating random errors throughout the sentence types, regardless of their syntactic structure. Nonetheless, some error patterns did arise, such as the generation of more errors on relative clauses than on the other syntactic types, suggesting that syntactic complexity played a role in the test results.

Results obtained from S02 led to the following conclusions:

1. S02 generated fewer errors on CONJOINED sentences than any other structure included in the OMB battery; this supports Hypothesis 1.

2. PASSIVE and ACTIVE structures did not present more difficulty than DATIVE and DATIVE PASSIVE constructions, although they did appear to be of comparable difficulty for S02; this supports Hypothesis 2.

3. S02 performed well on DATIVE ACTIVE, DATIVE PASSIVE, and PASSIVE CONJOINED sentences. The most difficult structures for the S02 were OBJECT-SUBJECT and SUBJECT-OBJECT sentences; this leads to the rejection of Hypothesis 3.

4. Comparisons of reading comprehension versus auditory comprehension resulted in conflicting views regarding Hypothesis 4. S02 performed slightly better on the reading stimuli than the aural stimuli on the OMB structures, but performed in the opposing manner for the ANAPHORA stimuli (where aural scores where better than reading); this leads to the rejection of Hypothesis 4.
5. S02 performed better on the OMB battery than the ANAPHORA battery; this leads to the rejection of Hypothesis 5.

The original tests, and the probes designed on the basis of these tests, are given as follows:

1. OMB aural (presented verbally). The original OMB battery of 36 items, including six presentations of six syntactic types.
2. ANAPHORA aural. The original ANAPHORA battery of 48 items covering eight different syntactic structures.
3. OMB 1A ("A" stands for "Aural"). This probe consisted of ten items which included repetition of the nine errors made on the original OMB battery, plus one sentence on which S02 verbalized the wrong verb (not scored as an error by Caplan’s criteria (pers. comm.), yet not the choice that a normal subject would make). It was hypothesized that S02 would perform differently on these types, either by getting them correct or by performing a qualitatively different error, since it was thought that a large number of her errors were due to attentional factors.

Results from probe OMB 1A indicated that S02 scored 2/10 correctly, fewer errors than she made on the original OMB test. Only one of the nine original errors was corrected on the second trial. Sentence 22 was the only other sentence corrected on the second trial. It was not counted as an original error but was given again in probe OMB 1A because it was performed with the incorrect verb on the original battery. Results indicated that S02’s performance did not vary as much as had been expected. Structures which she could not correctly comprehend on the first battery, continued to be difficult for her.

4. OMB 2A. This probe consisted of six items, including three revised S-O and three O-S
sentences, which were used to test the hypothesis that memory restrictions prevented S02 from performing correctly. The revised sentences (called "that phrases") included only two animals rather than three, and a "that" complementizer. It was thought that S02 would do better on these, since there was less information to hold in memory. Probe OMB 2A was used to test the hypothesis that S02 used a "first noun as Agent" strategy on, for example, sentences 10 and 29. It was anticipated that S02 would do poorly on S-O types, and do well on O-S types if she used this strategy without any ability to interpret the embedded phrase.

On probe OMB 2A, S02 performed correctly on all six revised "that phrases", indicating that she did better with two noun phrases involving only one verb. She did equally well on both types of sentences (for example, "the cow that scratched the goat", and "the turtle that the goat caught") indicating that she was not using a "first noun as Agent" strategy to process these sentences.

5. OMB 1R ("R" stands for "read", meaning the stimuli were read from cards). This probe consisted of the same ten stimuli as used in OMB 1A. It was anticipated that S02 would do better with written stimuli since she would have more time to process the information, and thus there would be less demand made on memory.

Performance on OMB 1R was better than on the aurally processed OMB 1A (5/10 versus 2/10 respectively), indicating that S02’s reading comprehension was better than her aural comprehension. The two sentences correctly interpreted in the aural test were also correctly interpreted in the reading test, indicating that her scores were not randomly correct. Results supported the hypothesis that the demand made on memory in the aural test aided in lowering S02’s comprehension scores.
6. ANAPH 1A. This probe consisted of 23 items, thirteen of which were exact repetitions of errors made on the original ANAPHORA battery. This probe was used to test the hypothesis that there would be variation of these errors in the second trial. Also included were revisions of seven sentences using the verb "swore". It was thought that S02 had only one lexical definition for this word, namely interpreting it as "curse", and did not interpret the word as "to tell the truth". Thus, it was anticipated that S02 would have difficulties with these seven items. Finally, included on the battery were three sentences from the THAT CLAUSE type, which were all performed correctly in the initial battery. These were retested to investigate whether a "chunk" of the sentence would "drop out" or be omitted, as it appeared to in the THAT CLAUSE sentences 24, 29 and 47.

On the ANAPH 1A probe, S02 performed correctly on 10/13 sentences which were incorrect on in the original battery. This indicated a improvement in comprehension over the two trials, and was evidence of the variability in performance which was expected but not shown in results from OMB 1A. Of the seven sentences which were revisions of sentences on the original battery containing the word "swore", S02 made fewer errors when this lexeme was omitted from the sentence, scoring 4/7 correct. It was suggested that this particular word, rather than the syntactic structure of the sentence caused S02 difficulties. Finally, of the three sentences which appeared to be incorrectly interpreted because a "chunk" of information was omitted in their interpretation, S02 performed correctly 2/3 times when they were presented in the probe. The one sentence which occasioned a further error, i.e. "The boy thought that the old man scratched himself.", was viewed as qualitatively different from that made on the original battery. On this occasion, S02 appeared to misinterpret the reflexive, rather than omit the middle portion of the sentence. The probe appeared to indicate that the tendency for the middle part of the sentence to "drop out" was not a common or systematic occurrence.
7. ANAPH 2A. This probe consisted of nine items given in wh-question form. These nine included sentence types on which there were errors in the original battery. In all of these nine stimuli, a wh-question was given before the sentence was presented aurally. Occasionally, the Agent was requested before the sentence was given; for example, in the stimulus set: "Who pinched him? The father believed that the old man pinched him. (wait for response here, then continue) Who got pinched?". In other stimuli, the Patient was requested first; for example: "Who got tickled? The father knew that the old man tickled the boy. (wait for response) Who tickled the boy?". It was anticipated that S02 would do better on those stimuli in which the question was presented before the sentence, since, (it was reasoned) this would help S02 attend to a particular piece of information. It was also anticipated that S02 would do better on a verbal task, than by responding in an "act out" (as on the original batteries, using figurines), since the act out task appeared to be overwhelmingly difficult for S02.

On the ANAPH 2A probe, S02 performed better when given a cue before hearing the sentence, than when given a question after the sentence had been presented (7/9 correct versus 2/8 respectively). This appeared to indicate that comprehension was better when S02 was given a cue about the information she needed to retain from the message. Of the nine sentences which produced errors in the original battery, S02 performed correctly on three in the wh-question task. Results indicated some variation in performance, possibly because for S02, the verbal task was less confusing than the act out task.

8. ANAPH 1R. This probe consisted of 23 items identical to ANAPH 1A, and was used to test the hypothesis that reading scores would be higher, since this task placed less demand on memory and attention than did the aural comprehension task.

On the ANAPH 1R probe, S02 scored 5/13 correct, a drop in scores from the ANAPH
1A probe, indicating that her aural comprehension was slightly better than her reading comprehension. These results are in contradiction to those found in the OMB 1R probe, which indicated that S02’s reading comprehension was slightly better than her aural comprehension. Of the original three sentences in which it was suspected that a "chunk" had "dropped out", S02 performed 2/3 correctly, making an identical error on one of the sentences (a sentence different from that which created an error in the aural condition), indicating that there was some consistency in S02’s use of this strategy (for example "The boy thought that the father hit him." is interpreted as "The boy hit him."). Finally, on the seven sentences used to test S02’s ability to interpret the word "swore", she scored only 2/7 correct, a drop in performance from the aural condition. If S02 was experiencing lexical difficulties with this word (as expected), then (it was hypothesized) the reading condition would cause even greater confusion, since she could not as easily misinterpret what she read (this assumes that on the sentences which she heard, but could not correctly comprehend, she could apply her own strategy for interpretation and quickly forget the correct form of the stimulus sentences).

In summary, S02’s most severe impairments on the aurally presented constructions were as follows:

OMB: There appeared to exist a severe impairment in the ability to interpret sentences containing "that" clauses, when having to assign thematic roles to three NP’s (S-O and O-S relatives).

ANAPHORA: There appeared to exist a severe impairment in the ability to interpret sentences which contained 1) a pronoun or noun in a "that" clause, 2) a simple infinitive, or 3) a pronoun within a prepositional phrase.
S02 made no errors on the following aural stimuli:

OMB: There appeared to be no impairment in the ability to interpret conjoined sentences.

ANAPHORA: not applicable, since there were errors present in all sentence types on the ANAPHORA battery.

S02’s reading scores gave variable results.
5.3 Case 03

5.3.1 History

This 70 year old woman was initially assessed at the UBC Alzheimer's Clinic on October 2, 1986, and a diagnosis of Alzheimer's Disease was made at that time. The onset of the disease was estimated to be 96 months prior to initial assessment; it was described as of "gradual onset", with sustained progressive deterioration. Subject 03 (S03) was described as having a questionable impairment (Level 2) of: problem solving/reasoning, and orientation. She had a mild impairment (Level 3) of affect, personal care, language and social/occupational skills. Her memory, and home and hobby skills were described as being moderately impaired (Level 4). No other medical factors were noted. A CAT scan taken on October 2, 1986, revealed ventricular dilation and mild to moderated cortical tissue loss. A second scan taken December 4, 1986, revealed lacunar infarcts in the basal ganglia bilaterally, and in the left lower mesencephalon. S03 lived with her husband. In the past year, they have moved to a home for the elderly where they have housemaid service, cafeteria facilities, and homemakers to help them with personal care. In 1984, prior to their move, their home burned, possibly due to "something being left on". S03 was quiet in group conversations, but when speaking to her alone, her conversational skills appeared appropriate.

5.3.2 Testing and Results

S03 was cooperative during testing. She completed the original two batteries quickly (34 minutes to complete the two batteries, not including pre-tests). She did not require any breaks during the test session. She appeared to have little problem understanding
what was required of her during the test. Her responses were easy to interpret. S03 required an occasional prompt, such as "Who is eating?", and "Show me falling.", since she would sometimes focus on the first action in the sentence and try to act it out, rather than acting out the second verb, as was required in the ANAPHORA battery.

On the initial test date, S03 completed both the OMB and the ANAPHORA aural batteries, scoring 28/36 and 42/48 correct respectively. An analysis of her errors revealed that S03 performed better on some constructions than on others. S03's scores on the different syntactic types in the two batteries, are given in the following tables:

TABLE V.v. S03 OMB: Aural Stimuli

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DATIVE ACTIVE</td>
<td>6/6</td>
</tr>
<tr>
<td>2. CONJOINED</td>
<td>6/6</td>
</tr>
<tr>
<td>3. DATIVE PASSIVE</td>
<td>5/6</td>
</tr>
<tr>
<td>4. OBJECT-SUBJECT RELATIVE</td>
<td>2/6</td>
</tr>
<tr>
<td>5. PASSIVE CONJOINED</td>
<td>6/6</td>
</tr>
<tr>
<td>6. SUBJECT-OBJECT RELATIVE</td>
<td>3/6</td>
</tr>
</tbody>
</table>

TABLE V.vi. S03 ANAPHORA: Aural Stimuli

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PREPOSITIONAL PHRASE INSIDE: PRONOUN REFLEXIVE</td>
<td>5/6</td>
</tr>
<tr>
<td>2. PRONOUN</td>
<td>6/6</td>
</tr>
<tr>
<td>3. REFLEXIVE</td>
<td>4/6</td>
</tr>
<tr>
<td>4. NOUN</td>
<td>6/6</td>
</tr>
<tr>
<td>5. PREPOSITIONAL PHRASE</td>
<td>1/2</td>
</tr>
<tr>
<td>6. TO PHRASE</td>
<td>7/8</td>
</tr>
<tr>
<td>7. SIMPLE</td>
<td>7/8</td>
</tr>
</tbody>
</table>

In general, few errors were repeated on the same syntactic type. Across types on the ANAPHORA battery, S03 chose an object which had not been mentioned (a doll character)
to participate in the act out; this was her most common error. The most consistent error observed in the OMB battery was made on the O-S sentences, where on 4/6 trials, S03 performed "Agent carryover", i.e. she interpreted the first part of the sentence correctly, but made Agent of this first portion, Agent of the second verb as well. For example, in sentence 5: "The goat hit the rabbit that grabbed the cow.", S03 acted out the goat hitting the rabbit, followed by the goat grabbing the cow.

In the S-O sentences, S03 appeared to: interpret the first noun mentioned as Agent, correctly interpret the last verb and noun, but misinterpret the middle portion of the sentence. For example, in sentence 2: "The monkey that the rabbit grabbed shook the goat.", she acted out the monkey grabbing the rabbit, followed by the rabbit shaking the goat.

Results from the OMB battery indicated that S03 could interpret correctly nearly all of the constructions tested. Exceptions were found in O-S, S-O, and DP constructions. S03 performed relatively better on the ANAPHORA battery, with her lowest score being 4/6 correct on sentences containing a reflexive within a "that" clause. In general, errors on the ANAPHORA battery were scattered across syntactic types more frequently than had been observed on the OMB battery.

Results obtained from S03 led to the following conclusions:
1. S03 made the most errors on S-O and O-S relatives, as well as DP constructions; this supports Hypothesis 1.
2. S03 made slightly more errors on DP's than CONJOINED PASSIVES; this supports Hypothesis 2.
3. S03 made more errors on O-S relatives than on other construction in the OMB battery; this leads to the rejection of Hypothesis 3.

4. S03's reading for the OMB stimuli were lower than her aural scores; her reading comprehension scores for the ANAPHORA stimuli were comparable to those in the aural mode. For S03, this leads to the rejection of Hypothesis 3.

5. S03 made performed fewer errors on the ANAPHORA battery than she did on the OMB battery; this supports Hypothesis 5.

The initial batteries and the probes designed on the basis of these tests, are given as follows:

1. OMB aural. The original OMB test of 36 items, presented verbally.

2. ANAPHORA aural. The original ANAPHORA test of 48 items, presented verbally.

3. OMB IA. This probe consisted of seventeen items, which included eight items on which errors had been made on the OMB aural battery. Probe OMB IA was used to test the hypothesis that S03 performed consistently, and that errors on the S-O and O-S types were primarily due to a syntactic deficit, not to attentional/memory variables. Thus, her performance was expected to remain the same on these types. Also included in the probe were three revised DP sentences, to determine whether S03 had misinterpreted the "by-phrase" of the passive construction as a "to phrase" (locative). The "to phrase" and the "by-phrase" were reversed, which would make it impossible for a normal language user to interpret the passive as a locative. The hypothesis that this was not the strategy that lead to S03's error on sentence 4, was investigated. Also included in the probe were six revised S-O and O-S relatives. These new stimuli were shortened phrases (called "that phrases"), for example, "the turtle that the goat caught" or "the goat that bit the rabbit". If she was using a "first noun as Agent" strategy, it was anticipated that S03 would perform poorly on the shortened O-S phrases, but would do well on the shortened S-O
phrases because of a decreased demand on memory, and the decreased syntactic complexity of the structures.

On OMB 1A, S03’s performance improved on only 2/8 of the original errors, supporting the hypothesis that her errors were primarily the result of a consistent syntactic deficit. She performed correctly on all three of the revised DATIVE PASSIVES, thus supporting the hypothesis that S03 misinterpreted the "by-phrase" as a locative in the original battery. She also performed correctly on all six of the short "that phrases" (whereas in the S-O and O-S form, she scored 1/6 correct), which would appear to indicate that she did not use a "first noun as Agent " strategy. It is likely that on these six stimuli, memory load was decreased, thus helping to improve her performance on both O-S and S-O types; it is also possible that decreased syntactic complexity of the stimuli played a major role in improving her scores.

4. OMB 2A. This probe consisted of four items which converted two S-O sentences into O-S, and vice-versa. These four items were selected from sentences on which S03 had previously made errors on on the original battery. If S03’s errors in the original OMB battery had been primarily due to a syntactic deficit, it was anticipated that S03 would again make errors on these sentences when presented in the probe.

On the OMB 2A probe, S03 performed correctly on all four stimuli, thus indicating some variability between test sessions in her ability to comprehend S-O and O-S relatives. It appears that it was not the syntactic structure alone which generated the errors which occurred on the original OMB battery. Thus, the evidence suggests that memory and/or attentional factors affected S03’s performance.

5. OMB 1R. This probe consisted of the repetition of all 36 items on the original OMB battery, except for three DP’s which were revised (described in OMB 1A). It was
hypothesized that S03's errors in the aural condition were not due to memory difficulties. She was therefore expected to perform at a comparable level in both reading and aural comprehension.

S03 scored 18/36 on the written stimuli in the OMB 1R probe, a decrease in performance from 28/36 with the aural stimuli. Of the three revised DP's (expected to be easier, since they were in the aural mode) S03's scores were lower in the reading mode (0/3 correct). On the revised DP's, S03 interpreted the dative "to phrase" correctly, but consistently reversed the Patient and Agent indicated by the "by-phrase". Of the three DP's on the probe (presented as in the original battery), S03 scored 1/3 correct, indicating a more severe impairment of reading than of aural comprehension.

6. ANAPH 1A. This probe consisted of seven items, which included a repetition of the six errors made on the original battery, plus the repetition of sentence 23, which was not scored as wrong by Caplan's criteria (pers. comm.), but neither was it answered in a strictly normal manner. In sentence 23: "The father of the boy kicked him.", S03 acted out the father kicking the friend rather than the boy, when the boy would have been the more likely Patient. It was anticipated that S03's scores on the probe would show no consistent error pattern, i.e. that her scores would be similar to her original performance in which existed a variety of errors across syntactic types, with no particular difficulty on any one syntactic type.

Of the seven items presented on the ANAPH 1A probe, S03 scored 7/7 correct, i.e. a better performance than that obtained on the original ANAPHORAS battery. Results indicated that S03's performance varied between test sessions.

7. ANAPH 1R. This probe consisted of the reading of all 48 items from the original ANAPHORAS battery. It was hypothesized that if attentional and/or memory deficits were
playing only a minor role in S03’s overall performance deficit, then her reading comprehension would be no better or worse than her aural comprehension. Thus, S03’s scores on the probe and original ANAPHORA battery were expected to be comparable. Some variability in the type of error was expected.

On the ANAPH 1R probe, S03 made five errors, a slight improvement over her performance in the aural condition. Only two sentences on which the subject made errors in the original battery forced errors a second time in the probe; only one of these two errors was identical to the error made on the original battery. These results support the suggestion that S03’s comprehension abilities varied over time.

In summary, S03’s most severe impairments on the aurally presented stimuli were as follows:

OMB: A severe impairment appeared to be present in the interpretation of: 1) relative clauses, and 2) dative passive constructions.

ANAPHORA: A severe impairment appeared to be present in the interpretation of sentences which contained reflexives inside a "that" clause (S03 tended to make unusual errors with reflexives throughout testing, i.e. i) misinterpreting "The father said that the old man tickled himself." as "The father tickled himself.", or ii) misinterpreting "The old man knew that his friend scratched the boy." as "The friend scratched himself.").

S03 made no errors on the following aural stimuli:

OMB: There appeared to be no impairment in the interpretation of sentences which were: 1) dative active, 2) conjoined, and 3) passive conjoined constructions.
ANAPHORA: There appeared to be no impairment in the interpretation of sentences which contained: 1) reflexives inside a prepositional phrase, and 2) pronouns/nouns inside a "that" clause.

Results indicated that S03's reading comprehension was more severely impaired than her aural comprehension.
5.4 Case 04

5.4.1 History

This 66 year old woman was initially assessed at the UBC Alzheimer's Clinic on April 9 & 11, 1985. Follow-up evaluations were conducted on November 5, 1985, and July 24, 1986. It was estimated that the onset of the disease occurred 48 months prior to initial assessment. The disease was described as of gradual onset, with the presence of sustained progressive deterioration. Subject 04 (S04) was described as having a questionable impairment of personal care, language, and orientation, and a mild impairment of home and hobbies, problem solving and reasoning. She was described as having moderately impaired memory, social/occupational skills, and affect. Other important medical factors included a history of depression in early adult life. A CAT scan taken on April 9, 1985, indicated mild to moderate cortical tissue volume loss. S04 was a widow, retired since 1983, and lived with her daughter and daughter’s family. She had a grade-8 education, and was a homemaker until the time of her retirement. The daughter reported that S04 attended a day care facility twice weekly for activities, and her hobbies included going for walks and watching t.v. In conversation, S04 was often repetitive and inappropriate. She was easily distracted, and prone to agitation. S04 was reluctant at times to complete testing, and stated that it was "a silly test" and could see no point in it. When given an explanation for the test, S04 would state that she understood now, and would then continue.

5.4.2 Testing and Results

S04 was occasionally uncooperative during testing. Her attentional skills were impaired, and breaks were required approximately every 20 minutes. She completed the
OMB aural battery in one hour, and the OMB reading probe in 35 minutes. It was not possible to administer the ANAPHORA battery due to time constraints. An ANAPH probe using ANAPHORA stimuli was presented in wh-question form, and took 10 minutes to complete. Testing continued over three sessions.

On the OMB aural battery, administered during the initial session, S04 scored 7/36 correct. In the next two sessions, she completed the OMB reading probe (a written presentation of stimuli identical to those on the OMB battery), scoring 3/32 correct. On the final probe administered, S04 scored 9/21 correct answering wh-questions verbally.

An analysis of S04's errors revealed that she made errors on all constructions in the OMB aural battery, except CONJOINED sentences, on which she scored 5/6 correct. S04's scores on the different syntactic types in the OMB battery, as well as the two probes administered, are given in the following tables:
TABLE V.vii. S04 OMB: Aural Stimuli

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DATIVE ACTIVE</td>
<td>2/6</td>
</tr>
<tr>
<td>2. CONJOINED</td>
<td>5/6</td>
</tr>
<tr>
<td>3. DATIVE PASSIVE</td>
<td>0/6</td>
</tr>
<tr>
<td>4. OBJECT-SUBJECT RELATIVE</td>
<td>0/6</td>
</tr>
<tr>
<td>5. PASSIVE CONJOINED</td>
<td>0/6</td>
</tr>
<tr>
<td>6. SUBJECT-OBJECT RELATIVE</td>
<td>0/6</td>
</tr>
</tbody>
</table>

TABLE V.viii. S04 OMB PROBE: Reading Stimuli

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DATIVE ACTIVE</td>
<td>0/5</td>
</tr>
<tr>
<td>2. CONJOINED</td>
<td>0/4</td>
</tr>
<tr>
<td>3. DATIVE PASSIVE</td>
<td>1/5</td>
</tr>
<tr>
<td>4. OBJECT-SUBJECT RELATIVE</td>
<td>2/6</td>
</tr>
<tr>
<td>5. PASSIVE CONJOINED</td>
<td>0/6</td>
</tr>
<tr>
<td>6. SUBJECT-OBJECT RELATIVE</td>
<td>0/6</td>
</tr>
</tbody>
</table>

TABLE V.ix. S04 ANAPH PROBE: Wh-questions

<table>
<thead>
<tr>
<th>Test Item</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PREPOSITIONAL PHRASE INSIDE: PRONOUN</td>
<td>1/4</td>
</tr>
<tr>
<td>2. REFLEXIVE</td>
<td>1/3</td>
</tr>
<tr>
<td>3. THAT CLAUSE: PRONOUN</td>
<td>1/2</td>
</tr>
<tr>
<td>4. REFLEXIVE</td>
<td>2/2</td>
</tr>
<tr>
<td>5. NOUN</td>
<td>1/1</td>
</tr>
<tr>
<td>6. INFINITIVE: PREPOSITIONAL PHRASE</td>
<td>0/2</td>
</tr>
<tr>
<td>7. TO PHRASE</td>
<td>2/3</td>
</tr>
<tr>
<td>8. SIMPLE</td>
<td>1/4</td>
</tr>
</tbody>
</table>

On the OMB battery, S04 scored 2/6 on DATIVE ACTIVES, but gave incorrect responses to all other stimuli. When reading the same set of stimuli, she performed incorrectly on all of DATIVE ACTIVES, and CONJOINED sentences, while scoring 1/5 and 2/6 on DATIVE PASSIVE and OBJECT-SUBJECT relatives, respectively. Results indicate that S04's performance on any given syntactic type varied on a daily basis, thus accurate
descriptions of the syntactic deficit were difficult to make.

S04 made least errors on direct wh-questions for which she was required to give a verbal response (rather than an "act out" response). Her most frequent error was to pick up each animal in the order mentioned in the sentence, while failing to "act out" any of the verbs. Thus, it was impossible to score her interpretation of Agent, Patient, and Goal. S04 experienced difficulties remembering what task was required of her, and continual coaching was necessary throughout the test period. This lead to an inconsistent administration protocol, since coaching to this extent was not necessary with the other subjects.

Results obtained from S04 led to the following conclusions:
1. S04 made more errors on DP, O-S, S-O, and PC structures than other structures in the OMB battery; this supports Hypothesis 1.
2. PASSIVE CONJOINED sentences generated as many errors as DATIVE PASSIVES; this leads to the rejection of Hypothesis 2.
3. S04 failed to interpret all presentations of S-O relatives and DATIVE PASSIVES; this supports Hypothesis 3.
4. S04 made more errors when reading the OMB stimuli (5% error in the aural condition vs. 15% in the reading condition), than when processing them auditorily; this leads to the rejection of Hypothesis 4.
5. S04 made fewer errors on the ANAPH probe than on the OMB battery; conclusions could not be drawn to support Hypothesis 5., since all ANAPH stimuli were presented to S04 as a wh-question, and cues to the answer were provided in each stimulus set. Thus, the ANAPH probe could not be compared to the OMB probe, since the two were presented in different manners. For S04; this leads to the rejection of Hypothesis 5.
In summary, S04 was severely impaired in her ability to interpret all constructions tested. For each of the following task conditions, presented are the exceptions which were structures that generated the least number of errors:

OMB aural: The least errors were generated by conjoined sentences.

OMB reading: The least errors were generated by O-S relatives.

ANAPHORA wh-questions: The least errors were generated by sentences containing a reflexive within a "that" clause.

Generally, in the reading condition, S04 gave one or two correct interpretations of each syntactic type, suggesting that her reading comprehension was slightly better than her aural comprehension.
As briefly discussed previously (Review, p.34), each of the different sentence types in the OMB and ANAPHORA batteries represented a different hierarchical structure called a **phrase structure tree**. For example, in O-S relatives, the NP acting as the **object** in the main clause (the "rabbit") acts as the **subject** in the embedded clause. In an S-O relative, the NP acting as the **subject** in the main clause acts as an **object** in the embedded clause. Grammatical roles are determined by the hierarchical relationships between the constituents (Caplan, 1986). The terms "subject" and "object" refer to syntactically defined positions in the phrase structure tree. The "subject" of a sentence is the noun phrase directly dominated by a sentence (S) node. The "object" is the noun phrase directly dominated by the verb phrase.

Thematic roles are different from syntactic roles, in that they are assigned on the basis of the grammatical roles of the constituents in relation to the verb(s) in the sentence. Agent, Theme, and Goal are all thematic roles. Syntactic positions do not always dictate the same thematic role for every case. For example, in "The cat scratched the dog", the subject (the "cat") is the Agent of the sentence, but in "The cat was scratched by the dog", the subject (the "cat") is the Theme of the sentence (the Theme is the recipient of the action). In "The boy received a gift", the subject (the "boy") is the Goal. Again, the thematic role is dictated by the verb, in this case "receive".

If a language impaired person cannot successfully comprehend a particular structure, but can interpret another, this discrepancy may be used to characterize that individual's
particular deficit. There are numerous different strategies available for an impaired individual to employ in order to compensate for a syntactic comprehension deficit. Caplan (1986) found that, for aphasic subjects, the types of strategies, and how many times a particular strategy would be used over a number of trials of one structural type, were unpredictable.

Caplan was able to describe the strategies which were most commonly found. He suggested that the error patterns made by the aphasic subjects were accounted for by applying particular strategies to linear sequences of the major lexical categories (nouns and verbs). He also suggested that features other than nouns and verbs might act as cues to interpretive strategies. For example, the "by-phrase" in the passive construction may act as a cue which would cause an aphasic subject to assign a thematic role in an abnormal (but not necessarily incorrect) way. Caplan found that, in general, interpretive rules commonly used were very simple, assigning thematic roles based on the position of a noun in the sentence, or a few lexical items such as "by", and simple precedence relations between words presented in a linear sequence. A description of these strategies (often referred to as heuristics) can be summarized as follows (Caplan, 1987):

1. In N-V-N or N-N-V sequences, assign either the immediately pre-verbal noun or the first noun in the sentence the role of Agent, and assign the remaining noun the role of Theme.

2. In sentences with a three argument verb, assign the first noun the role of Agent, the second the role of Theme, and the third noun the role of Goal.

3. In a sentence with two verbs, each with two arguments, use rule 1 around each verb.

4. Assign the role of Agent to the noun in the by-phrase.

It has been argued that the assignment of thematic roles may result from cognitive
operations which are prelinguistic (Lightfoot, 1982). As Caplan has suggested, there is no evidence to rule out the possibility that interpretive strategies do not involve non-linguistic factors such as the position of the word in the sentence (ie. initial, medial, or final). It is possible that these more general cognitive cues, inherent in the sentence, are related to memory. Caplan hypothesised that interpretive heuristics used by syntactically impaired individuals to assign, for example, theta roles or co-reference, are influenced by language specific parameters acting on the syntactic phrase structure. Parameters specified by linguistic rules determine such features as the hierarchy of branching in the phrase structure tree to dictate the word-order of the string, and ultimately the application of meaning to the structure. Thus the design and analysis of the probes used in this study were directed toward an investigation of this process of syntactic parsing.

As concerns the hypotheses investigated in this study (Methodology, p.9), a summary of the data from the four A.D. subjects is included in the following table:

TABLE VI.i. SUMMARY OF RESULTS RE: HYPOTHESES 1-5

<table>
<thead>
<tr>
<th>Hypoth.#</th>
<th>S01</th>
<th>S02</th>
<th>S03</th>
<th>S04</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>support</td>
<td>support</td>
<td>support</td>
<td>support</td>
</tr>
<tr>
<td>2.</td>
<td>support</td>
<td>support</td>
<td>support</td>
<td>reject</td>
</tr>
<tr>
<td>3.</td>
<td>reject</td>
<td>reject</td>
<td>reject</td>
<td>reject</td>
</tr>
<tr>
<td>4.</td>
<td>reject</td>
<td>reject</td>
<td>reject</td>
<td>reject</td>
</tr>
<tr>
<td>5.</td>
<td>support</td>
<td>reject</td>
<td>support</td>
<td>reject</td>
</tr>
</tbody>
</table>

Referring to TABLE VI.i, the following generalizations can be made:
1. Hypothesis 1, i.e. that more errors would occur on PASSIVE, O-S, and S-O constructions, was supported by the data obtained from all four A.D. subjects.

2. Hypothesis 2, i.e. that more errors would occur on DATIVE and DATIVE PASSIVE than ACTIVE and PASSIVE constructions, was supported by most of the data, with the exception of the data from S04, who showed severe impairment for all constructions.

3. Hypothesis 3, i.e. that S-O and DP constructions would generate more errors than all other stimuli tested, was not supported by the data obtained from any of the subjects. Thus, Hypothesis 3 was rejected.

4. Hypothesis 4, i.e. that reading comprehension scores would be higher than auditory comprehension scores, was not supported by the data obtained from any of the subjects. Thus, Hypothesis 4 was rejected.

5. Hypothesis 5, i.e. that ANAPHORA scores would be higher than OMB scores, was supported by the data obtained from Ss 01 and 03, but not supported by the data obtained from Ss 02 and 04. Using these data, a conclusion about the validity of Hypothesis 5 could not be made.

Several probes presented to Ss 01, 02, and 03 (these probes were not presented to S04, due to her severely impaired performance) were used to test the validity of a common set of hypotheses (labelled A, B, C, and D) which were devised following the analysis of the original batteries. These hypotheses were as follows:

A. Subjects suffer from a syntactic comprehension deficit. Thus, the severity of their inability to interpret a specific structure (defined as the percentage of correct responses on a set of trials) on the OMB battery, could be expected to be consistent over two separate test sessions.

B. In accordance with the reasoning behind Hypothesis A, subjects could be expected to
perform consistently on the ANAPHORA battery over two separate test sessions.

C. Due to a decrease in syntactic complexity and a decrease in the demand made on Work Space, subjects could be expected to perform better on the interpretation of "that phrases". Because they had used a "first noun as Agent" strategy, it was hypothesised that they would interpret "that phrases" derived from S-O relatives incorrectly, but would interpret "that phrases" derived from O-S relatives correctly.

D. Subjects would interpret the "by-phrase" in DATIVE PASSIVE constructions, as a locative.

A summary of the data regarding Hypotheses A-D is presented in the following table:

TABLE VI.ii. SUMMARY OF RESULTS RE: HYPOTHESES A-D

<table>
<thead>
<tr>
<th>Hypoth.#</th>
<th>S01</th>
<th>S02</th>
<th>S03</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>reject</td>
<td>reject</td>
<td>support</td>
</tr>
<tr>
<td>B.</td>
<td>reject</td>
<td>reject</td>
<td>reject</td>
</tr>
<tr>
<td>C.</td>
<td>support</td>
<td>support</td>
<td>support</td>
</tr>
<tr>
<td>D.</td>
<td>support</td>
<td>N/A *</td>
<td>support</td>
</tr>
</tbody>
</table>

* Probe stimuli relevant to Hypothesis D were not administered due to time constraints.

Referring to TABLE VI.ii, the following generalizations can be made:

1. Hypothesis A, i.e. that OMB scores would be consistent over test sessions, was supported by data obtained from S03 (the least impaired of the four subjects), but was not supported by data obtained from Ss 01 and 02. On the basis of these data, a conclusion about the validity of Hypothesis A could not be made.
2. Hypothesis B, i.e. that ANAPHORA scores would be consistent over test sessions, was not evidenced in either of the three data sets obtained; thus Hypothesis B was rejected.

3. Hypothesis C, i.e. that subjects would perform well on "that phrases" devised from S-O relatives, was supported by the data.

4. Hypothesis D, i.e. that subjects would perform well on dative passives in which the "by-phrase" and the locative positions had been reversed, was supported by the data.

The hypothesis that A.D. patients suffer from impaired syntactic abilities has been supported by the data presented in this investigation. A test such as that used (an object manipulation task requiring the interpretation of a variety of syntactic types) has the potential to indicate language deficits that may not be detected in a cursory language evaluation such as that given in the initial assessment. It is of interest to note that Ss 01 and 04 were described by the A.D. Clinic as having questionable language impairments; Ss 02, and 03 were described as being only mildly impaired linguistically. (Viewed in the light of this study), these diagnoses would appear to be inaccurate.

Data used in a comparison between aphasic and A.D. patients were obtained from the Department of Speech Language Pathology at the UBC Health Sciences Center. Data obtained came from four aphasic patients, all of whom had been tested by a speech-language pathologist, and had received some form of speech-language therapy prior to testing. General orders of ranking of both aphasic patients and A.D. subjects, from the least to the most impaired subject, are presented in TABLE A.i, A.ii, and A.iii (Appendix A). A very brief history of the aphasic patients follows:

Patient A: male; approximately 67 years of age; one and a half years post CVA (cardiovascular accident).
Patient B: female; approximately 27 years of age; possibly due to a congenital vascular disease, suffered at least one CVA.

Patient C: male; approximately 57 years of age; suffered from a series of three CVA's.

Patient D: male; approximately 72 years of age; suffered from at least one CVA.

The test stimuli administered to these four aphasic patients were identical to those administered in Caplan's study (1986). The battery involved the administration of 45 sentences, including five trials of nine different syntactic types, some of them similar to the syntactic types administered on the OMB aural battery presented to the A.D. group. Examples of the stimuli used are as follows:

1. ACTIVE: "The monkey patted the rabbit."
2. PASSIVE: "The monkey was touched by the rabbit."
3. CLEFT SUBJECT: "It was the monkey that hugged the goat."
4. CLEFT OBJECT: "It was the rabbit that the monkey kissed."
5. DATIVE ACTIVE: "The monkey sent the rabbit to the turtle."
6. DATIVE PASSIVE: "The monkey was brought to the turtle by the elephant."
7. COORDINATED: "The goat bit the monkey and caught the elephant."
8. SUBJECT-OBJECT RELATIVE: "The elephant that the goat hugged hit the turtle."
9. OBJECT-SUBJECT RELATIVE: "The elephant scratched the rabbit that caught the turtle."

Scores for the four aphasic patients (patients A,B,C, and D) are as follows:
### TABLE VI.iii. APHASIC OMB

<table>
<thead>
<tr>
<th>Syntactic Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ACTIVE</td>
<td>5/5</td>
<td>5/5</td>
<td>4/5</td>
<td>5/5</td>
</tr>
<tr>
<td>2. PASSIVE</td>
<td>4/5</td>
<td>3/5</td>
<td>3/5</td>
<td>1/5</td>
</tr>
<tr>
<td>3. CLEFT SUBJECT</td>
<td>5/5</td>
<td>5/5</td>
<td>4/5</td>
<td>4/5</td>
</tr>
<tr>
<td>4. CLEFT OBJECT</td>
<td>4/5</td>
<td>3/5</td>
<td>2/5</td>
<td>3/5</td>
</tr>
<tr>
<td>5. DATIVE ACTIVE</td>
<td>4/5</td>
<td>5/5</td>
<td>5/5</td>
<td>4/5</td>
</tr>
<tr>
<td>6. DATIVE PASSIVE</td>
<td>5/5</td>
<td>3/5</td>
<td>1/5</td>
<td>0/5</td>
</tr>
<tr>
<td>7. COORDINATED</td>
<td>5/5</td>
<td>5/5</td>
<td>5/5</td>
<td>1/5</td>
</tr>
<tr>
<td>8. S-O RELATIVE</td>
<td>2/5</td>
<td>0/5</td>
<td>0/5</td>
<td>0/5</td>
</tr>
<tr>
<td>9. O-S RELATIVE</td>
<td>4/5</td>
<td>2/5</td>
<td>3/5</td>
<td>4/5</td>
</tr>
</tbody>
</table>

The aphasic patient’s **lowest** scores were achieved on the following syntactic types:

- Patients A and B: S-O RELATIVE.
- Patient C: DATIVE PASSIVE.
- Patient D: S-O RELATIVE and DATIVE PASSIVE.

Aphasic patients made **no errors** on the following syntactic types:

- Patients A and B: ACTIVE, CLEFT SUBJECT, DATIVE PASSIVE, and COORDINATED.
- Patient C: DATIVE ACTIVE, and COORDINATED.
- Patient D: ACTIVE.

The results of this examination of aphasic patients suggested that there was consistency across patients concerning the syntactic constructions which occasioned more difficult, and those which were more easily interpreted. ACTIVE sentences generated the least number of errors for all patients. The next structure which generated a small number of errors was the COORDINATED construction. DATIVE ACTIVE, and CLEFT SUBJECT structures also generated a smaller number of errors. Results obtained were similar to those obtained from A.D. subjects, who for example, performed best on DATIVE ACTIVE.
and CONJOINED (similar to the COORDINATED stimuli used with the aphasics, except containing one verb and two nouns, whereas in COORDINATED structures, there are two verbs). A striking difference between the aphasics and the A.D. subjects was the good performance of the A.D. subjects tested (excluding S04), on DATIVE PASSIVES (3/6, 5/6, 5/6 and 0/6 respectively) when compared with the scores of aphasic patients. It appears that the passive construction was more difficult for the aphasics than for the A.D. subjects. An interesting similarity noted between the two groups was that both made inconsistent errors across test sessions and trials when observing syntactic type. It is possible that this indicates that the language impairment acquired in both pathologies, is variable across time, and affected by memory and/or situational factors such as attention. As previously mentioned, both groups experienced select difficulties with particular syntactic types, supporting the hypothesis that A.D. patients have syntactic comprehension deficits, even in the early stages of the disease. There is some evidence to suggest that this deficit is comparable to the impairment of syntactic comprehension evidenced in aphasic patients.

Although it appears that each of the four subjects in this study had different profiles of impairment, there were common syntactic structures which tended to be more difficult for all four to comprehend than others. Some of these syntactic types were also found to be more difficult for aphasic patients to interpret (eg. S-O RELATIVES). There were similarities between the language impairment resulting from these two different pathologies, in addition to several differences between the ways in which A.D. subjects and aphasics parsed structures, suggesting that one group had deficits uncommon to the other. For example, A.D. subjects were slower, and appeared more aware of their mistakes than the aphasics; A.D. subjects forgot the task more often and had more lexical difficulties than the aphasics. Two of the four A.D. subjects tested (04 and 02) became agitated during the
reading task, and commented that this task was more difficult than the aural task; A.D. subjects appeared less willing to apply a parsing strategy to difficult structures presented in writing than in an aural mode, and were often frustrated when unable to resolve written messages. In comparison, aphasics quickly interpreted (although not always correctly) the written stimuli, satisfied that the strategies they applied were adequate to carry out the parse. This variation in results indicated that predicting which structures may prove to be more difficult for a particular subject may not be possible, although the evidence suggests that some structures are more likely to present a problem than others.

Aphasic and A.D. subjects with the highest scores had more similarities in their profiles than aphasic and A.D. patients obtaining the lowest scores (re: Appendix A). The highest scoring subjects from both groups, 03 and A, performed poorly on S-O constructions, but performed relatively well in all other categories (with the exception of 03 who also performed poorly on O-S constructions). The two subjects with the lowest scores, 04 and D, had very different deficits. 04, the A.D. subject, had severe difficulties with all categories, whereas D, the aphasic patient, still showed some ability to comprehend ACTIVES, DATIVE ACTIVES, and OBJECT-SUBJECTS RELATIVES. Patient D’s profile was more similar to S01 than to S04. S01 had difficulties with S-O and O-S RELATIVES, as well as DATIVE PASSIVES; Patient D performed poorly on PASSIVES, DATIVE PASSIVES, S-O RELATIVES, and COORDINATED constructions. The A.D. group showed a wider range between the highest and the lowest scoring subject in the aphasic group; the A.D. group included the subjects who obtained the highest and the lowest scores, when both groups are combined.

Some difficulties arose during testing using the batteries described in this paper. It was of concern that it was difficult to predict the language level of the A.D. subjects,
using information provided by the assessment clinic. This resulted in testing subjects who were too impaired to perform the test without a great deal of frustration. Because of the criterion used to select subjects was that they should be only mildly impaired in their overall functioning, the initial subject group had only recently been diagnosed as having A.D.. As a result, subjects and their families were still adjusting to this disturbing information. As to the test procedure itself, it was noted that correct responses were often difficult to define, because as the protocol now stands, no credit is given for verbal responses offered by subjects; for the A.D. group, such responses often gave cue to lexical confusion, and correct repetition of a sentence often gave cue to some linguistic processes although the patient automatically picked up all three animals in the order mentioned. Subjects would often substitute the wrong verb (spoken verbally, but difficult to interpret visually), which nevertheless had to be scored as correct. It was especially difficult not to make changes in the protocol to reteach A.D. subjects who continually forgot either what the task was, or how to go about responding to the stimuli. A standardized method for administering the test to A.D. patients would be required if this type of battery were to be used as a diagnostic tool. A final difficulty experienced in testing A.D. subjects was the extra time required for testing. Further research should take cognizance of this peculiar problem by using only those subjects who are capable of volunteering for a series of sessions.

Because A.D. patients suffer from progressive deterioration in language capacity, they have been unlikely candidates for language therapy. Additionally, their loss of capabilities in other cognitive domains increases the likelihood that the A.D. patient will not be successful in a therapy program. Nonetheless, the subjects observed in this study ranged from one to two years post-diagnosis, and most were capable of comprehending a large portion of the stimuli presented in this rigorous test. As yet, the rate of deterioration
evidenced in the A.D. population is unpredictable; often it is slow.

Given the overwhelming interest shown by the caregivers of the A.D. subjects who participated in this study, especially in light of the lack of services available to them, it is proposed that a "communications" class and/or support group be made available to A.D. patients and their families. Personal language profiles could be provided for each patient, and discussed with the family. Reasonable expectations of diminishing language skills could be discussed in the context of how these expectations may differ in varying situations. Additional goals such a program would be to provide strategies for improving communication, and finally to provide a support group for both patients and caregivers who appear to be in need of this type of service. It is felt that the availability of such a service would increase morale, which appeared to be low in both subjects and their families.
REFERENCES


Cook, V.J. (1976). Strategies in the comprehension of relative clauses. 204-211.


APPENDIX A

Given below (Tables A.1, A.2, and A.3) are the total scores of the four A.D. subjects in the OMB aural; and the three scores of those who completed ANAPHORA aural:

TABLE A.i. A.D. OMB: TOTAL SCORES *

<table>
<thead>
<tr>
<th>Subjects:</th>
<th>S01</th>
<th>S02</th>
<th>S03</th>
<th>S04</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17</td>
<td>27</td>
<td>28</td>
<td>7</td>
</tr>
</tbody>
</table>

* Maximum score: 36

TABLE A.ii. A.D. ANAPHORA: TOTAL SCORES *

<table>
<thead>
<tr>
<th>Subjects:</th>
<th>S01</th>
<th>S02</th>
<th>S03</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38</td>
<td>35</td>
<td>42</td>
</tr>
</tbody>
</table>

* Maximum score: 48

Thus, in general performance, the A.D. subjects ranked from least to most impaired, as follows: 03, 02, 01, and 04.

Scores of aphasic patients on the 45 item OMB test (slightly different from the OMB battery administered to the A.D. subjects; re: Appendix B for OMB battery test stimuli) were as follows:

TABLE A.iii. APHASIC OMB: TOTAL SCORES *

<table>
<thead>
<tr>
<th>Patients:</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38</td>
<td>31</td>
<td>27</td>
<td>22</td>
</tr>
</tbody>
</table>

* Maximum score: 45
Thus, in general performance, the aphasics ranked from least to most impaired, as follows: A, B, C, and D.